

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

APPLICATION OF INDIANA MICHIGAN)
POWER COMPANY, AN INDIANA)
CORPORATION, FOR APPROVAL OF 20)
MW_{AC} CLEAN ENERGY SOLAR PROJECT;)
FOR APPROVAL OF RELATED)
ACCOUNTING AND RATEMAKING)
INCLUDING: TIMELY RECOVERY OF COSTS)
INCURRED DURING CONSTRUCTION AND) CAUSE NO. 45245
OPERATION OF THE PROJECT THROUGH)
I&M'S BASIC RATES OR A SOLAR POWER)
RIDER, APPROVAL OF DEPRECIATION)
PROPOSAL, AND AUTHORITY TO DEFER)
COSTS UNTIL SUCH COSTS ARE)
REFLECTED IN RATES; AND FOR)
APPROVAL OF SALE OF RENEWABLE)
ENERGY CREDITS.)

**INDIANA MICHIGAN POWER COMPANY'S RESPONSE TO DOCKET ENTRY
DATED JULY 3, 2019 AND TO OUCC'S MOTION TO DISMISS, OR, IN THE
ALTERNATIVE, MOTION TO STAY PROCEEDING**

Applicant, Indiana Michigan Power Company (I&M), by counsel, respectfully submits its Response to the Indiana Utility Regulatory Commission's Docket Entry in this Cause dated July 3, 2019 ("Response"), attached hereto as Exhibit A. In accordance with this Docket Entry, I&M also hereby responds in opposition to and asks the Commission to deny the Office of Utility Consumer Counselor's ("OUCC") Motion to Dismiss, or, in the Alternative, Motion to Stay Proceeding ("Motion"). In support of this Response to the OUCC Motion, I&M states as follows:

1. The relief sought in the Motion is unreasonable because the OUCC has the information it sought in discovery. I&M provided the most recent draft agreement between I&M and Notre Dame for the purchase and sale of renewable energy credits ("RECs")

("Notre Dame Contract") and the most recent draft of the Engineering, Procurement, and Construction contract ("EPC Contract") to the OUCC via large file transfer at 7:41 p.m. on Tuesday, July 2, 2019, which was the day after I&M's transmittal of its initial response to the OUCC's first set of discovery. During the time that elapsed between the initial and supplemental response, I&M continued to work to secure approval to provide the draft agreements subject to a non-disclosure agreement. Additionally, I&M provided the OUCC information consistent with that included in Exhibit A in writing on Monday, July 9, 2019 and communicated the information regarding the status of the agreements to the OUCC orally on Wednesday, July 3, 2019. The issuance of a supplemental discovery response is not uncommon and should not constitute a *per se* basis for dismissal or delay of the case.

As shown by the attached Response and the draft agreements themselves, all essential pieces of information have been provided to the OUCC. To the extent there was any confusion as to the status of the agreements the matter has been clarified by I&M providing the draft agreements and the associated clarifying information. In particular, both the project cost estimate and the compensation to be received from Notre Dame are the same as communicated in I&M's June 12, 2019 filing in this Cause. Therefore, the one outstanding issue identified in Exhibit A and formal execution of the documents should have no material adverse effect on the OUCC's ability to assess either the proposed Clean Energy Project or the Company's proposal to sell RECs to Notre Dame and flow that benefit through to customers as stated in the Company's prefiled testimony.

2. The OUCC motion is premature. The OUCC Motion was filed without the OUCC first seeking to resolve any discovery dispute informally as contemplated by Ind. Tr. Rule 26(F). It was also filed within a few days of I&M compromising on the procedural matters and governing statutory deadline. This is perplexing. I&M values its relationship with the OUCC, has a long track record of cooperating in discovery, and has previously offered to facilitate the OUCC's understanding of the Company's filing through discussions among the parties' respective technical resources.¹ The Company renews its standing offer to use technical discussions to facilitate the OUCC's discovery and understanding of the proposed project.

Furthermore, the Commission's rules provide that no continuance of a scheduled hearing shall be granted for inability to complete discovery unless the parties have complied with the provisions of 170 IAC 1-1.1-16, which include compliance with Ind. Tr. Rule 26(F). Because the OUCC Motion seeks to change the procedural posture of this case, the OUCC should reasonably be expected to have proceeded in accordance with Ind. Tr. Rule 26(F) before filing its Motion. Doing so may have allowed the OUCC and I&M to devote their resources to the merits of the proposed Project instead of to motion practice.²

3. The OUCC's contentions regarding the burden of proof lack merit. As the Commission has previously explained, the party with the burden of proof in a proceeding

¹ As stated in Applicant's Filing of Proposed Procedural Schedule (§7) the OUCC declined the Company's previous offer to facilitate the OUCC's review through technical meetings between the parties' respective technical resources.

² While the OUCC advised I&M that the Motion was being filed, that contact was made contemporaneous with the filing thereof and not within a timeframe that would have allowed I&M to advise the OUCC of the status of the discovery or otherwise attempt to resolve the OUCC's concern informally.

has the burden of going forward with evidence. *Indiana & Michigan Power Company*, Cause No. 39314 (IURC 11/12/93), p. 4. Thus, I&M has the burden of presenting a *prima facie* case regarding its proposed Solar Project. “A ‘prima facie case’ is one which presents ‘such evidence as is sufficient to establish a given fact and which if not contradicted will remain sufficient.’” *Id.*

The substantive legal standard applicable to filing under Ind. Code § 8-1-8.8-11 is whether the proposed project is reasonable and necessary. I&M presented substantial evidence in the form of prefiled testimony showing the South Bend Solar Project is reasonable and necessary and otherwise in accordance with Ind. Code § 8-1-8.8-11. Once I&M presented its *prima facie* case, other parties, like the OUCC, “have the burden of going forward with their evidence.” *Id.* The OUCC contention otherwise appears to blur the distinction between the burden of going forward with the evidence by filing a *prima facie* case and the ultimate burden of persuasion.

The OUCC’s unsupported contention that evaluation of a project under Ind. Code § 8-1-8.8-11 cannot be complete without the inclusion of the executed agreements lacks merit. OUCC Motion ¶7. The relevant details of the agreements have been finalized and the open matter identified. As shown in the attached Response, there are no open issues in the Notre Dame Contract and the EPC Agreement is nearly finalized.

Furthermore, the governing statute does not require contract approval. The governing statute requires a Commission determination that the proposed Clean Energy Project is “reasonable and necessary” and the Company’s prefiled case-in-chief provides extensive evidence supporting the conclusion that it is. More specifically, the Company’s substantial evidence in this Cause includes the following:

- a. **Description of project, including project size** (20 MW_{AC} solar facility; designed to use First Solar Series 6 thin film solar panels with single axis tracking supports and a total of 26 invertors and transformers and one generator step-up transformer);
- b. **Project location** (South Bend area (northeast corner of the intersection of Bittersweet Road and Cleveland Road, on an I&M owned 210 acre site); location is in close proximity to the I&M Twin Branch Generation Office, Interstate 90, and the University of Notre Dame);
- c. **PJM** (electrically interconnected to the PJM Interconnection (PJM) through a 34.5 kV tie line to the I&M-owned Capital Avenue Substation and be required to follow all PJM interconnection and operational rules; I&M entered the PJM interconnection queue on March 19, 2018; status of PJM's interconnection process);
- d. **Project construction and schedule** (SBSP facility will be designed and constructed by a qualified EPC contractor selected by a competitive Request for Proposal (RFP) process; description of RFP and contractor selection process; status of EPC process; the EPC contract is expected to be awarded in June 2019, with a notice to proceed contingent on the granting of regulatory approval; the start of construction for the Project is scheduled to occur in May of 2020, with completion on or before December 31, 2020);
- e. **Need for project and consistency with IRPs** (2015 IRP specifically identified 20 MWs of new solar capacity in 2020, which aligns with the solar capacity amount requested for approval in this filing; 2019 IRP includes additional solar resources; to efficiently achieve 350 MW of installed solar investment by 2030; I&M needs to begin planning and installing resources in the near future);
- f. **Project benefits** (zero-carbon source of electricity that can further diversify I&M's generation portfolio; allows I&M to add to its experience in integrating solar generation into its portfolio; addresses customer demand and expectations; furthers consumer education about renewable energy, encourages solar development and supports economic development; consistent with Indiana energy policy);
- g. **Project cost estimate** (\$37 million based on a competitive procurement process, with expected issuance of a notice to proceed to the EPC contractor in April 2020 and project construction to start in or around May 2020);
- h. **Company solar experience** (EPC contracting process; solar specification; approved equipment supplier list; project and construction management; ongoing operation and maintenance);

- i. **Proposed timely cost recovery and other accounting and ratemaking** (recognize in rates via pending rate case or Solar Project Rider); and
- j. **Treatment of RECs** (proposed long term sale of RECs, pricing methodology for the sale and proposed use of REC proceeds).

See also index of filing included as Exhibit A to Petition.

Notably, the Company's evidence in this Cause provides more details than were available for the Company's previous solar projects approved by the Commission. For example, in I&M's previous solar project proceeding the testimony explained that one or more third party contractors *would be* hired via a competitive RFP process. *Indiana Michigan Power Company*, Cause No. 44511 (IURC 2/4/15), p. 3. In the instant case, the Company has firmed up the project cost estimate *by already* conducting the RFP and negotiating an EPC contract. In Cause No. 44511, the Company's testimony presented the criteria that *would be* used to develop the project site list. *Id.* In the instant case, the location and cost thereof *have already been* identified and secured. In Cause No. 44511, the Company described how the project would be integrated into the PJM operating system. *Id.* The Company's testimony in the instant case also provides this information. In Cause No. 44511, the cost estimate approved by the Commission was based on *indicative pricing*. *Id.* at 3, 9. In this case, the Company has firmed up the cost estimate by acquiring the site and negotiating an EPC agreement based on a competitive solicitation. In other words, the cost estimate reflects actual costs to a much greater degree than the previous case.

The Commission has previously recognized that renewable resources are beneficial in efforts to retain and attract industrial and commercial customers seeking to meet renewable energy goals and has done so without requiring the execution of a written

agreement. *Southern Indiana Gas and Electric Company*, Cause No. 45086 (IURC 3/20/19), p. 26 (noting utility discussions with one customer and letter of intent with another). The Commission has also approved other utility construction projects without expressly approving the underlying agreements or requiring such agreements to be in existence prior to project approval. *E.g.*, *Duke Energy Indiana*, Cause No. 45002 (IURC 5/30/2018), p. 5 (following a competitive procurement process, Duke Energy Indiana intends to contract with EPC firm and procure the major solar and battery equipment directly from suppliers.), p. 10 (noting petitioner's intent to contract with an EPC firm); *Indianapolis Power & Light Company*, Cause No. 44339 (IURC 514/2014), pp. 6-7 (approving CCGT project with evidence explaining that EPC solicitation and contract award would follow; also approving Harding Street Refueling with procurement of major contracts through a competitive bidding process to follow).

The pre-approval process necessarily requires a balancing of the need for a proposed project to be developed to a point that will allow it be assessed with the risk that the cost incurred to do so may not be recoverable if the project is not approved. Additionally, it can be challenging to obtain firm contractor pricing and commitments in advance of a project actually having been approved. Moreover, in Cause No. 44242, where circumstances were such that the utility was able to execute a firm price EPC contract subject to Commission approval, the utility was accused by an intervenor of treating the Commission as a mere "rubber stamp." See *Indianapolis Power & Light Company*, Cause No. 44242 Post-Hearing Brief of Joint Intervenors, p. 2.

At bottom, I&M has endeavored to solidify details and move the project forward in a reasonable manner while balancing the need for review and Commission approval. At

the time the Petition and supporting testimony were filed, I&M and Notre Dame had reached an agreement as outlined in the filing and the Company expected to award the EPC contract by the end of June. The need to finalizing the remaining item in the EPC contract and execute the formalized written agreements has not changed the key terms thereof or the estimated cost of the Project.

Conclusion

The proposed South Bend Solar Project warrants timely consideration by the Commission. The Company's prefiled case-in-chief presents the information necessary for the project to be assessed and approved. Moreover, the status of the relevant agreements has been clarified without undue delay. The OUCC has the information it sought in discovery. Accordingly, the OUCC Motion should be denied.

Respectfully submitted,



Teresa Morton Nyhart (Atty No. 14044-49)

Jeffrey M. Peabody (Atty No. 28000-53)

Barnes & Thornburg LLP

11 South Meridian Street

Indianapolis, Indiana 46204-3535

Nyhart Phone: (317) 231-7716

Peabody Phone: (317) 231-6465

Fax: (317) 231-7433

Nyhart Email: tnyhart@btlaw.com

Peabody Email: jpeabody@btlaw.com

Attorneys for INDIANA MICHIGAN POWER
COMPANY

CERTIFICATE OF SERVICE

The undersigned certifies that the foregoing was served upon the following via electronic email, hand delivery or First Class, United States Mail, postage prepaid this 12th day of July, 2019 to:

Jason Haas
Office of Utility Consumer Counselor
PNC Center
115 W. Washington St., Suite 1500 South
Indianapolis, Indiana 46204
infomgt@oucc.in.gov
THaas@oucc.IN.gov

Jennifer A. Washburn
Margo Tucker
Citizens Action Coalition
1915 West 18th Street, Suite C
Indianapolis, Indiana 46202
jwashburn@citact.org
mtucker@citact.org


Teresa Morton Nyhart

Teresa Morton Nyhart (No. 14044-49)ni
Jeffrey M. Peabody (No. 28000-53)
BARNES & THORNBURG LLP
11 South Meridian Street
Indianapolis, Indiana 46204
Nyhart Phone: (317) 231-7716
Peabody Phone: (317) 231-6465
Fax: (317) 231-7433
Email: tnyhart@btlaw.com
jpeabody@btlaw.com

Attorneys for INDIANA MICHIGAN POWER COMPANY

DATA REQUEST NO. 1-1

Request

Provide a copy of the most recent draft agreement between I&M and Notre Dame ("Notre Dame Contract").

Response

The most recent draft Purchase and Sale Agreement for Renewable Energy Credits ("Notre Dame Contract") is included herewith at IURC DR 1-1 Attachment 1. This agreement is final except for the need to insert the bank account and contact information. The draft agreement was previously provided to the OUCG in discovery as "OUCG DR 1-10 Attachment 1.pdf." While I&M provided the draft to the OUCG per a nondisclosure agreement, the Company has since confirmed that the document may be filed publicly. The parties are working to execute the document. I&M plans to update this response to provide the executed document with the bank account details redacted.

INDIANA MICHIGAN POWER COMPANY
IURC JULY 3, 2019 DOCKET ENTRY
IURC CAUSE NO. 45245

DATA REQUEST NO. 1-2

Request

Provide a copy of the most recent draft of the Engineering, Procurement, and Construction contract ("EPC Contract").

Response

The most recent draft of the Contract Letter, Exhibit A, and Exhibit B for engineering, procurement, and construction of the South Bend Solar Project (redacted) are attached to this submission as IURC DR 1-2 Attachments 1, 2 and 3. Unredacted documents are being submitted to the Commission as a confidential filing per the Commission's June 19, 2019 Docket Entry granting I&M's Motion for Protective order. These materials were previously provided to the OUCC in discovery as "OUCC DR 1-25 Confidential Attachment 2.zip" with the caveat that the file reference on the header of the Statement of Work in Exhibit A has since been corrected to refer to version 11 rather than version 1.

INDIANA MICHIGAN POWER COMPANY
IURC JULY 3, 2019 DOCKET ENTRY
IURC CAUSE NO. 45245

DATA REQUEST NO. 1-3

Request

For both the Notre Dame Contract and the EPC Contract, provide an update on the current status of the contract negotiations, including, but not limited to, when I&M anticipates each contract will be executed.

Response

Notre Dame Contract – The parties have reached agreement on all terms of this contract. The remaining items are the bank account and contact information as shown on page 3 draft agreement provided in response to IURC 1-1 above.

EPC Contract – The parties have reached agreement on all terms of this contract except for one open item: the form of surety that the EPC contractor will provide in lieu of letter of credit. I&M and the Contractor are working to resolve this open item and I&M will provide the executed agreement once it is available.

INDIANA MICHIGAN POWER COMPANY
IURC JULY 3, 2019 DOCKET ENTRY
IURC CAUSE NO. 45245

DATA REQUEST NO. 1-4

Request

For both the Notre Dame Contract and the EPC Contract, identify the provisions that are still being negotiated.

Response

Notre Dame Contract – none.

EPC Contract – As described in response to question 3 above, the parties are negotiating one open item: the form of surety that the EPC contractor will provide in lieu of letter of credit. The contractor's surety will be addressed in Section 26 of the Scope of Work ("SOW"). (The SOW is one file included in Exhibit A of the EPC Contract). In addition, the contractor's form of surety bond will be made an attachment to the contract. There is a placeholder on page 3 of the Contract Letter to insert language concerning potential tariffs, which will read as follows: "Contractor and Owner agree that in the event Contractor's costs increase due directly or indirectly to the imposition of tariffs on the steel or aluminum components of the Equipment, the Contract Price shall be equitably adjusted in accordance with Article 14.0, Changes in Work and Extra Work, of the AEP General Terms and Conditions for Engineering, Procurement, and Construction Work, as modified as set forth in the Contract."

**EXHIBIT A
FORM OF SREC AGREEMENT**

**PURCHASE AND SALE AGREEMENT FOR RENEWABLE ENERGY CREDITS
TRANSACTION CONFIRMATION**

CONFIRMATION DATE: [Date]

TO: The University of Notre Dame du Lac

This Confirmation confirms the terms of the agreement made between The University of Notre Dame du Lac (“**Buyer**”) and Indiana Michigan Power Company (“**Seller**”) as of the Effective Date (the “**Transaction**”). Seller and Buyer are each referred to as a “**Party**” and, collectively, as the “**Parties**.” This Confirmation, including the attached General Terms and Conditions and Annex A, shall constitute the entire agreement (“**Agreement**”) between the Parties related to the subject matter hereof and supersedes and replaces any prior oral or written confirmation, including broker confirmations, regarding this Transaction.

Subject to any Governmental Approval, the terms of the Transaction to which this Confirmation relates are as follows:

Trade Date:	[INSERT]
Seller:	Indiana Michigan Power Company
Buyer:	The University of Notre Dame du Lac
Product:	Solar Renewable Energy Credits (“ RECs ”) generated from the Designated System.
Designated System:	Seller’s ground mounted, inverter-based solar photovoltaic generation facility system located in South Bend, Indiana, St. Joseph County as identified similarly through its registration at PJM EIS GATS and that has an expected total system size of 20MW AC (the “Designated System” or the “South Bend Project”).
Vintage:	Compliance Years 2021 – 2050 (or such applicable compliance years to cover 30 years from completion of the project)

EXHIBIT A
FORM OF SREC AGREEMENT

Contract Quantity:	<p>40% of the total RECs generated by the Unit during each Compliance Year beginning in 2021 through 2050, on a Unit Contingent basis.</p> <p>“Designated System Contingent” means Seller’s obligation to Deliver the RECs may be excused only on account of the failure of the Designated System to generate such RECs during the applicable Compliance Year, despite Seller’s diligent, commercial reasonable efforts if the Designated System is unavailable as a result of, or related to, (i) planned outages scheduled, noticed and permitted by this Agreement, (ii) forced outages, (iii) to the extent caused by, arising from or related to an event of force majeure, or (iv) any failure or derating of Designated System equipment which is not caused by failure to operate the Designated System in accordance with prudent industry practice or by the negligent acts or omissions of Seller or its contractors or agents (an “Equipment Failure”); provided, however, that Seller shall use commercially reasonable efforts, consistent with prudent industry practice, to mitigate the effects of such Equipment Failure by repairing or replacing such Facility equipment within a reasonable period following such Equipment Failure. In any of such events, Seller shall not be liable to Buyer for any damages. For the avoidance of doubt, economic shutdown is not an excused event.</p>
Contract Price:	<p>The average of the New Jersey Class 1 REC price during the Compliance Year in which the RECs were produced, plus a twenty percent (20%) administrative fee for such RECs effectively Transferred by Seller. If the REC product index price referenced above is no longer available or the state of Indiana adopts a Renewable Portfolio Standard that includes solar, wind, hydro, and other renewables, the Seller and Buyer will mutually agree on a market based REC price index as a replacement for establishing a corresponding rate.</p>
Delivery and Transfer:	<p>Seller shall effect Transfer and Delivery of the RECs through Seller’s retirement of RECs on behalf of Buyer on an annual basis in the year following the Compliance Year but no later than June 15th following the Compliance Year.</p>
Tracking System:	<p>PJM EIS GATS</p>

**EXHIBIT A
FORM OF SREC AGREEMENT**

Payment:	POST-TRANSFER. Within three (3) Business Days of the later of (a) the date the Buyer receives written, facsimile or electronic notification from Seller to Buyer that Transfer of the RECs have been confirmed from Seller to Buyer, as indicated on the PJM EIS GATS and (b) the date Buyer receives an invoice from Seller reflecting the total amount due Seller for such RECs at the Contract Price, then Buyer shall pay for such RECs in full.
Section 24: Financial Responsibility	<input checked="" type="checkbox"/> Financial Responsibility applicable. If not checked, inapplicable.
Seller's Account Information for Payments:	Bank Name: ABA # Account # Account Name:
Buyer's Tracking System Account Information:	Account Name: Account Administrator:
Seller's Contact Information:	Non-Invoice: [INSERT] Invoice: [INSERT]
Buyer's Contact Information:	Non-Invoice: [INSERT] [INSERT] [INSERT] Attn: Contract Administration Phone: [INSERT] Email: [Emissions_Contract_Admin@aep.com] Invoice: [INSERT] [INSERT] [INSERT] Attn: Settlements Phone: [INSERT] Email: [INSERT]

Capitalized terms used but not defined herein shall have the meaning given to them in the attached General Terms and Conditions and Annex A.

This Confirmation memorializes a verbal agreement between the Parties by reference part of and subject to the terms and conditions of the attached General Terms and Conditions and Annex A.

**EXHIBIT A
FORM OF SREC AGREEMENT**

**INDIANA MICHIGAN POWER
COMPANY**

**THE UNIVERSITY OF NOTRE DAME
du Lac**

By: _____
Name: _____
Title: _____
Date: _____

By: _____
Name: _____
Title: _____
Date: _____

PURCHASE AND SALE AGREEMENT FOR RENEWABLE ENERGY CREDITS
GENERAL TERMS AND CONDITIONS

1. DEFINITIONS

1.1 **Definitions.** In addition to any other terms defined in the Confirmation or these General Terms and Conditions, the following terms shall have the meaning ascribed to them as set forth below:

“Business Day” means a day on which Federal Reserve member banks in New York City, New York are open for business. A Business Day shall begin at 8:00 a.m. and close at 5:00 p.m. Eastern Prevailing Time (“EPT”).

“Compliance Year” or **“CY”** means: the calendar year in which the RECs are generated (for example Compliance Year 2019 is associated with generation from January 1 – December 31, 2019).

“Confidential Information” means all oral and written information exchanged between the Parties relative to the subject matter of this Agreement, including but not limited to the price, and all other material terms hereof. Notwithstanding the foregoing, the following shall not constitute Confidential Information for purposes of this Agreement: (i) information that is or becomes generally available to the public other than as a result of a disclosure by either Party in violation of this Agreement; (ii) information that was already known by either Party on a non-confidential basis prior to the execution of this Agreement; (iii) information which is obtained from a third person who, insofar as is known to the Party, is not prohibited from transmitting the information to the Party by a contractual, legal or fiduciary obligation to the other Party; (iv) information a Party is required to disclose in connection with obtaining any Government Approval; and (v) if applicable, information provided on the Attestation forms provided from Seller to Buyer.

“Costs” means, with respect to the Non-Defaulting Party, brokerage fees, commissions and other similar third party transaction costs and expenses reasonably incurred by such Party either in terminating any arrangement pursuant to which it has hedged its obligations or entering into new arrangements which replace this Agreement (or Tranche Transaction), and all reasonable attorneys’ fees and expenses incurred by the Non-Defaulting in connection with the termination of this Agreement or a Tranche Termination.

“Effective Date” means the date on which the Parties execute this Agreement.

“Governmental Approvals” means any approval required by a Governmental Authority.

“Governmental Authority” means any federal, state, county, municipal, or local government or any political subdivision thereof, or any other governmental, quasi-governmental, executive, legislative, administrative, regulatory, judicial, public, or statutory department, body, instrumentality, agency, ministry, court, commission, bureau, board, or other governmental

authority or regional transmission organization having jurisdiction over all or any portion of the this Agreement or a Party (in connection with this Agreement).

“**MWh**” means Megawatt-hour.

1.2 Definitions applicable to PJM GATS REC Transfers.

“**Certificate**” means an electronic record produced by the PJM GATS that identifies the relevant generation attributes of each MWh accounted for in the PJM GATS.

“**PJM**” means PJM Interconnection, L.L.C.

“**PJM EIS GATS**” means the Generation Attribute Tracking System used by PJM to account for the generation attributes of facilities.

“**RECs**” or “**Renewable Energy Credits**” means Certificates, but does not include the energy associated with such RECs.

“**Transfer**” means when PJM EIS GATS posts the recordation of the transfer of RECs from Seller’s PJM EIS GATS account to the PJM EIS GATS account of the Buyer, or when PJM GATS posts or confirms the recordation of the retirement of RECs by Seller on behalf of Buyer.

2. PAYMENT, TRANSFER, AND TITLE

2.1 Payment. The Contract Price shall be paid in accordance with the method identified in the Confirmation. All funds to be paid directly to Seller under this Agreement shall be rendered in the form of immediately available funds (United States dollars) by wire transfer to, or in such other form as reasonably requested by Seller.

2.2 Transfer. Seller shall effect Transfer and Delivery of the Contract Quantity to Buyer in accordance with the method identified in the Confirmation, whereupon title to and interest in such RECs shall transfer to Buyer. Upon notice by the applicable tracking system that any Delivery contemplated by this Agreement will not be recorded, the Parties shall promptly confer and shall cooperate in taking all reasonable actions necessary to cure any defects in the proper Transfer, so that the Transfer can be recorded.

2.3 Taxes. Each Party shall pay any taxes or other fees that are associated with its respective purchase or sale of the RECs as described herein.

2.4 Term. This Agreement shall be effective on and as of the Effective Date and shall terminate upon satisfaction by Buyer and Seller of their respective obligations pursuant to this Agreement. Notwithstanding the foregoing or anything to the contrary herein, in the event this Agreement, or the referenced South Bend Project, fails to obtain all necessary Governmental Approvals, this Agreement shall be terminated and neither Party shall have any obligations or liability to the other hereunder.

3. WARRANTIES OF SELLER

Seller hereby warrants to Buyer that, at the time of the execution of this Agreement and subsequently upon the Delivery of the RECs: (i) Seller will convey good title to the RECs to Buyer free and clear of any liens or other encumbrances or title defects, and (ii) Seller has not otherwise sold to any other person or entity, retired for its own benefit, or represented as a part of any energy sale for the RECs to Transfer to Buyer. Seller further warrants that at the time of the execution of this Agreement and upon Delivery of the RECs hereunder, the RECs comply with the technical specifications and relevant codes, laws, and regulations as set forth in the Confirmation. THE FOREGOING WARRANTY IS EXCLUSIVE, AND SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE RECS TO TRANSFER TO BUYER HEREUNDER, WHETHER AS TO MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR ANY OTHER MATTER. This Section 3 shall survive the expiration or termination of this Agreement.

4. MUTUAL REPRESENTATIONS AND WARRANTIES

Each Party hereby warrants that the person signing this Agreement on behalf of such Party is legally authorized to obligate the Party. Each Party further represents and warrants that it has and will maintain all legal and regulatory authorizations necessary to perform its obligations under this Agreement. Each Party hereby warrants that there is no pending or threatened litigation, arbitration, or administrative proceeding that materially adversely affects such Party's ability to perform its obligations under this Agreement.

5. LIMITATION OF LIABILITY

5.1 No Indirect Damages. FOR BREACH OF ANY PROVISION OF THIS AGREEMENT, EACH PARTY'S LIABILITY SHALL BE LIMITED TO DIRECT, ACTUAL DAMAGES ONLY AS DETERMINED IN ACCORDANCE WITH SECTIONS 7 AND 8, AND SUCH DIRECT, ACTUAL DAMAGES SHALL BE THE SOLE AND EXCLUSIVE REMEDY HEREUNDER, AND ALL OTHER REMEDIES OR DAMAGES ARE WAIVED. IN NO EVENT SHALL EITHER PARTY BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL, PUNITIVE, EXEMPLARY, OR INDIRECT DAMAGES, IN TORT, CONTRACT OR OTHERWISE.

5.2 Survival. This Section 5 shall survive the expiration or termination of this Agreement.

6. EVENTS OF DEFAULT

A Party is in default hereunder if that Party (the "**Defaulting Party**") does any of the following (each an "**Event of Default**"):

- (i) the failure by a Party to make, when due, any payment required under this Agreement if such failure is not remedied within three (3) Business Days after written notice of such failure is given to such Party; or

- (ii) any representation or warranty made by a Party in this Agreement shall prove to have been false or misleading in any material respect when made; or
- (iii) the failure by a Party to perform any covenant or agreement set forth in this Agreement (other than its obligations to make any payment or obligations which are otherwise specifically covered as a separate Event of Default), and such failure is not cured within ten (10) Business Days after written notice thereof to such Party; or
- (iv) if a Party shall:
 - (a) make an assignment or any general arrangement for the benefit of creditors,
 - (b) file a petition or otherwise commence, authorize or acquiesce in the commencement of a proceeding or cause under any bankruptcy or similar law for the protection of creditors, or have such petition filed against it,
 - (c) otherwise become bankrupt or insolvent (however evidenced), or
 - (d) be unable to pay its debts as they fall due; or
- (v) the guaranty of a Party's guarantor, if any, shall expire or be terminated or shall cease to guarantee the obligations of such party hereunder, or such guarantor shall become subject to any of the events specified in Section 6(iv) above; or
- (vi) the failure by a Party to provide Performance Assurance pursuant to Section 24.2, if applicable.

7. REMEDIES UPON DEFAULT

If an Event of Default occurs with respect to a Party at any time during the term of this Agreement, and subject to the cure period identified in Section 6, the other Party (the "**Notifying Party**") may (a) upon two (2) Business Days' written notice to the Defaulting Party terminate this Agreement, (b) upon two (2) Business Days' written notice to the Defaulting Party withhold any payments due in respect of this Agreement to the extent of its damages pursuant to Section 5 of this Agreement, and (c) exercise such other remedies as may be available at law or in equity or as otherwise provided in this Agreement; provided, upon the occurrence of any Event of Default listed in Section 6(iv) above as it may apply to any Party, this Agreement shall automatically terminate, without notice, immediately upon such event.

8. BUYER'S AND SELLER'S LIABILITY

8.1 Buyer's Liability. In the event Buyer causes or suffers an Event of Default and Seller elects to terminate this Agreement, then Buyer shall pay Seller termination damages equal to the sum of (a) the price for any RECs delivered to Buyer for which Seller has not been paid, if any, plus (b) the excess, if any, of (i) the aggregate price for all remaining RECs to be delivered during the compliance period of this Agreement at a fixed price of \$10/Mwh over (ii) the aggregate amount for which Seller is forecasted to be able to sell the remaining RECs to be delivered during the compliance period of this Agreement. The forecasted market price for future RECs as of the date of termination are to be determined based upon the average of forecasted

prices for PJM Class 1 RECs quoted by three independent third party brokerage services selected by Seller and reasonably acceptable to Buyer plus (c) reasonable Seller's Costs.

8.2 Seller's Liability. In the event Seller causes or suffers an Event of Default and Buyer elects to terminate this Agreement, then Seller shall pay Buyer termination damages in an amount equal to (i) the price for any REC's produced but not delivered to Buyer prior to the date termination at the Contract Price; plus (ii) the forecasted amount of REC's to be delivered in the period twelve (12) after the termination date at a fixed price of \$10/Mwh, plus (iii) reasonable Buyer's costs.

8.3 No Penalty. Both Parties hereby stipulate that the payment obligations set forth above are reasonable in light of the anticipated harm and the difficulty of estimation or calculation of actual damages, and each Party hereby waives the right to contest such payments as an unreasonable penalty.

9. PAST DUE PAYMENTS

All overdue payments shall bear interest from, and including, the specified due date to, but excluding, the date of payment at a rate equal to the lesser of two percent (2%) over the "**Prime Rate**", which shall be the per annum rate of interest equal to the prime lending rate as may from time to time be published in *The Wall Street Journal* under "**Money Rates**" or the maximum rates allowed by law; provided, the interest rate shall never exceed the maximum lawful rate permitted by applicable law.

10. ASSIGNMENT

This Agreement is not assignable by either Party, except as provided herein, without the prior written approval of the non-assigning Party, which consent shall not be unreasonably withheld or delayed. Any assignment without the written approval of the non-assigning Party, except as provided herein, is voidable by the non-assigning Party.

11. NON-DISCLOSURE OF CONFIDENTIAL INFORMATION

Except as provided in this Section, neither Party shall publish, disclose, or otherwise divulge the Confidential Information to any person, at any time during or after the term of this Agreement, without the other Party's prior express written consent. Each Party shall permit knowledge of and access to the Confidential Information only to those of its corporate affiliates, attorneys, accountants, representatives, principals, officers, directors, agents, and employees who have a need to know related to this Agreement.

If required by any law, statute, ordinance, decision, order, or regulation passed, adopted, issued or promulgated by a court, any governmental agency or authority having jurisdiction over a Party, such Party may release the Confidential Information, or a portion thereof, to such court, governmental agency or authority, as required by law, statute, ordinance, decision, order or regulation or action and a Party may disclose Confidential Information to accountants in connection with audits, provided that such Party has used its reasonable efforts to cause that

court, governmental agency or authority or accountants to treat such information in a confidential manner and to prevent such information from being disclosed or otherwise becoming part of the public domain.

In performing their obligations under this Agreement, the Parties shall employ procedures established to prevent unauthorized disclosure or use of the Confidential Information. Such procedures shall be no less restrictive than the procedures used by each Party to protect its own confidential data.

This Section shall survive for a period of one (1) year following the expiration or termination of this Agreement.

12. NO AMENDMENT

This Agreement may not be amended, changed, modified, or altered unless such amendment, change, modification, or alteration is in writing and signed by both of the Parties to this Agreement or their successors in interest.

13. SEVERABILITY

If any article, phrase, provision or portion of this Agreement is, for any reason, held or adjudged to be invalid, illegal or unenforceable by any court of competent jurisdiction, such article, phrase, provision, or portion so adjudged will be deemed separate, distinct and independent and the remainder of this Agreement will be and remain in full force and effect and will not be invalidated or rendered illegal or unenforceable or otherwise affected by such adjudication, provided the basic purposes of this Agreement and the benefits to the Parties are not substantially impaired.

14. COUNTERPARTS

This Agreement may be executed in several counterparts, including facsimile, each of which is an original and all of which constitute one and the same instrument.

15. WAIVER

No delay or omission by a Party in the exercise of any right under this Agreement shall be taken, construed, or considered as a waiver or relinquishment thereof, and any such right may be exercised from time to time and as often as may be deemed expedient. If any of the terms and conditions herein are breached and thereafter waived by a Party, such waiver is limited to the particular breach so waived and is not deemed to waive any other breach hereunder.

16. GOVERNING LAW

This Agreement is governed by and construed in accordance with the laws of the State of Indiana. The Parties agree that, to the maximum extent possible under applicable law, no provision of Article 2 of the Uniform Commercial Code (as in effect from time to time in the

State of Indiana), that is inconsistent with any provision of this Agreement shall apply to this Agreement. The Parties agree that any transaction entered into pursuant to this Agreement is a “qualified financial contract” within the meaning of Indiana Code 27-9-3.1-7. THE PARTIES HEREBY WAIVE THE RIGHT TO ANY TRIAL BY JURY ASSOCIATED WITH ANY DISPUTE ARISING UNDER THIS AGREEMENT

17. NOTICES

All notices, certificates, or other communications hereunder shall be in writing. All written notices are deemed sufficiently given when mailed by United States certified mail, return receipt requested or by recognized overnight courier service, postage prepaid, or hand-delivered, or sent by facsimile transmission, if the original communication is delivered by recognized overnight courier service, and shall be effective when received. For purposes hereof, notices, demands and other communications shall be sent to the names and addresses listed in the Confirmation (or such other address as the Seller or Buyer shall have furnished to the other Party in writing).

18. ENTIRE AGREEMENT

This Agreement constitutes the entire agreement of the Parties with respect to the subject matter hereof, and supersedes all other prior understandings or agreements, both written and oral, between the Parties relating to the subject matter hereof.

19. HEADINGS

The Article and paragraph titles in this Agreement are only for purposes of convenience and do not form a part of this Agreement and will not be taken to qualify, explain, or affect any provision thereof.

20. FORWARD CONTRACT

This transaction constitutes a “forward contract” and each Party represents and warrants that it is a “forward contract merchant” within the meaning of the United States Bankruptcy Code.

21. INDEMNIFICATION

Subject to Section 5, each Party agrees to indemnify, defend, and hold harmless the other Party, and any of said other Party’s affiliates, directors, officers, employees, agents and permitted assigns, from and against all claims, losses, liabilities, damages, judgments, awards fines, penalties, costs, and expenses (including reasonable attorney’s fees and disbursements) directly incurred in connection with or directly arising out of: (a) any breach of representation or warranty or failure to perform any covenant or agreement in this Agreement by said Party; or (b) any violation of applicable law, regulation or order by said Party.

22. SETOFFS

Each Party reserves to itself all rights, setoffs, counterclaims, combination of accounts, liens and other remedies and defenses which such Party has or may be entitled to (whether by operation of law or otherwise). The obligations to make payments under this Agreement and/or any other agreement between the Parties may be offset against each other, set-off or recouped therefrom.

23. CHANGE IN LAW

Upon the occurrence of a “**Change In Law Event**” (as defined herein), the Parties will in good faith use commercially reasonable efforts to reform this Agreement in order to give effect to the original intention of the Parties or transfer the RECs to another equivalent program if possible (an “**Alternative Program**”). If the Parties are unable, despite such commercially reasonable efforts, to reform this Agreement or transfer the RECs to an Alternative Program within thirty (30) days following notice by one Party to the other of the Change In Law Event (the “**Thirty Day Period**”), then the Parties shall resolve the matter through binding arbitration in accordance with the following procedures: (i) within five (5) Business Days after the conclusion of the Thirty Day Period (unless such period is mutually extended by the Parties), each of Buyer and Seller shall select an individual who is familiar with the solar industry and renewable portfolio standards to select an arbitrator to resolve the deadlock; (ii) within five (5) Business Days thereafter, the two individuals will select one individual familiar with the solar industry and renewable portfolio standards to act as sole arbitrator (the “**Sole Arbitrator**”) (to the extent that one of the Parties does not select an individual within the requisite time period, the one selected individual shall serve as the Sole Arbitrator), (iii) within five (5) Business Days of selection of the Sole Arbitrator, each Party shall submit a proposed amendment to reform this Agreement to resolve the Change In Law Event to the Sole Arbitrator, and (iv) within five (5) Business Days of the deadline for delivering the proposals, the Sole Arbitrator shall select one of the proposed amendments which the Sole Arbitrator regards as the better proposal to reform this Agreement and upon the Sole Arbitrator’s selection of such proposal this Agreement shall be deemed to be automatically reformed in accordance with that proposed amendment. The decision of the Sole Arbitrator shall be binding and nonappealable. To the extent there are any expenses related to the appointment of the Sole Arbitrator, the Parties shall equally share such expense. For purposes hereof, “**Change In Law Event**” means a change in any statutes, rules, regulations, laws, or any governmental action enacted, amended, granted or revoked that has the effect of changing the Transfer and sale procedures set forth herein such that the Delivery of the RECs becomes impracticable or impossible.

24. FINANCIAL RESPONSIBILITY

24.1 Financial Statements. Each Party agrees to make its annual financial statements available electronically to the other Party through a commercially accessible portal, the instructions for access to be provided when requested. The statements of either Party shall be prepared in accordance with generally accepted accounting principles.

24.2 Performance Assurance. In the event the public credit rating of either Party falls below investment grade at any time during which this Agreement is in effect, that Party (the “**Demanding Party**”) may demand security or assurance of performance in a form and amount reasonably required by it (“**Performance Assurance**”) before further deliveries or payments are made by it under this Agreement. In the event the other Party (the “**Demand Receiving Party**”) shall fail to give the required Performance Assurance within fourteen (14) Business days of the

request by the Demanding Party, that failure shall be an Event of Default of the Demand Receiving Party as described in Section 6(vi) of this Agreement.

24.3 Netting. If Buyer and Seller are required to pay any amount on the same day or in the same month under this Agreement and/or any other agreement between the Parties, then such amounts with respect to each Party may be aggregated and the Parties may discharge their obligations to pay through netting, in which case the Party, if any, owing the greater aggregate amount shall pay to the Party owed the difference between the amounts owed. Each Party reserves to itself all rights, setoffs, counterclaims, combination of accounts, liens and other remedies and defenses which such Party has or may be entitled to (whether by operation of law or otherwise). The obligations to make payments under this Agreement and/or any other agreement between the Parties may be offset against each other, set off or recouped therefrom.

CONTRACT LETTER

THIS CONTRACT, XXXXXXXXXX (“Contract”) is made this **10** day of June, 2019 (“Effective Date”) between American Electric Power Service Corporation, as agent for Indiana Michigan Power Company, an Indiana corporation (“Owner”) and White Construction, LLC, an Indiana corporation (“Contractor”).

Subject to the terms and conditions hereof, Contractor hereby agrees to furnish all supervision, labor, equipment and specified materials necessary to perform all phases of the Work as set forth and defined in Owner's Scope of Work (defined below) at a 210-acre parcel, located along Bittersweet Road in Granger, Indiana, as more fully described in Contractor’s Proposal dated December 14, 2018.

Contractor and Owner agree that the Work will be performed in accordance with:

- 1. This Contract Letter.
- 2. Owner's Scope of Work Specification AEP-LC-2672 Revision 11 dated **June 17, 2019**, including the attached Appendices 1 through 13 and all referenced documents therein, all of which are collectively designated as Exhibit A to the Contract and attached hereto and made a part hereof (collectively referred to as “Owner's Scope of Work Specification AEP-LC-2672,” the “Scope of Work” or the “SOW”).
- 3. Contractor's Proposal dated December 14, 2018, designated as Exhibit B to the Contract and attached hereto and made a part hereof.

In the event of a conflict among any of the Contract documents, the conflict shall be resolved by interpreting the documents in the following order of priority:

- 1. This Contract Letter;
- 2. Exhibit A; then
- 3. Exhibit B;

PROVIDED THAT, the Parties agree that the “WC_AEP South Bend Solar Form D Commercial Exceptions_Deviations_Clarifications FINAL **051419**” attached to and modifying Appendix 2 of the SOW shall govern in the event of any conflicts between it and any other terms or conditions in any of the Contract documents.

Pursuant to Section 5.2.1 of the SOW, Contractor shall achieve Substantial Completion of the Work on or before December 31, 2020 and complete all Work on or before April 1, 2021. Contractor’s achievement of Substantial Completion no later than December 31, 2020 is a material obligation under this **Contract**.

Commented [EA1]: The dates in the Milestone Payment Schedule are the projected completion dates, not the required completion dates.

Commented [S2R1]: Agreed, would it help to note that specifically with a footnote to that schedule.

In consideration of the performance of the Work by Contractor, Owner agrees to pay Contractor the fixed price, turnkey Contract Price of [REDACTED]

[REDACTED] Payments shall be made to Contractor in accordance with the Milestone Payment Schedule.

IN WITNESS WHEREOF, the parties hereto have caused this Contract to be signed by their respective officers thereunto duly authorized on the date set forth below to be effective as of the Effective Date.

AMERICAN ELECTRIC POWER SERVICE CORPORATION, as agent for
INDIANA MICHIGAN POWER COMPANY

By: _____
Nick Akins
Chairman, President, & CEO

Accepted this date: _____

WHITE CONSTRUCTION, LLC

By: _____

Full Name: _____

Title: _____

Accepted this date: _____



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1. The Contractor shall be responsible for obtaining all necessary permits and licenses for the performance of the work under this Agreement.

2. The Contractor shall be responsible for obtaining all necessary permits and licenses for the performance of the work under this Agreement.

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20. The Contractor shall be responsible for obtaining all necessary permits and licenses for the performance of the work under this Agreement.

21. The Contractor shall be responsible for obtaining all necessary permits and licenses for the performance of the work under this Agreement.

22. The Contractor shall be responsible for obtaining all necessary permits and licenses for the performance of the work under this Agreement.

23. The Contractor shall be responsible for obtaining all necessary permits and licenses for the performance of the work under this Agreement.

24. Owner or an affiliate of Owner and Owner or Owner's affiliate shall then assume the risk of loss of the work under this Agreement.

25. The Contractor shall be responsible for obtaining all necessary permits and licenses for the performance of the work under this Agreement.

26. The Contractor shall be responsible for obtaining all necessary permits and licenses for the performance of the work under this Agreement.

1. The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work.

2.

3. The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work.

4. The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work.

5. The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work. The Contractor shall communicate with the Owner's OSII control system via Modbus with DNP3 capability.

6. The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work.

7. The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work. The "start of work" means the period commencing on the date of the start of work.

8. The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work.

9. The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work. The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work. Upon the approval of such plan (the "Risk Management Plan") by the Contractor, the Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work.

10. The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work.

11. Risk Management Plan (RMP)

11.1 The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work. The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work. documents provided in accordance with this provision shall be subject to Owner's confidentiality.

11.2 The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work. Owner, Contractor shall have Owner's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work.

- The Contractor shall provide the Owner with a copy of the Contractor's Safety Plan (CSP) and a copy of the Contractor's Risk Management Plan (RMP) for review and approval by the Owner prior to the start of work.
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1. The Contractor shall provide and maintain at all times during the performance of the work, a sufficient number of competent and experienced personnel to perform the work in accordance with the Contract Documents.

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2. Depending upon the work in progress, and contingent upon Owner's approval, this work shall be performed in accordance with the Contract Documents.

3. CONTRACTOR'S RESPONSIBILITIES

3.1 The Contractor shall be responsible for obtaining all necessary permits and licenses for the performance of the work in accordance with the Contract Documents. Owner's requirements shall be as set forth in the Contract Documents. RD shall be provided by the Contractor.

3.2 The Contractor shall be responsible for providing and maintaining at all times during the performance of the work, a sufficient number of competent and experienced personnel to perform the work in accordance with the Contract Documents. The Contractor shall provide the necessary protection to, and prevent damage, injury, or loss to all of Contractor's property, including but not limited to, the Contractor's equipment, materials, and other property.

3.3 The Contractor shall include Contractor's drug testing policy. The cost of the drug testing shall be the responsibility of the Contractor.

3.4 The Contractor shall be responsible for obtaining all necessary permits and licenses for the performance of the work in accordance with the Contract Documents. The Contractor shall provide the necessary protection to, and prevent damage, injury, or loss to all of Contractor's property, including but not limited to, the Contractor's equipment, materials, and other property.

3.5 The Contractor shall be responsible for providing and maintaining at all times during the performance of the work, a sufficient number of competent and experienced personnel to perform the work in accordance with the Contract Documents.

3.6 The Contractor shall be responsible for providing and maintaining at all times during the performance of the work, a sufficient number of competent and experienced personnel to perform the work in accordance with the Contract Documents.

1. The Commission shall determine whether the proposed rate schedule is just and reasonable and not unduly discriminatory or oppressive.

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1.1.1.1.1.1.1.1 Maintenance and Repair (M&R)

1.1.1.1.1.1.1.1.1 The Commission shall determine whether the proposed rate schedule is just and reasonable and not unduly discriminatory or oppressive.

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1. The Contractor shall provide the Owner with a copy of the Contractor's schedule of values for the project.

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4. Materials and Methods

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4.1 Materials

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4.1.1 The Contractor shall provide the Owner with a copy of the Contractor's schedule of values for the project.

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- The Contractor shall provide the Owner with a copy of the Contractor's schedule of values for the project.
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4.2 Construction Turnover/Construction Release

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4.2.1 The Contractor shall provide the Owner with a copy of the Contractor's schedule of values for the project.

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4.2.2 The Contractor shall provide the Owner with a copy of the Contractor's schedule of values for the project.

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- The Contractor shall provide the Owner with a copy of the Contractor's schedule of values for the project.
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4.2.3 The Contractor shall provide the Owner with a copy of the Contractor's schedule of values for the project.

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4.2.4 The Contractor shall provide the Owner with a copy of the Contractor's schedule of values for the project.

Owner's execution of the Final Acceptance Certificate represents:

Owner's execution of the Final Acceptance Certificate represents:

- Contractor shall coordinate daily activities with Owner to insure Contractor's activities do not interfere with the construction of the Project.

Contractor shall coordinate daily activities with Owner to insure Contractor's activities do not interfere with the construction of the Project.

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- Letter of Credit ("LOC"). An Irrevocable LOC shall be in the format set forth in Attachment 2.

Contractor shall coordinate daily activities with Owner to insure Contractor's activities do not interfere with the construction of the Project.

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BOUNDLESS ENERGY



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PUBLIC VERSION

IURC DR-1-2 Attachment 2

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**PPROPOSAL FORMS THAT WOULD BE UNDER APPENDIX 1 HAVE BEEN
FILLED IN BY CONTRACTOR AND ARE NOW UNDER EXHIBIT B.**



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AMERICAN ELECTRIC POWER

AEP GENERAL TERMS AND CONDITIONS FOR ENGINEERING, PROCUREMENT AND CONSTRUCTION WORK

March 2009 Rev. 3 dated 6/14

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AFFIDAVIT OF COMPLETION

Exhibit 1

**AEP GENERAL TERMS AND CONDITIONS
FOR ENGINEERING, PROCUREMENT AND CONSTRUCTION WORK**1.0 DEFINITIONS

Subject to additional definitions contained in subsequent Articles, capitalized terms used in these General Terms and Conditions for Engineering, Procurement and Construction Work have the meanings set forth below:

- 1.1 Business Day: “Business Day” means any calendar day, other than a Saturday or Sunday or a calendar day on which U.S. commercial banking institutions are authorized or required by law to close.
- 1.2 Change Order: “Change Order” means a written order as defined and issued in accordance with Article 14.0.
- 1.3 Contract: “Contract” means collectively the Contracting Instrument and all documents referenced in the Contracting Instrument and any Change Orders, amendments or addenda.
- 1.4 Contract Price: “Contract Price” means the price to be paid to the Contractor for the performance of Work as set forth in the Contracting Instrument.
- 1.5 Contracting Instrument: “Contracting Instrument” means the contractual document that identifies the parties, the nature of the Work, the Contract Price, documents to be included as part of a Contract, and other matters relating to a Contract. The Contracting Instrument may be in the form of a contract letter, blanket purchase order, purchase order or other similar documents.
- 1.6 Contractor: “Contractor” means the entity contracting with Owner for the performance of Work.
- 1.7 Direct Cost: “Direct Cost” means the actual costs and charges incurred and payments made by Contractor, its Subcontractors for Site Equipment, materials, services and labor (including payroll burden and expenses) which are directly attributable to the performance of Contractor’s Work hereunder. Direct Cost includes Contractor’s home office or Site labor to the extent Contractor’s home office or Site labor is directly assignable to the Work which must be demonstrable under the circumstances. Direct Cost shall not include corporate, general and administrative costs including home office functions, sales, marketing, accounting, human resources, information technology, payroll, profit, research, development, quality assurance and control, purchasing, safety, management, administration, warranties, insurances, offsite or other unabsorbed costs.
- 1.8 Equipment: “Equipment” means all goods, materials and accessories to be purchased under the Contract, including all documentation required by the Contract.
- 1.9 Final Acceptance: “Final Acceptance” means Owner’s determination that the Work has been completed in accordance with the Contract requirements.
- 1.10 Initial Acceptance: “Initial Acceptance” means Owner’s determination prior to final inspection and testing that the Work conforms to the Contract requirements for purposes of receipt.
- 1.11 Owner: “Owner” means any one or more of the companies of the American Electric Power System as may be specified in the Contract Instrument.
- 1.12 Site: “Site” means Owner’s property or such other premises (including adjacent bodies of water and property owned or controlled by a third-party) upon which the Work is to be performed.

- 1.13 Subcontractor: “Subcontractor” means vendors, suppliers, consultants, and subcontractors of any tier, materialmen, professionals, laborers, and all other persons providing equipment, materials or services directly or indirectly to Contractor in connection with the Work.
- 1.14 Work: “Work” means all of Contractor's obligations under the Contract.

2.0 CONTRACTOR'S OBLIGATIONS

- 2.1 Contractor shall at its expense provide everything necessary for the complete, proper and timely execution of the Work including, but not limited to, home office support, labor, supervision, and technical field assistance; engineering, design, construction and start-up services; safety equipment, construction equipment, temporary utilities and facilities, equipment to be installed, materials, tools and supplies; fabrication and manufacturing; transportation; drawings and documentation, unless explicitly excluded in the Contract. Contractor’s performance of the Work shall include everything requisite and necessary to comply with prudent electric utility industry standards and to complete the Work, notwithstanding the fact that every item necessarily involved may not be specifically mentioned. Details and items not indicated by the Contract documents shall be adequately and properly performed by Contractor at no extra cost if such details and items are necessary to complete the intent of the Contract or otherwise to complete the Work.
- 2.2□ Contractor is responsible for considering the conditions affecting the Work including, but not limited to, conditions affecting the transportation, disposal, handling and storage of materials; the availability and cost of labor, water, electric power, utilities, and roads; the uncertainties of weather, river stages, and similar physical conditions at the Site; the conformation and condition of the ground; and the character of equipment and facilities needed. Contractor shall take into account the character, quality and quantity of surface and subsurface materials or obstacles to be encountered to the extent this information is reasonably ascertainable from the Contract documents or an inspection of the Site.
- 2.3 Contractor shall immediately and before such conditions are disturbed notify Owner of: (a) subsurface or latent physical conditions at the Site which differ materially from those indicated in the Contract; (b) unusual geologic conditions at the Site which differ materially from conditions ordinarily encountered or from conditions addressed in the Contract; or (c) artifacts or articles which appear to have archaeological or historical significance. Owner shall promptly investigate such conditions and, if such conditions do materially differ and cause an increase or decrease in Contractor's cost of, or the time required for, performance of any part of the Work, the parties shall agree to amend the Contract. No claim of Contractor under this clause shall be allowed unless Contractor has given immediate notice as required above and confirmed such notice in writing within ten (10) days of discovery.
- 2.4 Contractor shall have an authorized representative at the Site to whom Owner may give instructions at all times when Work is being performed.
- 2.5 Contractor shall assign qualified and competent supervision and personnel to perform the Work and have qualified and competent supervision at the Site at all times to direct and observe the Work. Key personnel shall not be removed or replaced without prior consent of Owner which shall not be unreasonably withheld. Contractor will investigate and take appropriate action with respect to any personnel problems brought to its attention by Owner.
- 2.6 Contractor shall confine all of its operations and personnel to those areas of the Site to which Owner authorizes access.
- 2.7 Contractor's personnel may not operate Owner's tools, vehicles, materials or equipment (“Owner’s Equipment”) without Owner's prior authorization. If Contractor borrows Owner's Equipment, Contractor (a) agrees that Owner has provided the Owner’s Equipment AS IS, with no representations or warranties; (b) assumes full responsibility for the protection of the borrowed Owner’s Equipment; (c) assumes all liability for injuries or damages resulting from the use of the

borrowed Owner's Equipment; and (d) agrees to return the borrowed Owner's Equipment to Owner in the same condition as when it was borrowed, or, if repairs are necessary, to cause such repairs to be performed promptly at Contractor's expense before the Owner's Equipment is returned to Owner. Owner has no obligation to lend Owner's Equipment to Contractor.

- 2.8□ Contractor shall cooperate with Owner and others working at or near the Site. Contractor shall promptly report to Owner any defects in the work of others which affects the Work. Failure to report such defects constitutes acceptance of the conditions by Contractor. Contractor shall properly fit, connect and coordinate its Work with that of Owner and other contractors.
- 2.9□ Contractor shall keep all of its work areas free from trash and debris, and keep its work areas "broom clean" on a continuous basis.
- 2.10 Contractor shall secure and protect its materials, tools, equipment and the Work, including Owner's Equipment.
- 2.11 As requested by Owner, Contractor shall provide Owner with periodic reports concerning the progress of the Work.
- 2.12 Contractor is responsible for the proper execution of the Work with respect to any base lines and bench marks established by Owner.
- 2.13 If the Work is subject to prevailing wage requirements, Contractor agrees to comply with such requirements.
- 2.14 Contractor, its Subcontractors, and their respective employees and agents involved in the Work shall adhere to the provisions contained in Owner's Code of Business Conduct which can be found at Owner's website.

3.0 TERM AND EFFECTIVE DATE

- 3.1 The Contract shall commence as of the effective date and, unless earlier terminated as provided in Article 29.0, shall terminate on the termination date set forth in the Contract. Unless specified elsewhere in the Contract, the effective date of the Contract shall be the earlier of the date on which Contractor begins performance hereunder or the date of the latter signature on the Contract.

4.0 RELATIONSHIP OF THE PARTIES

- 4.1 Contractor and all of its employees and Subcontractors are, with respect to Owner, independent contractors. Contractor will be solely responsible for the supervision, direction, and control of its employees and Subcontractors. Contractor is responsible for the payment of all compensation, benefits, and employment taxes with respect to the Contractor's employees.

5.0 ASSIGNMENT AND SUBCONTRACTING

- 5.1 Contractor shall not assign or otherwise dispose of the Contract, or any obligations hereunder, without the written consent of Owner. Any assignment or disposal without the written consent of Owner shall be null and void.
- 5.2 Prior to entering into any subcontract, Contractor shall submit to Owner a subcontractor data sheet that includes the name and address of the Subcontractor and the scope of work proposed to be included under such subcontract. Within five Business Days of receipt of a Subcontractor data sheet, Owner may reject such Subcontractor without cost or contract extension by giving written notice of such rejection to Contractor.

- 5.3 Contractor is responsible for the selection of any Subcontractor and for the Subcontractor's proper performance of the Work assigned to it. If the work of a Subcontractor is not in compliance with the Contract requirements, Contractor shall take immediate steps to bring the Subcontractor's work into compliance and, at Owner's written request, terminate its contractual relationship with the Subcontractor as it relates to the Work at no cost to Owner.

6.0 LABOR RELATIONS

- 6.1 Contractor shall comply with any project, national or local labor agreements that are applicable to the Work or Site. Contractor shall cooperate with Owner and other contractors in establishing and maintaining labor work rules and practices.
- 6.2 When the Work is performed by building and construction trades labor, a pre-job conference shall be held with local labor representatives prior to starting Work. Owner shall be afforded the opportunity to attend and participate in pre-job conferences.
- 6.3 Contractor shall provide immediate notice to Owner of any actual or potential labor dispute that may delay the timely, efficient and productive performance of the Work.
- 6.4 Contractor shall inform and cooperate with Owner on labor matters. Contractor shall consult with Owner prior to rendering its decision(s) on labor matters that may impact the timely, efficient and productive performance of the Work.
- 6.5 Contractor shall exercise its management rights contained in applicable labor agreements to establish, maintain, and enforce work rules conducive to timely, efficient, productive and harmonious work operation. Contractor shall take the necessary steps available to resolve grievances, jurisdictional disputes, or other violations of collective bargaining agreements.

7.0 SAFETY AND SECURITY

- 7.1 Contractor shall perform the Work in a safe and careful manner, provide first aid facilities and transportation, and use such safety devices and methods as are necessary to protect its employees, agents, Subcontractors, Owner's employees and agents, other contractors and the public from bodily injury and property damage.
- 7.2 Contractor shall comply with and enforce all laws, rules and regulations applicable to safety and health standards, including, but not limited to, the Occupational Safety and Health Act of 1970 ("OSHA") and any revisions of OSHA or successor legislation.
- 7.3 Contractor shall comply with project and Site safety and security rules and all procedures issued by Owner, provided that such rules and procedures do not conflict with OSHA or other safety laws, rules or regulations. Contractor shall assign a competent person at all times to manage, coordinate and enforce its safety program during performance of the Work.
- 7.4 Contractor shall provide Owner with Material Safety Data Sheets ("MSDS") for all applicable materials prior to delivery to Owner's Site.
- 7.5 Contractor shall obtain Site permits or approval from Owner for its vehicles, any excavation, use of explosives, access to restricted areas, use of Owner's Equipment, tools and facilities, and other similar activities.
- 7.6 Owner will arrange all necessary clearances on energized equipment, electrical and communications circuits, piping systems or other operational equipment. Contractor shall notify Owner requesting the clearances prior to the scheduling of such Work. Contractor shall comply with Owner's clearance permit system regarding tagout and lockout of electrical and mechanical systems and other equipment.

- 7.7 Contractor shall fully inform Owner in writing regarding the types, quantities and use of any hazardous materials brought on the Site; the types and quantities of hazardous wastes being generated from the Work; and Contractor's program for proper storing, handling and disposal of such materials in a safe and secure manner.
- 7.8 Contractor shall immediately inform Owner of all regulatory, safety, health and environmental inspections, citations and penalties associated with the Work. Contractor shall provide Owner with written reports and copies of all documents submitted to or by regulatory agencies and insurance companies.
- 7.9 Contractor shall promptly inform Owner of any injuries to its employees, agents, Subcontractors, or other persons arising out of the Work that require medical treatment.
- 7.10 Contractor shall obtain, maintain, and properly complete all record keeping required by regulatory agencies. Upon request, Contractor shall provide Owner with copies of all logs, reports and other records.
- 7.11 Contractor shall investigate all accidents resulting in personal injury, property damage, or near misses to determine root cause(s) and corrective action(s). Upon request, Contractor shall provide Owner with a copy of investigative reports, including all documents submitted to insurance companies.
- 7.12 All of Contractor's employees, agents, Subcontractors, vehicles, trailers, etc. entering or leaving the Site are subject to inspection at any time by Owner.
- 7.13 If a safety violation or other unsafe condition causes imminent danger, Owner may immediately shut down the Work involved without advance written notice.
- 7.14 Contractor and all Subcontractors performing Work at the Site must have a substance abuse program. This program must apply to all personnel of Contractor and its Subcontractors. Minimum requirements of this program shall include pre-hire testing, testing for cause and if requested, random testing. Screening substances and their associated cut-off limits are listed below.

Drug Classes	Screening Cut-Off Limit (ng/ml)	Confirmation Cut-Off Limit (ng/ml)
Amphetamines	1,000	500
Benzoyllecgonine	300	150
Cannabinoids	50	15
Opiates	2,000	2,000
Phencyclidine	25	25

Blood & Breath alcohol content: .02% per Department of Transportation.

Testing shall be performed by a testing facility certified by Department of Health & Human Services. Personnel must have evidence of having tested negative within a year prior to employment. Owner will accept conditional employment predicated upon (a) employee(s) furnishing evidence that they have submitted to testing within forty-eight (48) hours of initial employment and (b) employee(s) furnishing evidence of negative test results within five (5) Business Days of initial employment. Contractor shall ensure personnel are "drug free". Owner reserves the right to examine evidence outlined herein. Contractor's program shall incorporate reciprocity on "drug free" employee verification to minimize Owner's economic impact and employee(s) recertification while maintaining the program's intent.

- 7.15 If required by Owner, Contractor must meet certain security criteria set forth herein.

- 7.15.1 Contractor shall submit to Owner a copy of its background investigation process for Owner's review and file. If Owner, in its sole discretion, determines that Contractor's background investigations do not meet certain specific requirements, then Contractor, at its expense, must perform a background investigation that does meet Owner's certain specific requirements on each individual designated by Contractor to perform Work, or is performing Work on behalf of Contractor, for Owner (referred to herein for purposes of this Article, as an "individual"). Notwithstanding anything to the contrary stated herein, Owner reserves the right to conduct a background investigation on each individual at Contractor's expense.
- 7.15.2 Owner's certain specific requirements of background investigations include the following: (i) determination of whether an individual has been convicted of a felony crime in each state where the individual has resided during the past seven years; (ii) performance of the background investigation at the state level (in other words, to only search the records of the county in which the individual has resided during the past seven years is not a sufficient background investigation); and (iii) if the individual is to operate a motor vehicle while performing Work for Owner, then a state operator's license abstract must be completed in the states where the individual has been licensed as a vehicle operator during the past seven years.
- 7.15.3 If any background investigation reveals or indicates that an individual has been convicted of a felony crime, then the Contractor must notify the Owner prior to the individual commencing Work. Owner in its sole discretion shall have the option of barring from any Work Site any individual who has a reported felony conviction. Owner may audit or review specific Contractor screening files to ensure compliance with this Contract.
- 7.15.4 If an individual requires unescorted access to Owner's critical cyber assets, then Owner will conduct its own background investigation, which will include a Social Security Number verification. Additional specific provisions or requirements related to any Owner conducted background investigation pursuant to this Section 7.15.4 will be communicated to Contractor prior to implementation of such background investigation.
- 7.15.5 Contractor shall not perform any screening activities that violate the federal Fair Credit Reporting Act, Title VII of the Civil Rights Act of 1964 or any other applicable law in any circumstances. Contractor shall ensure that the substance and manner of any and all background investigations performed by Contractor conform fully to applicable law.
- 7.16 "Personally Identifiable Information" or "PII" means any information to which Contractor is provided access that could identify an individual either directly or indirectly including, without limitation to, the individual's name, credit card numbers, social security number, biometric, bank account numbers, passport numbers, computer passwords or health, financial or employment information and other individual confidential information.
- 7.16.1 To the extent that Work under the Contract requires Contractor to be given access to PII gathered and/or maintained by or on behalf of Owner, or in the event Contractor acquires access to or encounters any PII during performance of the Work, Contractor shall after receipt thereof, treat such PII as confidential and safeguard such PII from unauthorized use and disclosure. Upon request of Owner, Contractor shall have its employees execute a confidentiality agreement protecting PII. Contractor agrees not to appropriate such PII for its own use or to disclose such PII to third parties unless specifically authorized by Owner in writing. Contractor shall ensure that its employees will not discuss, divulge or disclose any such PII to any person or entity except those persons directly concerned with and only to the extent necessary to complete the performance of the Work. Contractor shall access, use and process PII and other data on behalf of Owner only for the purposes specified in the Contract.

- 7.16.2 Contractor shall comply with (i) NERC Reliability Standards as applicable, including without limitation, those relating to Critical Infrastructure Protection, (ii) Owner's security standards, and (iii) such further instructions as Owner may provide regarding the processing of such PII. Contractor shall inform Owner promptly if it has reason to believe that applicable law (or changes in applicable law) prevents Contractor from fulfilling the obligations relating to treatment of PII or other data under Owner's security standards and/or the Contract.
- 7.16.3 To the extent permitted by law, Contractor shall notify Owner promptly and act only upon Owner's instruction concerning: (a) any request for disclosure of PII or other data by law enforcement or other governmental authority; (b) any request by law enforcement or other governmental authority for information concerning the processing of PII or other data in connection with the Contract; or (c) any request received directly from an individual concerning his/her PII.
- 7.16.4 Contractor may not store PII, on computers, mobile devices, including but not limited to a cellular telephones and/or personal digital assistants, servers and/or storage devices including removable media (any of which, hereinafter known as a "Computer"), unless required for the performance of Work. Any such information must be deleted from a Computer, in a manner that ensures that it cannot be accessed or read, as soon as such storage is no longer required for the performance of Work.
- 7.16.5 Upon termination of the Contract or upon Owner's request, Contractor must promptly (a) return all PII in written form to Owner, and (b) delete all PII in Contractor's possession or control (on computer or in whatever other form or media) in a manner that ensures that this information cannot be accessed or read.
- 7.16.6 Contractor shall administer a monitoring process to ensure compliance with Section 7.16 and the related subsections hereof, promptly report any breaches to Owner, and implement immediate, appropriate corrective actions to contain and prevent recurrence. Contractor shall report to Owner immediately upon discovery of a real or suspected loss of PII. In the event of a breach of this provision or the occurrence of any other event regarding PII that requires notification under applicable law, Contractor agrees to assume responsibility for informing all such individuals in accordance with applicable law.
- 7.16.7 In addition to any remedy available to Owner under the Contract, Contractor acknowledges that any breach of Section 7.16 or the related subsections hereof by Contractor or its Subcontractors may subject Contractor to civil and criminal penalties. Contractor shall include the full text of Section 7.16 and the related subsections 7.16.1 through 7.16.7 in all appropriate subcontracts. However, including such provision in the subcontracts shall not relieve Contractor of its obligation to ensure compliance with the provisions of Section 7.16 and the related subsections 7.16.1 through 7.16.7.

8.0 EQUIPMENT

- 8.1 All Equipment shall be new and meet the requirements of all applicable codes. Equipment which will not become a part of the permanent installation is not required to be new. Owner reserves the right to reject Equipment which has not been previously used but which has been in storage for an unreasonable period of time. Title to the Equipment shall be free and clear of all liens and encumbrances.
- 8.2 Contractor shall not substitute Equipment specified in the Contract unless authorized by Owner in writing. Unless substitution has been so authorized, Contractor shall, at its expense, remove and replace any improperly substituted Equipment.

- 8.3 Upon Owner's request, Contractor shall, at its expense, submit to Owner samples of Contractor-furnished Equipment. Contractor must obtain Owner's written approval before performing Work involving the use of Equipment for which samples have been requested. Approval by Owner shall not relieve Contractor from responsibility for complying with the requirements of the Contract and all applicable codes. Equipment used shall conform to the approved samples. Contractor shall remove and replace nonconforming Equipment at its expense.

9.0 INSPECTION AND ACCEPTANCE

- 9.1 Contractor shall maintain an adequate inspection system and perform such inspections as will ensure that the Work performed conforms to the Contract requirements. Owner reserves the right to review and approve the adequacy of Contractor's inspection system. Contractor shall provide all quality control and quality assurance program information requested by Owner.
- 9.2 Owner shall have free access to the Work for inspection purposes. Owner's inspectors and expeditors shall be admitted at all reasonable times to the shops of Contractor, its Subcontractors for inspection purposes. Owner's inspection, receipt or Initial Acceptance of the Work shall not relieve Contractor of its obligation to comply with the terms of the Contract.
- 9.3□ Each party shall bear its own expenses in performing inspections, except that (a) Owner may use Contractor's facilities, ladders and scaffolds to perform inspections of the Work; (b) Contractor shall pay Owner's expenses in re-inspecting Work which was rejected as non-conforming to the Contract requirements in an earlier inspection; (c) Contractor shall pay the costs of uncovering and re-covering Work for Owner's inspection if Contractor failed to give Owner reasonable notice that the Work was ready to be covered; and (d) prior to Final Acceptance, if Owner requests an inspection of Work already completed which requires removing and tearing out Work, and the Work is found to be materially defective, Contractor shall pay the expenses of inspection and reconstruction, but if the Work is found to be in conformance with the Contract requirements, Owner shall pay the expenses of inspection and reconstruction.
- 9.4□ Owner will not pay for defective work. Contractor shall repair or replace all defective work at its expense. Contractor shall promptly remove from the Site any Equipment that does not comply with the requirements of the Contract. If Owner's Equipment has been used in any defective work, the cost of such Owner's Equipment shall be backcharged to Contractor.
- 9.5□ Contractor shall, at its expense, furnish to Owner certificates of shop inspection as required by laws or regulations, or by the National Board of Fire Underwriters, or by any company insuring the Equipment for the benefit of Owner.
- 9.6□ Owner shall have the right to take possession of or use any part of the Work. Owner's possession or use shall not constitute Initial Acceptance or Final Acceptance of the Work.
- 9.7□ Contractor shall make all production and shop tests at its expense. Owner shall have the right to have a representative present at such tests, including those at Contractor's suppliers' shops, and notice shall be given to Owner at least two weeks prior to any scheduled test. Contractor shall give Owner copies of certified test results promptly upon request.
- 9.8 Unless otherwise provided in the Contract, Final Acceptance by Owner shall be made as soon as practicable after all Work has been completed and inspected. Any part of the Work not rejected by Owner following Final Inspection shall be deemed to have achieved Final Acceptance.

10.0 SHIPMENT AND DELIVERY

- 10.1 Contractor shall coordinate shipment so that Equipment arrives at the Site on schedule and during Site receiving hours. Contractor shall provide shipping notices to Owner prior to shipment of the Equipment. Owner's storeroom at the Site where the Equipment is to be delivered shall be notified at least 48 hours in advance of the arrival of the Equipment, or as required by the Contract. Notification to Owner's storeroom and all shipping notices shall include special unloading and storage directions and a list of equipment required to unload the Equipment.
- 10.2 Contractor shall provide a complete bill of materials for each separate shipment. Every part that is not preassembled shall be identified on the bill of materials.
- 10.3 Contractor must attach metal tags with corrosion resistant tie wire, and waterproof markings and labels, to each piece and package, making reference to the bill of materials and Contract number.
- 10.4 Owner reserves the right to refuse shipments that do not contain proper markings, bills of materials, or for which proper shipping notices were not received. The return and redelivery will be at Contractor's expense.
- 10.5 Contractor shall deliver all Equipment F.O.B. Site, with freight prepaid and included in the Contract price.

11.0 TITLE AND RISK OF LOSS

- 11.1 Title and risk of loss shall pass to Owner upon Final Acceptance of the Work. Contractor agrees that title shall vest in Owner free and clear of all liens and encumbrances. If the Work is rejected as non-conforming, title and risk of loss shall remain with Contractor.
- 11.2 If the Work requires warranty work, title shall remain at all times with Owner, except that if the Work is replaced rather than repaired, Owner's title shall vest in the replacement Work.
- 11.3 If any part of the Work requires warranty work at Contractor's facility or any other off-Site location, risk of loss to that part of the Work shall pass to Contractor upon delivery by Owner of that part of the Work to a common carrier. Risk of loss to that part of the Work shall pass back to Owner upon delivery to Owner, installation at the Site and successful acceptance testing of the repaired or replaced Work.

12.0 SCHEDULE

- 12.1 Contractor shall perform the Work to meet the schedule date(s) set forth in the Contract documents. Contractor shall not commence Work until authorized by Owner to do so.
- 12.2 In a format acceptable to Owner, Contractor shall develop, update, maintain and provide to Owner a written schedule for execution of the Work. The schedule shall be time scaled, complete, and accurate in detail depicting Contract milestone dates, work activities and durations. Upon review and approval by Owner, this schedule shall become the Contract schedule. Updates to the Contract schedule shall be provided to Owner on at least a monthly basis. Updates shall depict actual progress measured against planned progress.
- 12.3 Contractor shall notify Owner within 24 hours of the first knowledge that any completion date(s) will not be met and shall, within five (5) Business Days thereafter, submit a detailed program depicting the plans and actions being taken to regain the lost time. The notice shall not limit any other rights or remedies afforded Owner under the Contract or by law.

13.0 TERMS OF PAYMENT

13.1 Except as otherwise provided in the Contract, the following terms of payment shall apply:

13.1.1 The Contract Price set forth in the Contract shall constitute full and complete payment for all Work.

13.1.2 Contractor shall submit invoices with proper documentation to Owner for the Work completed or for milestones achieved during the prior month. Owner may withhold all or any part of payment in an amount necessary to protect Owner from loss due to the occurrence, or imminent occurrence, of (i) Contractor's breach or failure to perform in accordance with the Contract, (ii) defective Work, (iii) Contractor's failure to pay any Subcontractor, (iv) other claims by Owner against Contractor, including indemnity claims, and (v) damages for delay or any agreed upon liquidated damages.

13.1.3 Owner shall pay [REDACTED] of each properly submitted and accepted invoice within [REDACTED] days of receipt. The release of retention shall become due and payable [REDACTED] days after the date of Final Acceptance of the Work.

13.1.4□ Each invoice shall contain a statement that all bills for material and labor relating to the Work have been paid in full by Contractor, and there are no unpaid bills for which a lien could be filed. If requested by Owner, Contractor shall provide evidence of such payments. The final invoice for the Work shall be accompanied by a satisfactorily completed Affidavit of Completion in the form attached as Exhibit 1. Payment of the final invoice and retention constitutes a full and final release of Owner from all claims, damages, liabilities and obligations under the Contract.

13.2□ Contractor shall promptly pay all of its Subcontractors.

14.0 CHANGES IN WORK AND EXTRA WORK

14.1□ Change in Work

14.1.1□ "Change Order" means a written order issued in accordance with this Article 14.0 documenting an addition to, deletion from, or other modification to the Work, including a change in the scope of Work, the Contract Price, the payment schedule, the completion dates, or the schedule for the Work.

14.1.2□ Owner may issue a Change Order: (i) at Owner's option, or (ii) if requested by Contractor due to the occurrence of an event that entitles Contractor to a Change Order as determined by Owner.

14.1.3□ If Owner issues a Change Order, Contractor shall perform the changed Work in accordance with the terms of the Contract and the issued Change Order.

14.1.4□ No order, statement or other conduct of Owner shall be treated as a change in Work until such change is authorized in writing by Owner.

14.1.5□ Contractor shall not be entitled to a Change Order for conditions such as, but not limited to, (i) work which is of such a nature as to be normally included in the Work or is reasonably inferable from the Contract; (ii) any errors, omissions, non-performance, negligence, deficiencies or improper or defective work on the part of Contractor (including miscalculations, incorrect estimates, or other errors in Contractor's proposal for the Work); (iii) changes relating to refinement, minor correction and detailing of the Work or

any part of the Contract; or (iv) other unallowable claims such as cost impacts not due to Owner and cumulative impact claims.

14.1.6□ With respect to Contractor claims for additional compensation, Owner shall pay only incremental Direct Costs associated with the proposed changes and only to the extent that Contractor can demonstrate that the changes actually increased its costs of performance. Any claims for additional compensation based on a change to the Work or extra work must be material in nature, and Contractor must provide full documentation supporting all elements of such claims. For a reduction in the scope of Work or a change which reduces Contractor's costs, the Contract Price shall be adjusted downward. The payment for changes to the Work shall be complete compensation to Contractor for performing such changes, including any schedule or cost impacts on the Work.

14.1.7□ If Owner requests in writing that Contractor furnish materials or Equipment to be permanently incorporated in changed work, extra work or cost-plus work, Owner shall reimburse Contractor for such materials or Equipment at its incremental Direct Cost plus a percentage mark-up to be agreed upon by the parties. Requests for payment for materials and equipment shall be accompanied by copies of receipted invoices. Owner has the right to audit Contractor's requests for changes and the financial basis therefor.

14.1.8 If Contractor and Owner disagree on whether any particular work is within the scope of Work and such work must be completed to insure timely progress, Owner will issue a disputed Change Order to cover the disputed work. Contractor shall diligently proceed with the disputed work. By noon on the work day following performance of the disputed work, Contractor shall submit to Owner for review timesheets itemizing all labor and equipment hours expended on the disputed work and an itemized listing of Contractor furnished materials. Such review is not an admission of liability by Owner. Prior to Final Acceptance, each disputed Change Order will be resolved to the mutual agreement of the parties.

14.2 Extra Work

14.2.1 "Extra work" is work which is beyond Contractor's scope of Work. At Owner's request, Contractor shall perform extra work at the applicable prices set forth in the Contract. If the Contract prices are not applicable to the type of extra work to be performed, Contractor shall promptly submit a proposal to perform the extra work, which proposal shall become an amendment to the Contract upon acceptance by Owner. If Owner directs Contractor to perform extra work on an overtime basis, Owner shall reimburse Contractor the actual payroll cost of premium time for direct job labor. Contractor shall invoice and maintain separate cost records for each extra work authorization issued by Owner.

14.2.2 If Owner elects, Contractor shall perform extra work on a cost-plus basis. Cost-plus extra work shall be paid in accordance with Article 15.0.

14.3 Contractor waives all claims for additional compensation for changes in work and extra work not made strictly in accordance with the terms of this Article 14.0.

15.0 REIMBURSEMENT FOR COST-PLUS WORK

15.1 Direct labor costs will be reimbursed at the actual payroll costs of direct labor wages, fringe benefits, payroll taxes and insurance required by collective bargaining agreements or by law, plus an agreed wage mark-up. Copies of certified payrolls and time sheets shall be provided to Owner for review and approval. Contractor shall not invoice Owner for social security, unemployment, workers' compensation, or other federal, state or local taxes or insurance at rates which exceed Contractor's actual costs.

- 15.2 Owner will pay Contractor actual invoice costs for subcontracted work, provided Owner has approved payment terms in advance of performing the work plus an agreed mark-up.
- 15.3 Contractor-furnished Equipment costs will be reimbursed at actual invoice costs plus an agreed mark-up.
- 15.4 Construction equipment costs will be reimbursed based on actual usage time during the performance of Work and established rental rates not to exceed monthly rates set forth in the "Rental Rate Blue Book for Construction Equipment" adjusted for geographical region as published by Dataquest or other basis acceptable to Owner. Hourly rates shall be established by taking the monthly rate divided by 176 hours per month.
- 15.5 Small tools and consumables costs will be reimbursed based on agreed rates.
- 15.6 Field supervision, clerical, safety and other non-direct labor costs will be reimbursed at agreed billing rates, except that reimbursement for these costs for cost plus extra work shall require the prior review and approval of Owner.
- 15.7 Project management, engineering, design, procurement, and other home office services will be reimbursed at billing rates contained in the Contract.
- 16.0 BACKCHARGES
- 16.1 Owner may impose backcharges against Contractor or deduct backcharges from monies owed to Contractor for performance or reperformance by Owner or others of Work, including but not limited to, costs associated with defective work, nonperformance by Contractor, termination for cause, clean-up and disposal of debris, damages to Owner's tools and equipment and warranty repairs. Contractor will be responsible for the cost of such performance or reperformance plus a [REDACTED] administrative charge.
- 17.0 TAXES
- 17.1 The Contract Price shall include, and Contractor shall pay, all taxes and assessments for unemployment insurance, workers' compensation, social security and disability benefits, and other taxes which are based upon the compensation paid to persons employed by Contractor or its Subcontractors for the performance of any Work under the Contract.
- 17.2 Except as provided below, the Contract Price shall include all applicable foreign, federal, state and local taxes payable by Contractor with respect to the Contract.
- 17.2.1 Contractor Purchases. If Owner specifies that tangible personal property to be incorporated into real property as defined for sales and use tax purposes or taxable services to be purchased by Contractor from Subcontractors qualify for exemption from sales or use taxes, Contractor shall not include sales or use taxes on such exempt tangible personal property or services in the Contract Price. Unless otherwise specified: a) consumable materials and supplies or Contractor's tools and equipment that are not incorporated into the Work or the overall project are not eligible for exemption and the Contract Price shall include, and Contractor shall pay, any sales or use taxes on such items; and b) Contractor will use its own properly-executed exemption or resale certificate, and not Owner's direct pay permit, to make exempt purchases of tangible personal property or services from Subcontractors.
- 17.2.2 Owner Purchases from Contractor. With respect to any Owner purchases from Contractor of tangible personal property not incorporated into real property as defined for sales and use tax purposes or taxable services, Owner shall provide to Contractor its

direct pay permit (if Owner has been issued a direct pay permit) or an appropriate exemption certificate required to relieve the Contractor of its responsibility to collect sales or use tax from the Owner. If Owner provides Contractor such direct pay permit or exemption certificate, sales or use taxes on Owner purchases from Contractor of tangible personal property or taxable services shall not be collected from Owner or included in the Contract Price. Unless otherwise approved or directed by Owner in writing, Contractor shall not use Owner's direct pay permit to make exempt purchases of tangible personal property or taxable services from Subcontractors.

- 17.2.3 Contractor Cooperation. Contractor shall take all steps reasonably necessary to ensure that Contractor's purchases from Subcontractors of items of tangible personal property or services are exempt from sales and use tax pursuant to any applicable exemption pursuant to the law of any U.S. jurisdiction or its political subdivisions.

18.0 INSURANCE

- 18.1 Contractor shall, at its sole expense, procure and maintain, and shall cause its Subcontractors to procure and maintain, throughout the term of this Contract except as set forth in Section 18.5, the following types of insurance with the following, minimum limits:

18.1.1 Workers' compensation insurance limits in accordance with all jurisdictions where Contractor has operations including where the Work is to be performed. If Contractor is a non-subscriber to workers' compensation, evidence of insurance equivalent to workers' compensation must be provided.

18.1.2 Employer's liability in an amount not less than \$1,000,000.

18.1.3 Business automobile insurance covering all owned, non-owned and hired autos in an amount not less than \$5,000,000 per occurrence.

18.1.4 Commercial general liability insurance covering claims of bodily injury and property damage in an amount not less than \$5,000,000 per occurrence.

18.1.5 Aircraft liability insurance with a combined limit of not less than \$10,000,000. Such insurance shall be required only if the Contractor or its Subcontractors shall utilize an aircraft in the performance of the Work.

18.1.6 If Contractor (or any of its Subcontractors) are engaged in operations which use marine vessels or floating equipment, or which are subject to maritime jurisdiction, the following insurance shall be required: Marine Liability insurance (including Jones Act and maritime employer's liability if operations are subject to federal jurisdiction) and pollution liability (under terms equivalent to current W.Q.I.S. policy provisions if operations are subject to federal jurisdiction) in amounts not less than \$10,000,000 per occurrence.

18.1.7 Professional liability insurance and/or errors and omissions insurance in an amount not less than \$5,000,000. Such insurance shall be required only if the Work includes professional liability exposures.

18.1.8 "All risk" property insurance covering the full replacement cost of Contractor's personal property.

- 18.2 To the extent permitted by law, Contractor shall waive, and shall cause each of its insurers to waive, any and all rights of recovery, by subrogation or otherwise, against Owner and its affiliates,

officers, directors, employees, agents and assigns of any type. Each of Contractor's insurance policies shall be primary to and non-contributory with any insurance or self-insurance of Owner.

- 18.3 The commercial general liability, the business automobile, and (if applicable) the aircraft liability and Marine Liability insurance shall include Owner as an additional insured with respect to Owner's liability arising out of the operations of Contractor. Such coverage shall also include blanket contractual coverage and contain no exclusion for explosion, collapse, or underground property damage (XCU coverage).
- 18.4 The insurance required by this Article 18.0 is in addition to and separate from any other obligations contained in the Contract.
- 18.5 Products and/or completed operations coverage shall be maintained for a period of five (5) years after the completion of the Work. If any of the policies indicated above are placed on a "claims-made" basis, such coverage shall be maintained for a period of not less than five (5) years following the completion of the Work.
- 18.6 Any deductibles or retentions on any of the policies required herein shall be the sole responsibility of the Contractor.
- 18.7 The above referenced limit requirements may be met by any combination of umbrella or excess and primary policies so long as the total limit of insurance requirement is met. The required coverages referred to herein shall in no way affect, nor are they intended as a limitation of, Contractor's liability with respect to its performance of the Work. The limits of insurance indicated herein are minimum requirements and are in no way intended to limit Contractor's liability.
- 18.8 In all cases where Contractor's employees (defined to include Contractor's direct, borrowed, special, or statutory employees) are covered by the Louisiana Worker's Compensation Act, La. Rev. Stat. Ann. 23:1021 et seq., Owner and Contractor agree that pursuant to Section 23:1061 (A) (1) all Work performed by Contractor and its employees under the terms and conditions of the Contract is an integral part of Owner's operations and is essential to Owner's ability to generate its goods, products and services. Additionally, Owner and Contractor agree that for purposes of Section 23:1061 (A) (3) Owner is the principal or statutory employer of Contractor's employees. Irrespective of Owner's status as the statutory employer or special employer of Contractor's employees, pursuant to Section 23:1031 (C), Contractor shall remain primarily responsible for the payment of Louisiana Worker's Compensation benefits to its employees, shall indemnify Owner from any and all claims of Contractor's employees or its Subcontractor's employees and shall not be entitled to seek contribution for any such payments from Owner.
- 18.9 Upon inception of the Contract and prior to the commencement of Work, Contractor shall provide Owner with an acceptable certificate of insurance evidencing the insurance required under Article 18. Contractor will not be permitted to bring its employees, materials or equipment onto the Site until Owner receives such evidence of insurance. Contractor also must provide an updated certificate of insurance at any time during the Contract term upon Owner's request. Contractor shall immediately notify Owner of cancellation or any material changes in the insurance policies required herein. If such insurance policies are subject to any exceptions to the terms specified herein, such exceptions shall be explained in full in such certificates. Owner may, at its discretion, require Contractor to obtain insurance policies that are not subject to non-standard exceptions.
- 18.10 In lieu of Sections 18.1 thru 18.9, the Owner may elect to implement an Owner Controlled Insurance Program ("OCIP"). If an OCIP is implemented, all Contractor(s) and Subcontractor(s) of any tier and such other persons or entities as the Owner may designate as enrolled parties, may, at Owner's option, be required to enroll and participate. Owner shall procure and maintain at its own expense during the performance of this Contract and a stipulated completed operations period, such

insurance coverage as Owner deems appropriate on behalf of enrolled parties. Eligible Contractor(s) and Subcontractor(s) must submit all necessary enrollment forms for acceptance into the OCIP, and agree to the terms of the Owner's project safety standards. Owner and Contractor agree that the terms of the OCIP as contained in amendments to this Contract and the OCIP Contractor Manual shall control. The OCIP does not relieve any Contractor or Subcontractor from its obligations to procure coverage for offsite operations or coverages not included in the OCIP. In the event an OCIP is implemented, amended insurance requirements for enrolled parties will be provided.

- 18.11 The furnishing of insurance by Owner through an OCIP will in no way relieve or limit any enrolled party of any responsibility, liability, or obligation imposed by the contract documents or by law, including without limitation any indemnification obligations which any enrolled party has to the Owner thereunder.

19.0 INDEMNIFICATION

- 19.1 The laws of the state where the Work giving rise to the claim is performed shall apply to this Article 19.0.
- 19.2 **TO THE EXTENT PERMITTED BY LAW, CONTRACTOR SHALL INDEMNIFY, DEFEND AT ITS EXPENSE, AND SAVE OWNER HARMLESS FROM, ANY LIABILITIES, COSTS AND CLAIMS, INCLUDING JUDGMENTS RENDERED AGAINST, AND FINES AND PENALTIES IMPOSED UPON, OWNER AND REASONABLE ATTORNEYS' FEES AND ALL OTHER COSTS OF LITIGATION (COLLECTIVELY, "LIABILITIES"), ARISING OUT OF THE CONTRACT, INCLUDING INJURIES, DISEASE OR DEATH TO PERSONS, OR DAMAGE TO PROPERTY, AND ENVIRONMENTAL CLAIMS AND LIABILITIES, CAUSED BY CONTRACTOR, ITS EMPLOYEES, AGENTS OR SUBCONTRACTORS, OR IN ANY WAY ATTRIBUTABLE TO THE PERFORMANCE OF THE CONTRACT, EXCEPT THAT CONTRACTOR'S OBLIGATION TO INDEMNIFY OWNER SHALL NOT APPLY TO ANY LIABILITIES ARISING FROM OWNER'S SOLE NEGLIGENCE. TO THE EXTENT PROVIDED IN THIS SECTION, IN STATES OTHER THAN OHIO, MICHIGAN, KENTUCKY, TENNESSEE, MISSOURI, OKLAHOMA, VIRGINIA, AND WEST VIRGINIA, CONTRACTOR AGREES TO INDEMNIFY OWNER FOR LIABILITIES ARISING FROM OWNER'S ACTS AND OMISSIONS, NEGLIGENT OR OTHERWISE. OWNER SHALL HAVE THE RIGHT TO SELECT ITS OWN COUNSEL AND TO HAVE COUNSEL SEPARATE FROM CONTRACTOR, ALL AT CONTRACTOR'S EXPENSE.**
- 19.3 **WITH RESPECT TO CLAIMS AGAINST OWNER BY CONTRACTOR'S EMPLOYEES, CONTRACTOR UNDERSTANDS AND AGREES THAT THIS INDEMNIFICATION OBLIGATION SHALL NOT BE LIMITED IN ANY WAY BY, AND CONTRACTOR EXPRESSLY WAIVES, ITS IMMUNITY AS A COMPLYING EMPLOYER UNDER ANY APPLICABLE WORKERS' COMPENSATION LAW, BUT ONLY TO THE EXTENT THAT SUCH IMMUNITY WOULD BAR OR AFFECT RECOVERY UNDER OR ENFORCEMENT OF THIS INDEMNIFICATION OBLIGATION.** With respect to the State of Ohio, this waiver applies to Section 35, Article II of the Ohio Constitution and Ohio Rev. Code Section 4123.74.
- 19.4 **CONTRACTOR SHALL BE LIABLE FOR REASONABLE ATTORNEYS' FEES AND ALL COSTS OF LITIGATION ASSOCIATED WITH ENFORCEMENT OF ALL INDEMNITY OBLIGATIONS SET FORTH IN THE CONTRACT.**

20.0 LIMITATION OF LIABILITY

20.1 Except as expressly provided herein, neither party shall be liable to the other for any incidental, indirect, special, punitive or consequential damages. Contractor must bring any cause of action arising under the Contract within one year from the time the cause of action accrues.

21.0 LIENS

21.1 To the extent permitted by law, Contractor shall not file or permit to be filed any lien with respect to the Work and hereby expressly waives any right to file or cause to be filed a lien. Contractor, in its subcontracts, shall require all Subcontractors to expressly waive the right to file any liens against Owner's property, and, if requested, provide Owner with copies of such waivers.

21.2 In the event any claim is asserted or any lien filed against Owner or its property, or notice of lien is provided to Owner in violation of this provision, further payment to Contractor shall not become due under the Contract until the claim is satisfied or the lien released without cost to Owner and Contractor shall provide Owner with evidence of payment relating to such claim or lien. If Contractor fails to settle any claim or secure the release of any lien, Owner may take whatever steps it deems necessary to settle the claim or release the lien, including bonding off the lien. Owner may deduct its costs and expenses for settling any claim or securing the release of any lien filed by Contractor or its Subcontractors from any money due or to become due to Contractor under the Contract. If final payment has been made, Contractor shall reimburse to Owner its costs to settle any claim or secure the release of any lien arising out of the Contract.

22.0 INTELLECTUAL PROPERTY

22.1 Contractor warrants that its performance of the Work will not infringe upon or violate any trademarks, patents, copyrights, trade secrets or other third party property rights. If the performance of Work is held in any action to constitute infringement, or the use of the Work is enjoined, Contractor, at its expense, shall procure for Owner the right to continue use of the Work, or replace the Work with non-infringing materials or methods satisfactory to Owner, or modify the Work in a manner satisfactory to Owner so that the Work becomes non-infringing. Contractor agrees to indemnify and save Owner harmless from and against any liability or damages, including attorneys' fees, arising out of any alleged infringement or violation.

22.2 All inventions, discoveries, documents, works of authorship, methods, and the derivative works thereof, resulting from the Work, including patents, patent applications, copyrights, trade secrets and other intellectual property (collectively "Intellectual Property"), shall be the sole and exclusive property of Owner. Contractor shall promptly inform Owner of the development of any such Intellectual Property and does hereby assign and transfer the entire right, title and interest, together with all rights of priority, in and to such Intellectual Property to Owner. Contractor shall promptly cooperate with Owner in signing any additional documentation necessary to assign and perfect ownership of such Intellectual Property in Owner or to allow Owner to register its property rights therein. Contractor warrants that it has obtained written agreements from its employees and agents as necessary to effectuate the purpose of this Section. The Intellectual Property assigned and transferred to Owner shall be the Confidential Information of Owner.

22.3 Contractor grants Owner a nonexclusive, nonrevocable, perpetual, fully paid license to utilize Contractor's intellectual property existing separate from the Contract, including inventions, discoveries, works or authorship, methods, and trade secrets, regardless of whether such are the subject of patents, copyrights or other intellectual property protection, to the extent necessary for Owner to achieve the full benefit of the Work.

22.4 Contractor shall not use Owner's name or logo in marketing, endorsements, or other business purposes without prior written consent from Owner.

23.0 DRAWINGS AND DATA

- 23.1 Contractor shall furnish for Owner's review, prior to commencement of Equipment manufacture or fabrication, general and detailed drawings of the Equipment in the format requested. Such drawings shall be certified as to accuracy and completeness and shall show information adequate to enable Owner to design and provide suitable clearances. If required by the Contract or any code, law or agency, Contractor will provide professional engineer or architect sealed drawings and reports for the state where the Equipment is to be finally installed. Figures shall take precedence in all cases over scaled measurements on drawings. Where obvious discrepancies exist, Contractor shall consult with and follow the instructions of Owner. Owner's approval of Contractor's drawings shall not relieve Contractor of its obligation to comply with the contract requirements.
- 23.2 All written data, such as drawings, plans, reports, designs and specifications, prepared by Contractor for Owner during the performance of Work shall become the property of Owner. Such data, together with all data furnished by Owner and lent to Contractor for return, shall be delivered to Owner upon request, or upon completion of the Work or termination of the Contract. For clarification purposes, Owner shall have the unrestricted right to use, release, disclose, copy and reproduce such data for purposes of operation, maintenance, analysis, testing, cleaning, erection, improvement or modification of any facilities owned or operated by Owner. Contractor shall cooperate with Owner by executing such documents as are necessary to assign and perfect ownership in Contractor provided data to Owner.

24.0 CONFIDENTIALITY

- 24.1 "Confidential Information" means any confidential or proprietary information, whether written, oral, or visual, whether or not it constitutes a trade secret under applicable law. "Confidential Information" includes, but is not limited to, business plans and methods; customer information; engineering, operating and technical data; and the dates of Owner's outage schedule, information concerning the Work, and Owner's activities. "Confidential Information" does not include information that (a) has become part of the public domain other than by acts or omissions of the recipient; (b) has been furnished or made known to the recipient by a third person as a matter of legal right and without restriction on use; (c) was in the recipient's possession prior to disclosure by the disclosing party without restriction on use; or (d) is independently developed by the recipient without access to the Confidential Information.
- 24.2 Subject to Section 24.5, each party agrees (a) to protect the Confidential Information of the other with at least the same degree of care used to protect its own Confidential Information; (b) not to use (except for the purpose described herein), publish or disclose to third parties such Confidential Information; and (c) upon the request of the disclosing party, to promptly deliver to the disclosing party all written copies of its Confidential Information. Notwithstanding the foregoing, a recipient shall be entitled to disclose Confidential Information to its officers, employees, affiliates (including any joint ventures of which Owner or any of its affiliates are a member and the other members of such joint ventures), agents, lenders, attorneys and other advisors (collectively, "Representatives"), provided that the Representatives shall be informed of the confidentiality obligations provided herein.
- 24.3 If either party is required pursuant to applicable law or otherwise becomes legally compelled to disclose any of the Confidential Information, such party shall promptly advise the disclosing party in order that the disclosing party may seek a protective order or such other remedy as the disclosing party may consider appropriate in the circumstances. In any event, the compelled party may disclose only that portion of the Confidential Information which such party is legally required to disclose in the judgment of the party's legal counsel without any liability to the disclosing party hereunder and such disclosure shall not be a breach of this Section.

- 24.4 Contractor shall require its Subcontractors, if any, to expressly comply with the confidentiality provisions as set forth herein.
- 24.5 All documents prepared by Contractor for Owner during the performance of Work that incorporate, in whole or in part, information owned or provided by Owner shall not be marked or designated in any way as the confidential or proprietary information of Contractor without also stating that Owner has rights in such documents. Owner shall have the right to question the designation of Confidential Information by Contractor and Contractor agrees to provide Owner with reasonable cooperation in explaining such designation. Contractor agrees that Owner's acceptance of documents containing the Confidential Information of Contractor shall not be construed as a restriction on Owner's rights to use, release, disclose, distribute, copy or reproduce the documents.
- 25.0 DEFAULT
- 25.1 The occurrence of any of the following shall constitute an "Event of Default":
- 25.1.1 Contractor files a petition in bankruptcy, or if its creditors file an involuntary petition in bankruptcy, or if it makes a general assignment for the benefit of its creditors, or if a receiver is appointed on account of its insolvency.
- 25.1.2 Contractor (a) fails to maintain the schedule set forth in the Contract, or (b) fails to promptly pay Subcontractors for material or labor, or (c) commits repeated or substantial violations of laws, rules, regulations or policies, or (d) fails to perform in accordance with the Contract, and Contractor fails to take corrective action or submit an acceptable plan within two (2) Business Days after the receipt of a notice of non-conformance from Owner.
- 25.2 Upon an Event of Default, Owner may take any or all of the following actions without affecting the Contract Price or schedule:
- (a) Owner may direct Contractor to cease performance on all or part of the Contract until satisfactory corrective action has been taken;
- (b) Owner may have others take corrective action necessary to achieve compliance with the Contract. Owner may deduct the cost of such corrective action by others from any monies due to Contractor. Corrective action by others shall be taken when, in the judgment of Owner, the noncompliance threatens safety, unreasonably interferes with or delays the work of others, or otherwise creates a situation the resolution of which cannot be delayed without adversely impacting quality, cost or timely completion;
- (c) Owner may pursue damages for delay under the terms of Article 26.0;
- (d) Owner may suspend the Contract under Article 28.0; and/or
- (d) Owner may terminate the Contract under the terms of Section 29.1
- 25.3 Each of Owner's rights set forth above shall be cumulative and additional to any other rights or remedies provide in law or equity or otherwise.
- 26.0 DAMAGES FOR DELAY
- 26.1 Contractor shall be liable for any direct damages incurred by Owner arising out of Contractor's failure to perform on time.

26.2 In lieu of Section 26.1, if the parties have agreed to liquidate the amount of direct damages resulting from Contractor's delay, the parties agree that such damages which might be incurred by Owner as a result of Contractor's delay in performance are uncertain and would be difficult to calculate. The parties agree that the liquidated damages contained in the Contract would be reasonable and fair compensation for late performance. Contractor commits to pay and Owner agrees to accept such sum as liquidated damages and not as a penalty in the event of late performance.

27.0 FORCE MAJEURE

27.1 Neither party shall be in breach of the Contract to the extent that any delay or default in performance is due to a Force Majeure Event. The term, "Force Majeure Event" shall mean any cause beyond the reasonable control of the delayed or defaulting party, including, but not limited to, acts of God including unusually adverse weather, fire, and epidemic; acts of public enemy including war, acts of terrorism, riot, and civil disturbance; and national labor strikes, which by exercise of due foresight such party could not have been expected to avoid or overcome. Contractor's inability to obtain adequate and sufficient labor in order to maintain progress of the Work shall not constitute a Force Majeure Event. No delay in performance resulting from a Force Majeure Event shall result in any liability on the part of Owner. Notwithstanding the preceding sentence, in the event of a delay caused by any act or failure to act on the part of Owner, Contractor's sole remedy shall be as set forth in Article 14.0.

27.2 The delaying party shall immediately notify the other party of the beginning of a delaying event, and shall confirm the notice in writing within ten (10) Business Days of the beginning of the event. The notice shall contain a detailed account of the delay, including the cause of the delay, an estimate of the duration of the delay, an estimate of the delay's impact to the schedule, and the plan to mitigate the effects of the delay.

27.3 If Contractor is the delaying party, and the delay is a Force Majeure Event as defined in Section 27.1, Owner shall grant Contractor an extension of the time for performance, to be mutually agreed upon by Contractor and Owner. The extension of time granted as a result of a Force Majeure Event shall in no case exceed the length of the delay and such extension may be withheld or reduced to the extent Contractor does not provide notice in accordance with Section 27.2. If Owner so requests, Contractor shall expedite its schedule to mitigate the effects of the excusable delay. Owner shall pay incremental, Direct Costs incurred by Contractor for expediting at Owner's request.

28.0 SUSPENSION

28.1 Owner may at any time suspend all or any part of the Work. Owner shall provide Contractor written notice verifying the suspension date. Immediately upon receipt of the suspension notice, Contractor shall take the necessary actions to comply with the suspension notice.

28.2 Owner shall pay Contractor in accordance with the terms of payment set forth in the Contract for the Work completed prior to the time of suspension and for the incremental, Direct Costs that result from Contractor's compliance with the suspension notice.

28.3 Owner may, at any time during the suspension period, either terminate the Contract in accordance with Section 29.2, or authorize the Work or any portion thereof to be restarted. Owner shall pay Contractor the incremental, Direct Costs associated with the restart of the Work and shall resume payments to Contractor in accordance with the terms of payment under the Contract thirty (30) days after the restart of Work.

28.4 The schedule shall be adjusted to provide for a reasonable extension of time for Contractor's performance.

29.0 TERMINATION

29.1 Termination for Cause

- 29.1.1 Upon an Event of Default, Owner may terminate the Contract upon written notice to Contractor.
- 29.1.2 In the event of such termination, Contractor shall immediately prepare and submit to Owner an itemization of the Work completed by Contractor. Owner may require Contractor to leave the Site. Owner may take over such Work and complete it, or have the Work completed by others. Owner may take possession of and utilize in completing the Work Contractor's materials, Equipment to be installed, supplies, tools and equipment at the Site.
- 29.1.3 Contractor shall not be entitled to further payment until all of the Work is completed in its entirety and Final Acceptance has been achieved. If the cost of completion exceeds the unpaid balance under the Contract, Contractor shall pay the difference to Owner within thirty (30) calendar days of demand.
- 29.1.4 In the event that a court determines that the termination was not properly a termination for cause, pursuant to Section 29.1.1, Contractor's remedy shall be limited to the payments permitted in accordance with Section 29.2.

29.2 Termination for Convenience

- 29.2.1 Owner may terminate this Contract, in whole or in part, for its convenience. Owner will give Contractor written notice of termination specifying the extent to which the Contract is terminated and the date, immediately or otherwise, on which termination becomes effective.
- 29.2.2 Upon termination for convenience, Contractor will comply with instructions in the notice of termination regarding delivery to Owner of all Work in progress and all completed Work, which shall become the property of Owner upon delivery.
- 29.2.3 In the event of such termination, Contractor shall receive payment, including the retained percentage, for the Work satisfactorily performed up to the time of such termination. In addition, Owner shall reimburse Contractor for incremental, Direct Costs resulting from the termination, provided that compensation was not otherwise made for such costs. Final payment shall be made upon the parties' agreement of the amount of the final invoice and Owner's receipt of an Affidavit of Completion in the form of Exhibit 1. Owner shall not be responsible for Contractor's lost profit on the terminated portion of the Contract.

30.0 EQUIPMENT AND WORKMANSHIP WARRANTY

- 30.1 Beginning upon Final Acceptance and for a period of one year thereafter, or for such period as may be specified elsewhere in the Contract, Contractor warrants that (a) it will perform the Work in accordance with the accepted standards of care and competence found in the engineering or other applicable profession as such standards relate to and are commonly used in the electric utility industry, and (b) all Equipment and workmanship shall be free of any and all defects and shall be in conformity with the requirements of the Contract.
- 30.2 Subject to the provisions of Section 30.3, in the event that the Equipment or workmanship does not comply with the warranty, Contractor shall, at no cost to Owner, promptly repair or replace such nonconforming Equipment or workmanship with as little disruption to Owner's operations as

practicable. Contractor shall be responsible for the total cost of correcting any defects, including but not limited to, the costs of engineering, design, materials, labor, any necessary equipment removal, disassembly, shipping, reinstallation and retesting of the installation. Owner shall give Contractor notice of observed defects with reasonable promptness. If nonconforming Equipment or workmanship causes an outage or other delay of operations, Contractor shall make the repair or replacement on an overtime, maximum effort basis, at Contractor's expense.

- 30.3 If Owner directs Contractor to repair or replace any defect and Contractor fails to do so within a reasonable time, or if an emergency exists rendering it impracticable for Contractor to perform the repair or replacement, Owner may make or cause to be made such repair or replacement without affecting the validity of the warranty. Owner's cost for making the repair or replacement shall be deducted from the Contract Price or any unpaid portion thereof. If the unpaid portion of the Contract Price is insufficient to cover such cost, Contractor shall reimburse Owner.
- 30.4 Owner will not pay for any defective portion of the Equipment or workmanship until remedied by Contractor at Contractor's expense in accordance with the Contract requirements.
- 30.5 Owner must approve any proposed correction or alteration by Contractor of the Equipment or workmanship, or parts thereof, made at any time or at any location, before such correction or alteration is undertaken. Approval by Owner shall not relieve Contractor from responsibility for complying with the requirements of the Contract and all applicable codes.
- 30.6 Any Equipment or workmanship which are repaired or replaced pursuant to this Article 30.0 shall be warranted for a period of one year from the date of completion and acceptance of such repair or replacement, or for the remainder of the original warranty period, whichever is longer.
- 30.7 Contractor shall obtain, for the benefit of Owner, all available warranties from Subcontractors of Contractor. Such warranties shall be in addition to the warranties set forth in this Article. If such warranties are in written form, Contractor shall provide Owner with the original warranties.

31.0 REPORTING OF COMPLAINTS

- 31.1 Contractor shall immediately report to Owner, in accordance with Article 35.0, the complete details of all complaints, including any OSHA violations and complaints received from governmental authorities, Subcontractors, laborers, other third parties or members of the public relating to the Work.

32.0 RETENTION AND EXAMINATION OF INFORMATION, BOOKS AND RECORDS

- 32.1 Owner reserves the right to audit records necessary to permit evaluation and verification of (i) claims submitted, (ii) Change Orders, and related overhead and general and administrative costs, and (iii) Contractor's compliance, in the performance of the Contract and its dealings with Owner with (a) the Contract requirements; and (b) Owner's Code of Business Conduct governing business ethics. Owner's right to audit shall not extend to fixed, lump-sum or unit pricing.
- 32.2 Contractor shall cooperate with Owner and provide Owner with information and records ("information") pertaining to the Work as requested by governmental agencies, Owner, or courts of law.
- 32.3 Contractor shall retain for a period of three years after Contract termination or expiration all information relating to the Work. Owner may audit and copy such information at Contractor's premises during regular business hours. If requested by Owner, Contractor shall submit to Owner a copy of each of its subcontracts. Contractor shall include in its subcontracts a provision granting Owner the rights against Subcontractors contained in this Article 32.0.

33.0 COMPLIANCE WITH LAWS

- 33.1 Contractor warrants that all materials and Equipment supplied and all Work performed will comply with, and be manufactured, priced, sold and labeled in compliance with all applicable federal, state and local laws, rules, regulations, orders and ordinances, including, without limitation, environmental protection, energy, safety and health, and labor laws and regulations and applicable industry codes and standards.
- 33.2 Unless exempted, **Contractor shall abide by the requirements of 41 C.F.R. § 60-1.4(a)(7), 41 C.F.R. § 60-300.5(a), and 41 C.F.R. § 60-741.5(a). These regulations prohibit discrimination against minorities, females, qualified protected veterans, and qualified individuals on the basis of disability and require affirmative action by covered prime contractors and subcontractors to employ and advance in employment minorities, females, qualified protected veterans, and qualified individuals with disabilities.** Contractor represents that it does not, and shall not for the term of the Contract, provide or maintain for its employees facilities that are segregated on the basis of race, color, religion, sex, national origin, veteran status or disability status. Contractor represents that it will not assign its employees to perform any work related to the Contract at a location where facilities are segregated on the basis of race, color, religion, sex national origin, veteran status or disability status. Contractor agrees that it will not enter into any agreement to obtain goods or services relating to the Contract with any entity that provides, maintains or assigns its employees to work at locations where facilities are segregated on the basis of race, color, religion, sex or national origin. As used herein, “facility” means waiting rooms; work areas; restaurants and other eating areas; time clocks; locker rooms and other storage or sleeping areas, except as necessary to ensure privacy between male and female employees; parking lots, drinking fountains; recreation or entertainment areas; and transportation. If not otherwise exempted by Title 48 and to the extent applicable, Contractor will comply with 48 CFR §52.219-8, Utilization of Small, Small Disadvantaged, and Women-Owned Small Business Concerns, and 48 CFR §52.219-9, Small, Small Disadvantaged, and Women-Owned Small Business Subcontracting Plan. If not otherwise exempted by 41 CFR §60-1.5, Contractor represents that it will file all reports or other required information specified in 41 CFR §60-1.7. Contractor shall also abide by the requirements of 29 CFR Part 471, Appendix A to Subpart A, which is incorporated by reference, as applicable.
- 33.3 Contractor shall indemnify and save Owner harmless from any and all costs or expenses arising out of any violations of such laws, ordinances and regulations.

34.0 PERMITS AND LICENSES

- 34.1 Contractor shall obtain all permits and licenses required by any regulatory authority for the performance of any portion of the Work, except that Owner shall obtain permits and licenses for all structures which are to become a permanent part of the Site. Before starting Work, Contractor shall submit to Owner a copy of all permits and licenses required by any such regulatory authority.
- 34.2 Contractor shall obtain and maintain all professional licenses necessary to perform the Work.
- 34.3 Contractor shall indemnify and save Owner harmless from any and all costs or expenses arising out of the failure of Contractor to obtain such permits and licenses.

35.0 NOTICES

- 35.1 Each party shall designate in writing a representative to receive any and all notices required under the Contract. Notices shall be in writing and shall be given to the representative designated to receive them, either by personal delivery, certified mail, facsimile, e-mail (with confirmation of receipt) or any similar means, properly addressed to such representative. All notices shall be effective upon receipt, or upon such later date following receipt as set forth in the notice. Either party may, by

written notice to the other, change the representative or the address to which such notices are to be sent.

36.0 SEVERABILITY

36.1 In the event that any of the provisions, or portions thereof, of the Contract are held to be unenforceable or invalid by any court, the validity and enforceability of the remaining provisions, or portions thereof, shall not be affected.

37.0 WAIVER

37.1 Either party's waiver of any breach of the Contract shall not be deemed to be a waiver of any other breach of the same or a different term of the Contract.

38.0 NON-DISCLOSURE

38.1 Except as required by law, regulation, or judicial or administrative order, neither party shall disclose the terms of the Contract without the consent of the other party. Notwithstanding the foregoing, Owner may disclose the terms of the Contract without the consent of Contractor (a) to any of its affiliated companies (including any joint ventures of which Owner or any of its affiliates are a member and the other members of such joint ventures); and (b) to any prospective transferee or purchaser of assets of Owner or any of affiliates.

39.0 HEADINGS

39.1 Headings are provided for the convenience of the parties, and shall not affect the interpretation of any provision.

40.0 AFFILIATED COMPANIES

40.1 Any indemnification of Owner or any limitation of Owner's or Contractor's liability under this Contract shall to the same extent apply to Owner's or Contractor's directors, officers, employees, agents, and affiliated companies (including any joint ventures of which Owner or any of its affiliates are a member and the other members of such joint ventures), including any directors, officers, employees and agents thereof.

40.2 The affiliated companies (including any joint ventures of which Owner or any of its affiliates are a member and the other members of such joint ventures) of the American Electric Power System are severally and not jointly liable for obligations arising hereunder.

41.0 APPLICABLE LAWS AND JURISDICTION

41.1 Except for Article 19.0, the rights and obligations of the parties arising out of the Contract shall be governed in all respects by the laws of the State of Ohio, excluding any conflict-of-law rules. Any reference herein to the laws of other states is made only to the extent that the laws of that state might apply, notwithstanding the intent of the parties that the laws of the State of Ohio should apply.

41.2 Contractor agrees that all actions and proceedings brought by Owner against Contractor may be litigated in courts located in the State of Ohio or the state where work was performed. Contractor agrees that such courts are convenient forums and irrevocably submits to the personal jurisdiction of such courts. Contractor waives personal service of process and consents to service of process by certified or registered mail at the address designated for receiving notices under this Contract.

42.0 ENTIRE AGREEMENT

42.1 The Contract constitutes the entire agreement between the parties and supersedes all previous and collateral agreements or understandings with respect to the subject matter of the Contract. No waiver, alteration, amendment or modification of any of the provisions of the Contract shall be binding unless in writing and signed by duly authorized representatives of the parties.

43.0 BINDING EFFECT; NO THIRD-PARTY BENEFICIARIES

43.1 Subject to the restrictions on assignment in Section 5.1, this Contract shall be binding upon and shall inure to the benefit of the parties of their respective successors and permitted assigns.

43.2 No provision of the Contract is intended or shall be construed to be for the benefit of third party other than as set forth in Article 38.0.

44.0 EXECUTION; COUNTERPARTS; ELECTRONIC SIGNATURES

44.1 The Contract shall not be binding or effective until properly executed by each of the parties hereto. The Contract may be executed in any number of counterparts, each of which shall be deemed to be an original, and all of which, taken together, shall constitute but one and the same Contract, which may be sufficiently evidenced by one counterpart.

44.2 Each party agrees that any electronic signatures, whether digital or encrypted, of the parties included in this Contract are intended to authenticate this writing and to have the same force and effect as manual signatures. Electronic signature means any electronic sound, symbol or process attached to or logically associated with a record and executed and adopted by a party with the intent to sign such record.

45.0 SURVIVAL

45.1 All of the terms of the Contract which by their nature extend beyond the expiration or termination of the Contract, including indemnification obligations, confidentiality obligations, limitations of liability, shall survive expiration or termination of the Contract and remain in full force and effect.

AFFIDAVIT OF COMPLETION

State of _____

County of _____

_____, being duly sworn, states that:
(Name of Affiant)

1. S/He is the _____ of
(Office held by Affiant)

(Legal Name of Contractor) (Contractor)

that has a contract with _____
(Legal Name of Owner)

(Owner) dated _____ (Owner's Contract No. _____)
(Contract Date) (Contract No.)

involving work on the Owner's property at _____
(Project Name)

located near _____
(City, State)

2. All of the Work required to be performed by the Contractor under said Contract has been performed. All bills and claims for material, labor and services to employees and Subcontractors covering the Work required to be performed under the Contract, have been paid in full by the Contractor. There are no unpaid amounts on the basis of which a lien has been filed, or can be filed, in connection with the Work performed under the Contract.

Signature of Affiant

Sworn to before me and subscribed in my presence this _____ day of _____, _____.

Notary

R D		
		"Contractor shall remain liable for the completion of the Project and shall not be relieved of its obligations by the termination of the Project for any reason."
		"Contractor shall remain liable for the completion of the Project and shall not be relieved of its obligations by the termination of the Project for any reason. 18, it being the parties' specific intent that this limitation shall not relieve the insurers' obligations for such insured risks."
	11	"Except to the extent of Owner's failure to make proper payment to Contractor for undisputed amounts due, to".
		"Contractor shall remain liable for the completion of the Project and shall not be relieved of its obligations by the termination of the Project for any reason. occurrence shall constitute an "Owner Event of Default". Upon such an Owner Event of Default, Contractor may pursue any or all of the Contractor directly resulting from any such suspension, as demonstrated by Contractor to Owner's reasonable satisfaction and shall be set forth
		"25.4 Each of Owner's or Contractor's rights set forth above shall be cumulative and additional to any other rights or remedies provided in law"
	11	"Contractor shall remain liable for the completion of the Project and shall not be relieved of its obligations by the termination of the Project for any reason."
	11	"Contractor shall remain liable for the completion of the Project and shall not be relieved of its obligations by the termination of the Project for any reason."
	11	"Contractor shall remain liable for the completion of the Project and shall not be relieved of its obligations by the termination of the Project for any reason."

Section D

Requirement Description	Section	Response
Requirement 1	Section D	Response 1
Requirement 2	Section D	Response 2
Requirement 3	Section D	Response 3
Requirement 4	Section D	Response 4
Requirement 5	Section D	Response 5
Requirement 6	Section D	Response 6
Requirement 7	Section D	Response 7
Requirement 8	Section D	Response 8
Requirement 9	Section D	Response 9
Requirement 10	Section D	Response 10
Requirement 11	Section D	Response 11
Requirement 12	Section D	Response 12



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1.0 DEFINITIONS AND ABBREVIATIONS

Unless otherwise defined below, capitalized terms shall have the same meaning as assigned to them in the Contract terms and conditions.

1.1 Health and Safety Plan (HASP) - A Health and Safety Plan is a written description of the manner in which Contractor will manage the Work under the contract in order to ensure the health and safety of all personnel involved in or affected by the work, including but not limited to Contractor and Subcontractor employees, Owner employees, other contractors' employees, visitors, vendors, and the general public.

1.2 Job Safety/Site Assessment (JSA) - A job briefing process that includes 5 main steps to prepare employees to work safely during the task. The five main steps include: 1) identifying and talking about the job scope; 2) identifying the hazards associated with the job and controls to protect employees; 3) considering the environmental aspects of the job, 4) visiting the job site and assessing hazards and; 5) cleaning up after the job.

1.3 Job Hazard Analysis (JHA) - A detailed 3-step analysis that helps eliminate and/or reduce risk. This 3 step process breaks each task down into basic job steps, identifies existing and potential hazards associated with each step and provides recommendations/procedures to eliminate, reduce or control hazards, and the option of assessing potential severity.

1.4 Pre-Work Hazard Assessment (PWHA) - Owner's initial hazard assessment for the Work to be executed by Contractor that identifies anticipated hazards as best as can reasonably be determined by Owner that may require elimination or mitigation. The PWHA will be provided to Contractor and is intended to provide a basis for initial planning purposes only and no warranty is expressed or implied that it is accurate, complete, comprehensive, or all-inclusive, or that items not listed will not be present or pose no threat to personnel safety or health.

1.5 Owner's Site Safety, Health and STAR/Zero Harm Orientation Training - Owner's site specific Safety and Health Orientation and any additional safety and health awareness training the site may require such as Stop Think Act Review (STAR) training.

1.6 Safety and Health Coordinator - Individual responsible for assisting Contractor supervision in carrying out its responsibilities for job site safety and health and other loss prevention programs associated with the Work.

1.7 Abbreviations:

1.7.1 ACM –Asbestos Containing Materials

1.7.2 HASP - Health and Safety Plan


1.7.3 JHA - Job Hazard Analysis

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- 1.7.4 JSA - Job Safety/Site Assessment
- 1.7.5 SDS - Safety Data Sheets
- 1.7.6 OSHA - Occupational Safety and Health Administration
- 1.7.7 MSHA – Mine Safety and Health Administration
- 1.7.8 PACM - Presumed Asbestos-Containing Material
- 1.7.9 PWA - Pre-Work Hazard Assessment

2.0 INTRODUCTION

- 2.1** These Safety and Health Requirements shall be used in conjunction with the-applicable AEP System General Terms and Conditions for Work performed at AEP System Generation facilities. These Requirements convey Owner’s minimum expectations regarding safety and health practices and may exceed the requirements of federal, state, and local regulatory agencies. Contractor shall submit to Owner or ISNetworld a copy of their Environmental, Health and Safety manual.
- 2.2** In the event Owner determines that an unsafe condition exists at the site, Owner shall have the absolute right to immediately order corrective measures or stop the Work until the unsafe condition is corrected by Contractor without advance written notice. To the extent Contractor or its subcontractors have caused the unsafe condition and subsequent delays or impacts to the Work, Contractor shall be solely responsible for any costs it incurs associated with the Work stoppage and shall not be allowed additional time to complete the Work. This provision does not relieve Contractor of its exclusive responsibility for safe work practices nor impose upon Owner any obligation to supervise Contractor’s work practices.
- 2.3** **These Safety and Health Requirements apply in their entirety to the Work unless Owner has waived the requirement for the Health and Safety Plan (HASP) described in Paragraph 3.2 in writing. In such case, the following highlighted paragraphs do not apply to the Work: 3.2, 3.6, 4.1.3, 4.1.4, 4.2.2, 5.4, and 6.1**

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2.4 For MSHA regulated facilities, Contractor shall comply with and enforce all laws, rules and regulations applicable to safety and health standards, including, but not limited to, the Federal Mine Safety and Health Acts of 1977, and any revisions, amendments, and successor legislation, to the extent governing and applicable to the Work. To the extent that this Contract (and particularly within Generation Contractor Supplemental Safety & Health Requirements incorporated herein) references an OSHA definition or requirement(s), and there is an MSHA definition or requirement(s) that is reasonably comparable to such OSHA definition or requirement, then the comparable MSHA requirement shall control, if MSHA has jurisdiction over the referenced subject matter and/or location. Further, any MSHA requirements for which there are no comparable OSHA requirements, and which are applicable to the Work, shall apply. To the extent that this Contract requires compliance to OSHA requirements for which there are no comparable MSHA requirements, or to the extent that this Contract imposes safety and health requirements for which there are no comparable OSHA or MSHA requirements, and which are applicable to the subject matter and/or location, Contractor shall comply with the strictest of: (i) the OSHA requirement; (ii) any applicable Owner requirement; or (iii) any applicable Contractor rule or procedure. Generation Contractor Supplemental Safety & Health Requirements shall apply in addition to applicable OSHA and/or MSHA requirements.

3.0 HEALTH AND SAFETY PLANNING

Owner expects each Contractor to exercise planning and forethought regarding the safety and health aspects of all Work performed.

3.1 Pre-Work Hazard Assessment (PWH)

3.1.1 Owner will provide Contractor with Owner's completed PWH. Contractor shall consider the PWH and understand that the PWH is informational for initial planning purposes only. The PWH does not relieve Contractor of its obligation to conduct its own hazard assessments of the Work.

3.2 Health and Safety Plan

3.2.1 Contractor is required to prepare and submit a Health and Safety Plan (HASP) to Owner for review and discussion prior to the start of Work under the contract unless Owner waives or modifies this requirement in writing. The HASP shall cover the Work of Contractor and its subcontractors, agents and representatives. (See AEP Contractor Safety Site)

3.2.2 Proposed revisions to the HASP during the course of the Work require discussion and review with Owner.

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3.3 Job Hazard Analysis (JHA)

3.3.1 If Owner requires a HASP, Contractor shall prepare Job Hazard Analyses in accordance with its HASP. Where a HASP is not required, Contractor shall prepare a JHA for the planned Work subject to review by Owner prior to starting Work. In either case, Owner may require Contractor to prepare additional JHAs. Contractor shall use and update JHAs to consistently apply proper safeguards. All Job Hazard Analyses are subject to review by Owner. (See AEP Contractor Safety Site) The HASP and JHA's shall be signed by the site superintendent to ensure clear understanding of the safety and health plan at the local level.

3.4 Job Safety/Site Assessment (JSA)

- 3.4.1** Before any Work begins at the start of each shift and whenever job scope, activity, procedures, or location changes, Contractor shall conduct a JSA utilizing Owner's JSA form or Owner-approved equivalent form. In the preparation of the JSA, Contractor shall consult applicable JHA's that may exist for the Work. (See AEP Contractor Safety Site)
- 3.4.2** Whenever a problem, circumstance, or result that was not covered in the JSA is encountered during the course of the Work, Contractor shall stop Work immediately, evaluate the situation, and conduct a new or revised JSA before resuming Work.
- 3.4.3** No work shall be performed without a JSA. Only persons signed onto the JSA may perform the Work covered by the JSA.
- 3.4.4** Contractor front line supervision and above shall attend at least one JSA discussion daily and audit at least two jobs in progress each shift for adherence to the JSA process requirements, including thoroughness and quality, and shall sign the JSA to document these actions. JSA's are subject to observation, review, and audit by Owner. (See AEP Contractor Safety Site)
- 3.4.5** Contractor is expected to take appropriate action for individuals who fail to comply with the JSA requirements including performing Work outside the parameters of the JSA.
- 3.4.6** Contractor shall retain completed JSA forms for at least 30 days or as directed by Owner. In the event of an OSHA-recordable injury, Contractor agrees to include the associated JSA with the accident investigation paperwork and retain it in accordance with applicable OSHA record retention requirements.

3.5 Continuous Hazard Assessment

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3.5.1 Owner expects all of Contractor's personnel to continuously assess their Work locations and activities for hazards throughout the work day including the start of the shift, before changes in work or locations, after breaks, and in some cases prior to performing certain routine or repetitive activities. As an aid in performing these assessments, some sites may require each employee to document their assessments using Owner-supplied checklists or equivalent means such as a STAR Card. (See AEP Contractor Safety Site for STAR Card and other tools.)

3.6 Safety and Health Coordinator

Contractor shall provide an on-site full-time Safety and Health Coordinator for each shift of Work in which the total of craft personnel (Contractor and its Subcontractors) exceeds 40 personnel. Contractor shall provide Owner with the resumes of proposed Safety and Health Coordinator personnel. While the Owner may not designate an individual or individuals to perform the role of Safety and Health Coordinator, qualification for these individuals shall include completion of the OSHA 500 or 510 training and satisfactory work experience as determined by Owner. Owner may request Contractor to provide a fulltime Safety and Health Coordinator for Work with fewer than 40 craft personnel per shift if Owner determines the nature of the Work justifies additional safety oversight.

3.7 Working Hour/Day Limitations

- 3.7.1** Contractor shall staff and plan in a manner that prevents any person from working more than 13 consecutive days without a 24 hour rest period. Exceptions shall be pre-approved in writing by Owner's representative at the Director level or above.
- 3.7.2** Contractor shall staff and plan in a manner that prevents any person from working more than 16 hours in any rolling 24 hour period. After working 16 hours a minimum of 8 hours of rest shall occur before returning to work. A two hour exception may be granted in order to arrange for relief if a job has gone longer than expected. Exceptions shall be pre-approved by Owner's representative at the Director level or above.

4.0 TRAINING AND QUALIFICATION REQUIREMENTS

4.1 Training

All personnel are required to successfully complete the following prior to being allowed to commence Work on site:

- 4.1.1** Owner's Site Safety, Health, and/or STAR/Zero Harm Orientation. Initial orientation takes up to two hours and an annual refresher is required. Additional training may be required as determined by Owner.
- 4.1.2** Contractor's own Asbestos Awareness Training in addition to specific safety and health training required to complete the Work.

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- 4.1.3** All superintendents are required to have OSHA 30-Hour Construction Training. A two-week grace period may be granted at Owner’s sole discretion for those who have successfully completed the OSHA 10-Hour Construction Training.
- 4.1.4** For all supervision/workers below the level of superintendent, OSHA 10-Hour Construction Training, or equivalent training deemed acceptable to Owner, is required. A two week grace period may be granted at Owner’s sole discretion.
- 4.1.5** Some sites may require Supervision to attend Owner’s “Supervisors’ Responsibilities and Expectations Briefing” program. If required the program must be completed within two weeks after arrival at Owner’s site and takes approximately one hour.
- 4.1.6** Contractor shall utilize Owner’s briefing on procedures and controls in addition to Contractor’s own written procedures for Work activities involving confined space entry, clearance permits, work on or near energized circuits, etc.

4.2 Training Administration

- 4.2.1** Contractor shall maintain up-to-date documentation of training and have it readily available on site for Owner’s inspection upon request.
- 4.2.2** Contractor is responsible for the cost of all OSHA 10- and 30-Hour Training or equivalent training.
- 4.2.3** For MSHA regulated facilities, contractor is responsible for the cost of all MSHA Surface Certification, New Miner and Miner Refresher Training.
- 4.2.4** Owner will reimburse Contractor the cost of its personnel attending Owner required training specified in Paragraphs 4.1.1, 4.1.5, and 4.1.6.
- 4.2.5** Owner, at its sole discretion based on Work observations or for other reasons, may at any time withdraw its acceptance of any previously approved or completed training and require personnel to repeat the training.

5.0 ADMINISTRATIVE

5.1 Record Availability

- 5.1.1** Documentation of training/inspection records must be kept on site for the duration of the job.

5.2 Regulatory Inquiries

- 5.2.1** Contractor shall provide Owner, for Owner’s review, all written reports and copies of all documents 24 hours prior to submittal to a regulatory agency.

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5.3 Incident Reporting and Investigating

- 5.3.1** Contractor shall promptly notify Owner of all safety related events. These include near-miss incidents; self-aid, first-aid, and minor incidents; exposure incidents; OSHA recordable injuries and illnesses; and vehicle accidents.
- 5.3.2** Contractor shall submit a written summary to Owner's representative by 8:00 a.m. each scheduled Work day listing all safety related events that occurred the previous scheduled Work day.
- 5.3.3** Contractor shall immediately secure the scene of an incident and not disturb the scene or items at the scene unless necessary to attend to injured personnel or to prevent additional injury or property damage. Work may not resume and no items at the scene may be moved or discarded until authorized to do so by Owner's designated Safety and Health representative.
- 5.3.4** The injured/involved person's immediate supervisor shall submit a completed Report of Injury or Illness Form PS-138A to Owner within 24 hours of the event. (See AEP Contractor Safety Site)
- 5.3.5** Owner and Contractor shall promptly initiate an investigation into the facts and circumstances leading up to the event and Contractor shall submit a report to Owner within 48 hours unless granted an extension by Owner. Contractor's Superintendent or most senior representative on site shall conduct or lead the investigation. The immediate supervisor may not serve on the investigation team unless no other supervisory personnel are available. Owner may choose to participate in the investigation. Based on the actual or potential severity of event, Owner may require Contractor to form an incident investigation committee, the makeup of which is subject to Owner's approval. Notwithstanding Contractor's obligations as specified herein, Owner reserves the right to conduct its own independent investigation, with support or input from the Contractor as requested by Owner.
- 5.3.5.1** Investigator(s) shall examine the scene of the event and promptly interview the injured/involved persons and witnesses.
- 5.3.5.2** The names of the injured/involved persons, supervisors, and witnesses, investigation findings, causal factors, and corrective/preventive actions shall be documented in the investigation report.

5.4 Weekly Reporting

- 5.4.1** Contractor shall report the following to Owner each week:
- **Direct and Indirect** hours worked weekly and year-to-date at Owner's worksite.
 - A summary of recordable injuries, first aids, near misses, etc. that occurred during the week.
 - Year-to date severity rate calculations on Owner's worksite.

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- Up to date list of employees with last four digits of their social security numbers in order for Owner to implement random drug testing.

5.5 Individuals Restricted from Access to Owner's Work Sites

5.5.1 Contractor shall provide to Owner a list of all individuals (whether Contractor's or its Subcontractor's personnel) which Contractor intends to use at Owner's sites. The list shall identify the individuals by name and the last four digits of their Social Security numbers.

5.5.2 Owner may provide Contractor with a list of persons that are restricted from Owner's worksite. Prior to commencement of the scheduled Work and during the duration of the Work, Contractor shall ensure that no person on the list shall be admitted to the site.

5.5.3 Owner may deny access to its work sites to any individual who fails to comply with the provisions set forth in these Generation Contractor Supplemental Safety & Health Requirements, or who, in Owner's discretion, otherwise demonstrates unsafe or unacceptable behaviors. Examples include, but are not limited to, the following:

- Unsafe job performance.
- Failure to follow Owner's JSA process.
- Failure to pass drug/alcohol test.
- Displaying incompetence in performing their job.
- Participating in pranks, horseplay or practical jokes.
- Failure to report injuries and/or accidents.
- Fighting or acts of aggression.
- Making threats.
- Theft or vandalism.
- Violation of Life Saving Rules, which include risks associated with:
 - Fall Protection
 - Confined Space Entry (29 CFR 1910.146 and Owner's Confined Space Procedure)
 - Control of Hazardous Energy
 - Energized Work
 - Working Near Water
 - Seat Belt Use
 - Working Near Moving Machinery
 - Barricades

5.5.4 Contractor shall provide Owner with the name of each employee removed by Contractor from Owner's property and the reason(s) for their removal.

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5.5.5 Contractor shall promptly notify Local Union Hall of any employee removed from Owner's property and the reason(s) for their removal.

5.6 Communication

5.6.1 Contractor shall ensure that its personnel clearly understand oral and written instructions, signs and labels associated with Work. This includes but is not limited to ensuring they understand the scope of Work they are to perform; Owner's Site Safety, Health and/or STAR/Zero Harm Orientation Training; the hazards associated with the Work; the necessary precautions to protect themselves from the Work hazards; site specific Hazard Communication plans; and Emergency Action Plans.

5.6.2 Contractor shall provide signage, such as, but not limited to, barricade signs and labeling (Caution, Danger, Asbestos, Arsenic, Radiation, Authorized Personnel only, etc.), hazardous material signs (Gasoline, Used Oil, Caustic, Acid, Oxygen, etc.), HazCom labels, key information signs (Exit, No Exit, High Noise Area, Wet Floor, Universal Waste, No Smoking, Wetlands-Keep Out, etc.), and all legally required employment posters. All signage, labeling and barricade tape shall be UV protected. Contractor shall routinely inspect and replace signage, labeling and barricade tape that is damaged, missing, etc.

5.6.3 When Contractor employs workers that are not fluent in or understand English, Contractor shall provide the following:

5.6.3.1 Barricade tape, signs and labeling that are either bilingual or pictorial for any areas it is working where there is a danger to any of its personnel or its Subcontractor's personnel.

5.6.3.2 A translator who is working or supervising in the immediate work area where there are workers not fluent in the English language. Additional translators will be required if ready communication cannot be established with any worker who is not fluent in English. Contractor's translator shall be easily identifiable by Owner such as by the color of their hardhat, clothing etc.

5.6.3.3 Protocols to assure a translator are immediately available to support nursing, EMT responses to injuries or accidents, and during site orientations.

5.7 MSHA Inspections

5.7.1 For MSHA regulated facilities, MSHA Surface Certified person to perform required on shift inspection, document, and sign MSHA on shift book.

6.0 SUBSTANCE ABUSE PROGRAM

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6.1 Contractor and all subcontractors performing Work at Site must have a substance abuse program. This program must apply to all personnel.

6.2 Minimum requirements shall include pre-hire testing, post-accident testing for cause and when requested, random testing. Screening substances and their associated cut-off limits are listed below.


Drug Screening Classes	Screening Cut-Off Limit*** (ng/ml)	Confirmation Cut-Off Limit (ng/ml)
Amphetamines Methamphetamines	500*	250* 250**
MDMA MDA MDEA	500*	250* 250* 250*
Barbiturates	300	200
Benzoyllecgonine (Cocaine Metabolite)	150*	100*
Cannabinoids (THC)*****	50*	15*
Opiates Codeine Morphine Oxycodone Hydromorphone Hydrocodone 6-Acetylmorphine	2000* 2000 2000 100 300 300 10	2000* 2000 2000 100 300 300 10
Phencyclidine (PCP)	25*	25*
Benzodiazepines	300	300
Methadone	300	300
Propoxyphene	300	300
Breath alcohol content	.040g/210L	.040g/210L

* Cut-off limits established by the Department of Health and Human Services in their mandatory Guidelines for Federal Workplace Drug Testing Programs.

** To be reported positive for methamphetamine, a specimen must also contain amphetamine at a concentration equal to or greater than 100ng/ml.

*** In no event will the cutoff limits set forth in this paragraph be less than the cutoff limits set forth in the Technical Guidelines adopted from time to time by the United States Department of Health and Human Services.

**** The Medical Review Officer will not accept assertions that a positive THC resulted from the use of hemp oil or the injection of hemp products, and therefore verify a marijuana test negative. Individuals should avoid use of such products.

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- 6.3** Testing shall be performed by a third party testing facility certified by Department of Health & Human Services, Drug & Alcohol Testing Industry Association (DATIA) or the Substance Abuse Program Administrators Association (SAPAA). The analytical method for a confirmatory drug test must combine chromatographic separation and mass spectrometric identification (i.e. GC/MS, CL/MS). Alcohol testing shall be performed only by certified Breathalyzer equipment (appearing on the Department of Health and Human Resources conforming product list) and trained breath alcohol technician. All positive breath alcohol tests shall be confirmed by an Evidentiary Breath Test that provides a print out.
- 6.4** Contractor's personnel must provide evidence of having tested negative within a year prior to employment. Owner will accept conditional employment predicated upon (a) employee(s) furnishing evidence that they have submitted to testing within forty-eight (48) hours of initial employment and (b) employee(s) furnishing evidence of negative test results within five (5) workdays of initial employment. Contractor shall ensure personnel are "drug free". Owner reserves the right to examine evidence outlined herein. Contractor's program shall incorporate reciprocity on "drug free" employee verification to minimize Owner's economic impact and employee recertification while maintaining the program's intent.
- 6.5** Owner's reimbursement of the costs for testing shall be in accordance with the applicable Building Trades Council, Association or Craft program terms, whether based upon a per-hour contribution or unit price per test rate or at actual cost to Contractor, without additional markups, predicated upon Contractor's submittal of copies of the actual invoice(s) for the testing to Owner. Owner will recognize established area programs provided the aforementioned base line parameters are met.
- 6.6** For Work not covered by Paragraph 6.5 above, Owner will reimburse Contractor at its actual cost, without additional markups, predicated upon Contractor's submittal of copies of the actual invoice(s) for the testing to Owner.
- 6.7** If an instant drug test is requested by the contractor and the employees test results are positive, the employee will be removed from site until the result can be verified by laboratory analysis. If the result is confirmed positive, the employee will be placed on the ban list. If the result is confirmed negative, the employee may return to the site. The Owner will not be responsible for back pay to the employee under these circumstances.

7.0 ADDITIONAL HEALTH AND SAFETY REQUIREMENTS

7.1 Personal Protective Equipment

Contractor shall provide Personal Protective Equipment to its employees appropriate for the hazards they may face. In addition, Contractor shall comply with the following:

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7.1.1 Footwear: With the exception of site office buildings, Contractors personnel shall wear appropriate safety toed work boots meeting minimum requirements for appropriate footwear means ASTM F2412-11 and ASTM F2413-11 approved footwear with a compression rating of C75, with sturdy upper portions, a defined heel, hard and heat resistant sole, sufficient to protect an employee's feet from normal work hazards unless owner agrees with Contractor's Job Hazard Analysis (JHA) which justifies otherwise.

Additional protection such as metatarsal guards, puncture resistant soles, etc. may be required based upon the job hazard assessment for certain work assignments or special environmental conditions.

The following footwear shall be prohibited except in office areas:

- Open-toed,
- Open-heeled, and
- Athletic/Tennis Shoes


7.1.2 Respiratory Protection: Owner's respiratory protection and ventilation requirements for welding, cutting and other hot work are defined in the Welding, Cutting and Brazing Policy (see AEP Contractor Safety Site). Filtering face piece respirators may only be used on a voluntary basis (not OSHA required) and only in areas where there will not be an exposure above the Permissible Exposure Limits (PEL). Filtering face piece respirators include any fabric "dust mask" type respirators with filter efficiencies from 95 through 100.

7.2 Industrial Hygiene Practices for Metals and Heavy Metals

7.2.1 Unless directed otherwise, Contractor is responsible for personal industrial hygiene sampling for any contaminants that may pose an exposure hazard to their employee (e.g. arsenic, lead, mercury, hexavalent chromium, cadmium, crystalline silica, etc.). Contractor shall provide copies of industrial hygiene test results to Owner.

7.2.2 Contractor must comply with Owner's Negative Exposure Assessment Guidelines in determining when personal protective equipment and regulated area requirements can be removed.

7.2.3 Owner requires regulated areas for all work involving potential exposure to hexavalent chromium regardless of the type of work conducted (General Industry or Construction). Owner's competent person for hexavalent chromium shall be consulted regarding the appropriate size, location and demarcation of the regulated area.


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7.3 Lead/Cadmium Based Paint

- 7.3.1** Structural steel and equipment throughout Owner's facilities may have been coated with lead/cadmium based materials including galvanizing. Contractor shall treat all surfaces as containing lead/cadmium unless tested otherwise prior to performing any grinding, welding, sanding, heating, sandblasting or similar activity. Owner requires that any coating containing lead at a level of 0.05% (500 ppm) or more be treated as a lead-containing coating.
- 7.3.2** In nearly all cases, abatement of lead/cadmium-containing coatings is required before any hot work may be performed. Owner has a specific Post Abatement Hot Work (see AEP Contractor Safety Site) process that contractors must follow to either ensure abatement is effective or that contractor employees are properly protected while performing hot work after abatement.
- 7.3.3** Contractor shall submit to Owner, prior to beginning Work, its written lead/cadmium compliance program.
- 7.3.4** Contractor shall collect all removed lead/cadmium bearing paint and contaminated materials used for the removal of lead/cadmium bearing paint. These shall be placed in Owner-supplied DOT approved containers and properly labeled and stored per Owner instructions.

7.4 Asbestos Containing Material

- 7.4.1** Asbestos-containing materials (ACM) may exist in the form of insulating products, siding, coatings, gaskets and similar materials throughout Owner's facilities. Contractor shall conduct ACM Awareness training in accordance with Paragraph 4.1.2 to notify employees of the possibility of asbestos on the job and the appropriate response (STOP and report it immediately) if presumed asbestos-containing material is encountered. Contractor shall use care and diligence in the execution of its Work to avoid the disturbance of or damage to asbestos-containing material not specifically identified as a part of the Work. This may include, but is not limited to, the installation of protective barriers, temporary platforms or any other means deemed necessary by Contractor to comply with this requirement. Contractor personnel shall immediately report the observance of any ACM or PACM that is not intact to their supervision for immediate response. Contractor shall immediately notify Owner of any disturbance of or damage to asbestos-containing material, presumed asbestos-containing material (PACM) or unknown material. Contractor is responsible for ensuring that its personnel and the public are not exposed to ACM material due to Contractor's disturbance of or damage to the ACM.

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7.5 Firearms, Alcohol, Drugs

7.5.1 Firearms, alcohol, illegal drugs (marijuana, cocaine, etc.) or drugs taken for non-medicinal purposes are prohibited on all Owner sites. In certain States, firearms may be permitted to be secured in personal vehicles in accordance with State laws and plant security procedures.

7.5.2 Contractor is responsible for ensuring its personnel who are under the care of a physician or are taking medication are capable of performing their Work safely and within the terms of any restrictions issued by the treating physician.

7.6 Hazard Communication

7.6.1 Owner's Safety Data Sheets for generated products are located on the AEP Contractor Safety Site. Other non-Owner generated SDS are available for Contractor review.

7.6.2 Contractor shall provide a list of the chemicals, materials and products that Contractor intends to bring on-site and the corresponding Safety Data Sheets (SDS) for Owner's approval prior to delivery of the materials to Owner's site. The list and the SDS shall be kept up to date. Chemicals containing 1,1,1-Trichloroethane, methylene chloride, trichloroethylene, tetrachloroethylene (perchloroethylene), 1-bromopropane (N-propyl bromide), any confirmed human carcinogen, asbestos, lead or mercury will not normally be approved.

7.7 Hazardous Materials Management


7.7.1 Contractor shall have a program for proper storing, handling and disposal of hazardous materials in a safe and secure manner.

7.7.2 Contractor shall minimize the quantities of hazardous materials it intends to use and hazardous waste it expects to generate. Contractor shall keep Owner informed of all generated wastes and its disposal management practices.

7.7.3 Bulk storage (55 gallons) of hazardous materials shall be provided with adequate weather protection. Damaged or leaking containers are unacceptable.

7.8 Tools

7.8.1 When material needs to be cut in the work place, cutting tools other than a knife, i.e. wire cutters/strippers, side cutters, snips and other cutting tools shall be considered first. A safety utility knife with an automatic retracting blade or other means of blade protection would be the second selection. The use of a company issued pocket knife or non-safety utility knife is only permitted if a safety utility knife or other cutting tool cannot be used. In these cases, they can only be used in combination with wearing appropriate glove protection, as determined by the JSA.

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7.8.2 No handheld grinder shall be used with a switch which is capable of being locked in the “ON” position unless a hazard analysis determines it is safer. Handheld Grinders 4 ½” thru 6” shall be equipped with a safety clutch to aid in preventing kickback and potential personal injury to the user. Contractor(s) shall have a grinder control procedure established to assure when grinders are being used for either grinding or cutting, front line supervision has determined that a grinder is the safest and best tool for the job.

7.8.3 Job site fabricated tools or tools with no Original Equipment Manufacturer shall be engineered for a specific task and approved by Owner prior to use.

7.8.4 Contractor shall furnish hand protection appropriate for the task in accordance with the Generation Glove and Sleeve Selection Matrix (see AEP Contractor Safety Site).

7.9 Additional AEP Safety and Health Requirements

7.9.1 In addition to OSHA requirements, AEP has special requirements for the following subjects:


- Lifting and Rigging (follow Owners specific Business Unit requirements, may vary by contract release)
- Suspended Scaffold
- Excavation
- Floor and Wall Opening
- 15’ Scaffold Access
- Arc Flash

7.10 Safety and Health Audits

7.10.1 Owner conducts random safety and health audits and observations. Contractor and its subcontractors shall cooperate fully with Owner’s representative during a safety and health audit. Owner may terminate any Contract, at its sole discretion, based on the results of any such safety and health audit.

8.0 REVIEW AND REVISION HISTORY

DATE	REVISION #	COMMENTS	REVIEWER
8/1/11	8		
10/2/17	9	Complete Revision	Rev 9 Safety Ts & Cs Team

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LIST OF AEP SPECIFIC DOCUMENTS ON AEP CONTRACTOR SAFETY SITE

- Generation Contractors Job Safety Analysis (JSA)
- Health and Safety Plan (HASP)
- Welding, Cutting and Brazing Policy
- Lead Exposure Control Post-Abatement Hot Work and Conducting Hot Work Without Abatement
- Negative Exposure Assessment Guidelines
- Scaffolding Safety Procedure
- 15' Scaffold Access Procedure
- Confined/Enclosed Space Procedure
- Confined Space Entry Permit
- Clearance Permit Policy Fossil/Hydro Generation
- Clearance Permit Procedure Fossil/Hydro Generation
- Clearance Permit Form Fossil/Hydro Generation
- Excavation Policy
- Floor and Wall Opening Permit Procedure
- Barricade Tape and Flagging Guideline (Generation Only)
- Arc Flash Protection Policy (Generation Only)
- C.OI-730.12.02 - Electric Lines and Equipment Clearance (PC&C)
- STAR Card(s)
- PS-138 A
- Generation Glove and Sleeve Selection Matrix
- Safety Data Sheets (S.D.S)
- AEP Lifting and Rigging Procedure (Plant/Business Unit specific)
- AEP Generation Culture Playbook



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Pre-Work Hazard Assessment (PWA)

Work Description: _____

Work Location: _____

The scope of this Work may involve certain hazards requiring Contractor to implement controls to eliminate or mitigate personnel exposures. The hazards and hazard-producing activities checked below are anticipated as best as can reasonably be determined by Owner to be those with the potential to pose risks to safety and health during the Work. This list has been developed by Owner for its and Contractor's initial planning purposes only. No claim or representation is expressed or implied that it is comprehensive, all-inclusive, accurate, or complete, or that items not listed will not be present or pose no threat to personnel safety or health. If selected below, ensure that the contractor and contractor oversight reads and understands the applicable AEP Policies and Procedures.

*** May require site permit** **** Reference AEP Contractor Safety Site**

Work Activities

<input type="checkbox"/> *Numerous, deep, or complex excavation or trenching*	<input type="checkbox"/> Diving operations	<input type="checkbox"/> Special PPE Requirements _____
<input type="checkbox"/> *Drilling, auguring, boring, or other soil disturbances in areas with congested buried utilities*	<input type="checkbox"/> Prolonged work in tight or awkward locations (ergonomics)	<input type="checkbox"/> Other items list below
<input type="checkbox"/> Working over water	<input type="checkbox"/> Cutting: ** Knife Policy Requirements	<input type="checkbox"/>
<input type="checkbox"/> Operating equipment under or near overhead power lines	<input type="checkbox"/> *Open, installing, removing grating*	<input type="checkbox"/>
<input type="checkbox"/> Crane use Tons Reach Lift ** C-OI - Rigging and Hoisting	<input type="checkbox"/> *Demolition*	<input type="checkbox"/>
<input type="checkbox"/> Multiple cranes operating simultaneously - ** C-OI - Rigging and Hoisting	<input type="checkbox"/> Helicopter operations	<input type="checkbox"/>
<input type="checkbox"/> *Exposed energized electrical lines or equipment ** C-OI-Electric Lines and Equipment Clearance	<input type="checkbox"/> Pile driving	<input type="checkbox"/>
<input type="checkbox"/> Working at heights - ** Fall Protection Requirement FAQ	<input type="checkbox"/> Water impoundment (dam, dike, etc.)	<input type="checkbox"/>
<input type="checkbox"/> Scaffolding _____ft	<input type="checkbox"/> Heavy earth-moving equipment	<input type="checkbox"/>
<input type="checkbox"/> **Gate Req/Suspended Scaffold Rigging/15' Procedure	<input type="checkbox"/> *High pressure (air, water, steam, gas)*	<input type="checkbox"/>
<input type="checkbox"/> Stacked work (i.e., working above & below)	<input type="checkbox"/> *Clearance Permit* # _____	<input type="checkbox"/>
<input type="checkbox"/> *Permit-required confined space entry* # _____	<input type="checkbox"/> *Hot work*	<input type="checkbox"/>
<input type="checkbox"/> Explosive use/blasting	<input type="checkbox"/> Arc Flash	<input type="checkbox"/>
<input type="checkbox"/> Highly flammable gases or chemicals _____		

Worksite Conditions

<input type="checkbox"/> High water table, site subject to flooding, or heavy rains	<input type="checkbox"/> Abandoned-in-place utilities or equipment
<input type="checkbox"/> Contaminated soil or water	<input type="checkbox"/> Low lighting
<input type="checkbox"/> Congested work site	<input type="checkbox"/> Vehicular traffic
<input type="checkbox"/> Adjacent activities:	<input type="checkbox"/> Working around Moving/Operating/Energized Equipment
<input type="checkbox"/> Combustible dust	<input type="checkbox"/> Other items list below
<input type="checkbox"/> High winds	<input type="checkbox"/>
<input type="checkbox"/> Ice/snow/freezing temperatures	<input type="checkbox"/>
<input type="checkbox"/> Rugged, uneven, treacherous terrain or site conditions	<input type="checkbox"/>
<input type="checkbox"/> Animals/insects	<input type="checkbox"/>

Human Performance

<input type="checkbox"/> First time evolution New/ Inexperienced Workforce Plan	<input type="checkbox"/> Error Traps _____
<input type="checkbox"/> Schedule ** "13 Day Rule " S&H T&C Section 3.8	<input type="checkbox"/> Other items list below
<input type="checkbox"/> Non-English Speaking Employees Bilingual Action Plan	<input type="checkbox"/>
<input type="checkbox"/> Confusion/Mix-up potential (labeling, look-alike equipment, etc)	<input type="checkbox"/>
<input type="checkbox"/> Distractive environment	<input type="checkbox"/>

Environmental/IH

<input type="checkbox"/> Arsenic**	<input type="checkbox"/> IDLH atmosphere
<input type="checkbox"/> Asbestos	<input type="checkbox"/> Legionella/biological – circulating water
<input type="checkbox"/> Chemical	<input type="checkbox"/> PCB
<input type="checkbox"/> Cadmium**	<input type="checkbox"/> Lead**
<input type="checkbox"/> ** Negative Exposure Assessment/Weld fume Specifics	<input type="checkbox"/> Plants/Weeds
<input type="checkbox"/> Heat stress	<input type="checkbox"/> Mercury
<input type="checkbox"/> Hazardous Waste	<input type="checkbox"/> Radiation (ionizing & non ionizing)
<input type="checkbox"/> Herbicide/pesticide	<input type="checkbox"/> Silica
<input type="checkbox"/> Hexavalent Chromium**	<input type="checkbox"/> Welding Fume** (Welding, Cutting, Brazing Policy Section)
<input type="checkbox"/> Anhydrous Ammonia**	<input type="checkbox"/> Other items list below
<input type="checkbox"/> Noise Current/existing _____ db	<input type="checkbox"/>
<input type="checkbox"/> Noise created during work _____db	<input type="checkbox"/>



Owner will use the Generation Guideline Implementation of Generation Contractor Supplemental Safety and Health Requirements to determine whether work requires the preparation of a HASP. If a HASP is determined to not be needed (per Decision Flow Chart), the selected contractor will be required to prepare a comprehensive Job Hazard Analysis (JHA) prior to starting work, in accordance with the Safety and Health Requirements. Owner, at its discretion, may waive the HASP requirement if all of the following conditions are met:

1. Low or Limited exposure to the following
 - a. Hazardous energy (such as electrical, pneumatic, hydraulic, etc)
 - b. Crane use or any rigging or hoisting
 - c. Excavation
 - d. Working at heights greater than 6' without primary fall protection (i.e., handrail)
 - e. Asbestos
 - f. Confined Space Entry
 - g. Lead or Heavy Metals, including fumes
 - h. Potential for high severity consequences
2. Contractor safety and health manual which adequately covers the scope of Work.
3. Contractor prepares a quality JHA for the Work.
4. Contractor demonstrates effective hazard control.
5. Contractor has an effective safety and health training program for its employees.

In accordance with the PWA and the above guidelines, the contractor who will be selected to perform this work:

_____ is required to prepare a Health and Safety Plan (HASP) and follow the Safety and Health Requirements in their entirety.
 _____ may prepare a comprehensive Job Hazard Analysis (JHA) in lieu of a HASP and paragraph 2.11 applies.
 _____ is exempt with management approval (see below)

The HASP and/or JHA(s) shall be submitted to Owner for review and discussion before Contractor may start work.

AEP Rep. Signature: _____ Date: _____

----- **ONLY REQUIRED IF EXEMPT** -----

Name: _____

Signature: _____

Exemption Expiration Date: _____

Services that could be considered for exemption may include;

ID	TYPE OF CONTRACTOR SERVICE
1	AERIAL SURVEYING
2	ASH SALES AGREEMENTS - Customer/Company has personnel reporting to a plant on a daily basis to perform service contract duties associated with buying/selling Combustion Coal Products.
3	ASH SALES AGREEMENTS - Customer/Company activities associated with Contractors entering plant on a short-term, daily basis for work that could include the plant loading of customer/company trucks.
4	ASH PICKUP BY LOCALS FOR BACKFILL OR BY COUNTY / CITY / STATE FOR USE ON ROADWAYS
5	COPIER, OFFICE OR JANITORIAL SERVICE IN OFFICE OR SERVICE BUILDING
6	ENGINEERING / DESIGN SERVICES
7	ENVIRONMENTAL/GENERAL CONSULTING, MONITORING, AND/OR INSPECTING SERVICES INCLUDING SURVEYING - Except for those activities that may disturb the earth through drilling, shoveling, and/or motorized vehicle traffic.
8	DELIVERY, INSPECTION AND REPAIR OF RENTAL EQUIPMENT
9	MATERIAL DELIVERY OR WASTE HAULING
10	LAWN OR LANDSCAPING SERVICE
11	ON SITE NURSING OR SECURITY SERVICES
12	ROAD MAINTENANCE INCLUDING SNOW REMOVAL EXTERIOR OF PLANT MAIN GATE AND PAVING
13	NO COST SERVICE AGREEMENTS TO ALLOW A VENDOR TO COME ONTO OUR SITES FOR A SITE VISIT, PRE-BID MEETING, ETC.
14	TRAINING PROVIDERS (ONSITE OR OFFSITE)



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	Contractor Environmental Requirements Document	Date: 10-20-2016	Attachment 2
<i>Christian Beam, VP Projects, Controls, & Construction (PC&C)</i>		<i>PC&C, F&H Plants, FEL, Generation Procurement, ES&H Management Systems, & Environmental Services</i>	
Document Holder		Sponsoring Organizations	

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1.0 INTRODUCTION

- 1.1 Owner's philosophy is that no aspect of its operations is more important than the health and safety of people and that its customers' needs will be met in harmony with the environment. Owner is committed to social responsibility and sustainability. Owner is proactive in its efforts to protect people and the environment by committing to:
 - 1.1.1 Utilizing Contractors that maintain compliance with all applicable environmental requirements;
 - 1.1.2 Ensuring that Contractors performing Work for Owner understand and integrate environmental responsibilities into their business practices;
 - 1.1.3 Utilizing Contractors that support continuous process improvement of their environmental performance; and
 - 1.1.4 Utilizing Contractors that eliminate hazards through continual process improvement.
- 1.2 The **purpose** of this document is to convey Owner's minimum expectations to all Contractors on how to meet its philosophy and policy outlined in 1.1 above. This document is applicable to all of Owner's Fossil and Hydro Generation facilities; its Projects, Controls, and Construction work-sites; its Fuel, Emission, and Logistics - Operations and Mining facilities and work-sites, and Generation Procurement. Otherwise stated, Contractor shall exercise prudent planning and diligence regarding the environmental aspects of all Work to be performed.
- 1.3 Owner's environmental requirements are to be used in conjunction with the applicable General Terms and Conditions for Work performed at Owner's work-sites. These environmental requirements convey Owner's minimum requirements regarding environmental practices. These environmental requirements are in addition to any of Contractor's and its subcontractors own policies, procedures, guidance, instructions or other requirements. Contractor and its subcontractors shall comply with all project, outage, and/or facility environmental rules and all procedures issued by Owner; provided that such rules and procedures do not conflict with any other Federal, State, and/or Local agency's environmental laws, rules or regulations. However, if such a conflict does arise, precedence shall be given to the most stringent environmental laws, rules, regulations or procedures that apply.
- 1.4 Contractor understands that any environmental requirements as may be provided by Owner are not intended to (and do not) provide legal or other professional advice. Owner makes no representations or warranties that the information contained herein satisfies Federal, State, and/or Local laws or regulations. Contractor agrees that it shall consult with its own legal counsel or other qualified persons with respect to satisfying the requirements of any such laws as may be applicable to its Work. Contractor acknowledges and agrees that: (i) it is not relying on any claim or representation of Owner relative to any environmental requirement, (ii) Owner expressly disclaims any claim or representation that the information contained in any environmental requirement will produce any particular result, and (iii) Owner shall not be responsible for any errors or omissions in the design, implementation, and/or enforcement of any environmental requirements. Contractor remains completely responsible for its compliance with the requirements of Federal, State, and/or Local environmental laws.
- 1.5 Contractor shall designate an environmentally Competent Person(s) who represents Contractor and who shall have full and complete authority to act on behalf of Contractor to manage, assess, coordinate, and enforce its environmental compliance during performance of Work. Contractor shall provide Owner with the resumes of the proposed environmentally Competent Person(s). While the Owner may not designate an individual or individuals to perform this role, qualifications for these individuals shall include the proper training listed in section 5.1.1 and satisfactory work experience as determined by Owner. Contractor's environmentally Competent Person(s) shall be on-site or off-site, full-time or part-time at the discretion of the Owner, as indicated on the Environmental Work Compliance Assessment (EWCA) or Owner's localized, equivalent form. Environmentally Competent Person(s) shall notify Owner of any environmental issues to be remedied. Contractor's Workers are to immediately notify the environmentally Competent Person(s) of any environmental issues they observe.

- 1.6 If Owner believes that a non-compliant environmental condition exists at the work-site which is a failure to comply with this Contractor Environmental Requirements Document and/or a legal demand of a Federal, State, and/or Local law or regulation, Owner shall have the right to immediately order corrective measures or stop Work until the non-compliant condition is corrected. To the extent Contractor has caused the non-compliant condition and there are subsequent delays or impacts to the Work, Contractor will be responsible for any costs it incurs to bring the Work into compliance and costs associated with Work stoppage. This provision does not relieve Contractor of its responsibility for environmentally-compliant work practices nor imposes upon Owner any obligation to supervise Contractor's work.
- 1.7 Contractor's failure to comply with and enforce these environmental requirements and all Federal, State, and/or Local agency laws, rules, and/or regulations applicable to the Work may be cause for the Contract to be terminated and may prevent eligibility for future work.
- 1.8 Contractor shall remove from Owner's work-sites any worker(s) who repeatedly fail(s) to comply with this Contractor Environmental Requirements Document.

2.0 ENVIRONMENTAL PLANNING

2.1 Environmental Work Compliance Assessment (EWCA)

- 2.1.1 Prior to Contractor beginning Work, Owner will provide Contractor with an initial EWCA using the form located in Attachment A (or equivalent). The EWCA is an informational document for initial and subsequent environmental planning and communication purposes. No claim or representation is expressed or implied that the information provided is comprehensive, all-inclusive, accurate, complete or that items not listed will not be present or pose a threat to environmental compliance.
- 2.1.2 Contractor shall meet with Owner prior to commencing Work to inform Owner as to how it intends to implement the requirements listed in the supplied EWCA throughout the course of the Work. Contractor may invite its subcontractors to attend these meetings and in some cases may be required to do so by Owner. An EWCA may be required for subcontractors in addition to the Contractor's EWCA, as determined by the Owner.
- 2.1.3 With prior Owner approval, Contractor environmental plans, procedures or guidelines in response to the EWCA may be included in the Health and Safety Plan (HASP) as required by Owner's S&H Requirements Document. However, for larger or environmentally complicated projects, all such information should be provided as a separate document to Owner.
- 2.1.4 The EWCA does not relieve Contractor of its obligation to conduct continuous environmental assessments of the Work. If Contractor determines during the performance of its Work that there are negative environmental impacts, concerns, questions, etc. not listed on the original EWCA, Contractor shall immediately inform Owner and the EWCA will be updated jointly by Owner and Contractor. Owner shall then be informed by Contractor of how it will manage such Work related activities which could result in a negative environmental impact.
- 2.1.5 After Owner evaluates the Contractor's scope-of-work, Owner may waive any portion or all of the Additional Environmental Requirements listed in Section 5 of the CERD. Should this take place, the Section(s) waived will be documented on the EWCA or an Exemption Form will be filled out.
- 2.1.6 Contractor's environmentally Competent Person(s) shall communicate all initial and subsequent environmental aspects addressed in the EWCA to its employees, provide environmental training as required, and will oversee the implementation and management of each environmental aspect of the Work.

2.2 Owner's Environmental Management Plans or Instructions

- 2.2.1 Contractor shall comply with Owner's Environmental Management Plan(s) or Instructions, as provided. Contractor may also be required to participate in Owner's Environmental Management planning activities.

2.3 Environmental Audits and Inspections

- 2.3.1 Random and scheduled environmental audits or inspections may be conducted by Owner or Federal, State, and/or Local agency representatives. Contractor shall cooperate fully with all inspector/auditor representatives during an environmental audit or inspection. Contractor shall have available upon request, all applicable environmental records required as part of the Work, work-site permits or applicable environmental laws or regulations. Owner may conduct audit evaluations during the course of the Work at its facilities or work-sites. An example of a typical audit form that may be used is located in Attachment B.
- 2.3.2 For additional requirements on handling Regulatory Inquiries, refer to Owner's document on Contractor Safety & Health Requirements.

3.0 ADMINISTRATIVE

3.1 Record Availability

- 3.1.1 Prior to the start of Work, Contractor and Owner shall agree upon the appropriate means of maintaining on-site environmental records and documentation applicable to the Work. Contractor shall provide a copy of all applicable records and documentation (e.g. permits, training records, etc.) to Owner upon its request and at the completion of the Work.

3.2 Communication

- 3.2.1 Unless directed otherwise, Owner will be the single point of contact for all regulatory agency interaction for environmental communication (written or verbal) that is applicable to the Work. For **emergency communication** requirements, see section 4.1. For **non-emergency communication** requirements, see section 4.2.
- 3.2.2 Contractor shall ensure that its personnel clearly understand oral and written instructions, signs, and labels associated with the Work. This includes, but is not limited to ensuring they understand the scope of the Work they are to perform, Owner's Environmental Management Plans or Instructions (see section 2.2), Contractor's Environmental Plans, all other Owner and/or Contractor specific training, site specific environmental permits/plans, and/or Hazard Communication manuals, as they pertain to the Work.

4.0 EMERGENCY PREPAREDNESS AND RESPONSE

4.1 Discharges, Spills or Releases

- 4.1.1 Prior to commencing Work, Contractor shall review with Owner its work-site specific environmental emergency response plans involving potential discharges, spills or releases from substances, chemicals, materials or products that may be brought on-site. Owner and Contractor shall jointly agree who will be responsible for making immediate notifications to governmental entities of oil spills to water and releases of reportable quantities of hazardous substances to the environment. Additionally, Owner and Contractor shall jointly agree who will be responsible and to what extent for responding to an emergency situation based on personnel qualifications, availability, experience, etc. and the type of substances, chemicals, materials or products involved.
- 4.1.2 Owner's Environmental Coordinator, environmentally Competent Person or designee is responsible for assisting Contractor in carrying out its emergency environmental duties at the work-site and other associated issues with the Work. This person will verify the Contractor's

- proper clean-up of all discharges, spills or releases that occurred during an Emergency Environmental Situation.
- 4.1.3 In the event of a discharge, spill or release that results in an Emergency Environmental Situation, Contractor shall identify the material and immediately notify Owner. The emergency responder, identified in 5.1.1, shall attempt to stop or contain the source from spreading, reaching a drain, and/or waterway; as long as conditions are safe and the persons are properly trained or qualified to do so in accordance with all applicable Federal, State, and/or Local laws and regulations.
- 4.1.3.1 When possible, Owner will assist Contractor in conducting all required response actions and may perform the duties of the On Scene Incident Commander, if qualified to do so or until relieved by a qualified responding governmental agency or authorized response Contractor.
- 4.1.4 Immediate agency notifications are required when certain thresholds are met for reportable discharges, spills or releases to the environment. 'Immediately' has been interpreted by AEP, based upon the monetary penalties outlined in EPA's 'Enforcement Response Policy', to be within 15 minutes of discovery of the discharge, spill or release. If the Owner's representative cannot be reached within the timeframe allowed by the EWCA and the Contractor has been designated to make any Federal, State, and/or Local agency notifications; the Contractor's eCP will conduct this task.
- 4.1.4.1 If the Contractor has been authorized to conduct such official notifications, Owner will train the Contractor's eCP to conduct this important responsibility.
- 4.1.4.2 If possible, Owner's immediate representative on-site shall have the opportunity to review and approve such notifications or to even conduct it on behalf of the Contractor. This requirement shall in no way impede or restrict the ability of the Contractor to provide such official notification within the required regulatory timeframe.
- 4.1.4.3 For any Contractor-initiated agency notifications, Contractor shall provide Owner with all incident and reporting information immediately after this notification takes place or when the incident is under control.
- 4.1.5 Contractor shall document all such Emergency Environmental Situations using the Environmental Event Report (EER) form located in Attachment C and shall submit the completed report to Owner the following work day. Equivalent spill reporting forms may be used. All spills of any quantity will be documented.
- 4.1.6 Contractor may be required to participate in Owner's investigation into the facts and circumstances of an Owner or Contractor initiated agency notification that resulted from an environmental incident, spill, release, discharge, and/or event.
- 4.2 Notification Requirements for Non-Emergency Environmental Situations**
- 4.2.1 Contractor shall notify Owner as soon as possible of all non-emergency environmental situations. These can include, but are not limited to minor oil/chemical spills (as defined by Owner at each work-site), wastewater or process water discharges, sewage seepage, complaints from the general public/Owner's neighbors or events that do not trigger the immediate notification to a regulatory agency.
- 4.2.2 Contractor shall document non-emergency events using the EER form located in Attachment C and shall submit the completed report to Owner the following Work day after notifying Owner as required in 4.2.1. Equivalent spill reporting forms may be used. All spills of any quantity will be documented.
- 4.3 Emergency Planning and Community Right-to-know Act Reporting**
- 4.3.1 Before storing fuel (diesel fuel or gasoline), black beauty (media blasting), sulfuric acid (batteries), ammonia and other EPCRA (Emergency Planning and Community Right-to-know Act) reportable chemicals on the Work site the Contractor shall provide a detailed list for evaluation to the Owner for inclusion with the Facilities EPCRA Section 311 (Safety Data Sheet Reporting) and Section 312 (Annual Chemical Inventory) report to the State Emergency

- Response Commission (SERC), Local Emergency Planning Committee (LEPC), and Local fire department with jurisdiction over the Facility.
- 4.3.2 If the Contractor elects to store EPCRA reportable chemicals at the Work site the Contractor shall inform the Owner of the maximum amount that will be stored, as well as the type of storage container(s) that will be used, and where the storage container(s) will be located and maintained. If Contractor elects to store EPCRA reportable chemicals on site above the applicable threshold planning quantity (TPQ), which in most AEP states is 10,000 pounds (500 pounds in Louisiana), the Contractor shall provide all necessary information to the Owner for reporting.

5.0 ADDITIONAL ENVIRONMENTAL REQUIREMENTS

5.1 Environmental Training and Qualification Requirements

- 5.1.1 Environmentally Competent Person(s) shall have environmental training that is appropriate to the type of Work that the Contractor routinely performs, in addition to having the training specified in the EWCA. Training specified in the EWCA must be completed prior to mobilization or prior to start of work. Typical training that an environmentally Competent Person is expected to have may include, but is not limited to the following and shall be provided at Contractor's sole expense:
- 5.1.1.1 Training that meets the requirements of OSHA's HAZWOPER Standard (1910.120 or 1926.65) for First Responder - Awareness. The environmentally Competent Person(s) must be able to demonstrate to Owner that they meet these minimum requirements. The requirement to have this type of training or similar will be identified on the EWCA.
 - 5.1.1.2 If the type of Work that the Contractor routinely performs involves the use of Hazardous Materials or Wastes, they are expected to demonstrate their ability to the First Responder - Operations stage for spill response according to OSHA's HAZWOPER Standard. The requirement to have this type of training will be identified on the EWCA. The Contractor's environmentally Competent Person may also be required to complete training for:
 - 5.1.1.3 Storm Water Pollution Prevention
 - 5.1.1.4 Spill Prevention, Control, and Countermeasures
 - 5.1.1.5 Fugitive Dust Emissions and Control
 - 5.1.1.6 Solid and Hazardous Waste Management
 - 5.1.1.7 Other environmental training, as identified on the EWCA (e.g. wetlands, Ozone Depleting Substances, etc.)
- 5.1.2 Contractor's employees and workers shall be trained and/or qualified by Contractor's environmentally Competent Person(s) for the environmental portion of the Work they will be performing, as identified within the EWCA. This training should focus on the worker(s) expected duties, especially those that could create environmental risk, and/or potentially create an environmental discharge, spill or release for which an emergency response may be necessary. Training must be completed as soon as possible but no later than 14 days of the worker(s) starting at the project site. Personnel working in, around or near environmentally sensitive areas shall have all training identified on the EWCA completed prior to starting work. General environmental training typically includes, but is not necessarily limited to the following training opportunities listed below depending on their specific work assignments.
- 5.1.2.1 HAZWOPER First Responder - Awareness training may be required per the EWCA and will be provided by the Contractor's environmentally Competent Person(s) or its third party training provider. This training will meet the requirements of OSHA's HAZWOPER Standard (1910.120 or 1926.65). This training will be performed annually, but could be more often if required by Owner. This training is often site-specific so additional training

may be necessary for workers reassigned to other Work. The requirement to have this type of training will be identified on the EWCA. Contractor shall maintain all training records as stated in section 3.1.

- 5.1.2.2 If the type of work that Contractor's employees and craft routinely performs involves the use of Hazardous Materials or Wastes, then they are expected to demonstrate their ability to the First Responder - Operations stage for spill response according to OSHA's HAZWOPER Standard (1910.120 or 1926.65). The requirement to have this type of training will be identified on the EWCA. Additional training the Contractor's employees may be required to have includes the following:
 - 5.1.2.3 Storm Water Pollution Prevention Awareness
 - 5.1.2.4 Spill Prevention, Control, and Countermeasures Awareness
 - 5.1.2.5 Fugitive Dust Emissions and Control Awareness
 - 5.1.2.6 Solid and Hazardous Waste Management Awareness
 - 5.1.2.7 Other environmental training, as identified on the EWCA (e.g. wetlands, Ozone Depleting Substances, etc.)
- 5.1.3 Contractor is responsible for the cost of all HAZWOPER First Responder - Awareness training for its direct employees and workers, including contingent staff (i.e. those who typically travel from job to job for the Contractor).
- 5.1.4 Owner will reimburse Contractor the cost of all HAZWOPER First Responder - Awareness training for all non-direct (e.g. temporary union craft or non-union craft) workers. This HAZWOPER training should take up to, but not more than 2 hours to perform and this training is subject to review and acceptance by Owner.
- 5.1.5 Owner will reimburse Contractor for the cost of its worker(s) attending Owner-required training, as specified below. Contractor shall submit timesheets for Owner's review and approval for all such training.
 - 5.1.5.1 Owner's Environmental Management Plan(s) or procedures training, if applicable;
 - 5.1.5.2 Site-specific environmental orientation (e.g. waste storage practices, environmental emergency actions, Used Oil procedures, Avian Protection Program, etc.). Site-specific environmental orientation may take up to 1.5 hours in aggregate;
 - 5.1.5.3 A periodic refresher may be required (e.g. Storm Water Awareness, Universal Waste Awareness), per Owner or regulatory direction; and
 - 5.1.5.4 Additional training may be required, as determined by Owner, based on site specific issues (e.g. Process Water Spill Awareness, Wetlands Protection, etc.).
- 5.1.6 If on-going work observations indicate additional environmental hazards or if the scope of work changes, Owner may require Contractor to augment the training required in 5.1.1, 5.1.2, and 5.1.4.
- 5.1.7 If Contractor fails to comply with Owner's environmental requirements and/or fails to achieve environmental compliance as it relates to the Work, Owner may require that the environmentally Competent Person(s) and/or its employees be replaced or receive additional training at no additional expense to Owner.

5.2 Chemical Management Plans

- 5.2.1 This section applies to hazardous substances, chemicals, materials or products that Contractor may bring on Owner's work-sites (e.g. Two-Part Epoxy Resins, Gasoline, Ammonia, Polymers, etc.). These are substances or materials deemed hazardous by Federal, State, and/or Local regulations, where exposure may result in adverse effects on the health or safety of employees and/or contamination of the environment.
- 5.2.2 Prior to mobilization and if identified on the EWCA, Contractor shall prepare a Chemical Management Plan for all hazardous substances, chemicals, materials or products that will be

- stored on-site in cumulative quantities equal to or greater than 55 gallons. Areas to address in the Chemical Management Plan include, but are not limited to:
- 5.2.2.1 Identifying all applicable hazardous substances, chemicals, materials or products and how they will be used;
 - 5.2.2.2 Description of how all applicable hazardous substances, chemicals, materials or products (e.g. flammables, combustibles, caustics, etc.) will ultimately be containerized and stored (i.e. fire-rated storage unit);
 - 5.2.2.3 Description of spill response resources that Contractor will have available (e.g. spill kits/materials, equipment, manpower, and Personal Protective Equipment) and how potential spills will be managed;
 - 5.2.2.4 The frequency of Contractor's inspections of all applicable hazardous substances, chemicals, materials or products, a copy of the inspection form to be used, and who will perform these inspections;
 - 5.2.2.5 Identification of Contractor's primary and alternate Chemical Management Plan points of contact; and
 - 5.2.2.6 Any oil products to be used and stored on-site that are not covered under an applicable Spill Prevention Control and Countermeasures (SPCC) Plan shall be covered under the Contractor's Chemical Management Plan. This part of the plan shall include the location of all such oil product containers with an individual capacity equal to or greater than 55 gallons.
- 5.2.3 All chemical storage containers to include "Conex" boxes shall be marked on their exterior with appropriate labeling made of Ultra-Violet resistant material which will include Contractor identification, contact information, and chemical hazards.
- 5.2.4 Contractor may be required to submit an updated Chemical Management Plan if Owner requires revisions to the original based upon scope of work changes, etc. that require additional substances, chemicals, materials or products be brought on-site.
- 5.2.5 Contractors performing Work in Michigan or Louisiana may be required to follow Michigan's Rule 5 Pollution Incident Prevention Plan requirements or Louisiana's Spill Prevention and Control Plan requirements for chemicals at Owner's work-site(s).
- 5.2.6 Prior to Contractor demobilizing, any remaining substances, chemicals, materials or products (not yet determined to be a waste by Owner) must be removed by Contractor, including partially used containers. No substances, chemicals, materials or products shall be left on Owner's work-site without written authorization. Any substances, chemicals, materials or products found to be left on-site will be returned to Contractor and Contractor billed for shipping and handling.
- 5.2.6.1 For any substances, chemicals, materials or products left behind without prior approval by Owner and are determined to be a waste incapable of being returned to Contractor because of Federal, State, and/or Local regulation or law; Owner will either properly dispose of this waste and Contractor will be billed for this service or else notify Contractor to come back and properly dispose of the waste itself. Owner will decide which option is in the best interest of the corporation.
- 5.2.7 For additional requirements on Hazard Communication and Hazardous Materials Management, refer to Owner's document on Contractor Safety & Health Requirements.

5.3 Spill Prevention, Control and Countermeasures

- 5.3.1 Owner will instruct Contractor on the need to develop and/or maintain a Spill Prevention, Control, and Countermeasures (SPCC) Plan or follow Owner's Plan, via the EWCA document. If required, the Contractor's plan must be reviewed and approved by Owner prior to oil/fuel being brought on-site. If Contractor is required to have and maintain a SPCC Plan, it must meet the requirements of the U.S. EPA (40 CFR 112). This is required if Contractor anticipates having greater than 1,320 cumulative gallons of oil/fuel storage capacity on-site

- counting all containers equal to or greater than 55 gallons, regardless of the potential to discharge to nearby navigable waters and adjoining shorelines.
- 5.3.2 Contractors performing Work in Virginia, West Virginia or Louisiana may be required to follow Virginia's Chapter 91 and 9 Virginia Administrative Code 25-91-10, Section 22-30 of the Code of West Virginia, or Louisiana's Spill Prevention and Control Plan requirements for Above-ground Storage Tanks at Owner's work-site(s).
- 5.3.3 Contractor shall document and perform, at a minimum, monthly visual inspections of all applicable oil/fuel containing equipment, containers, and storage areas as specified within their approved SPCC Plan. These inspections shall occur no sooner than 14 days and no later than 30 days from the date of the last inspection. Owner's site-specific policies and/or State/Local regulations may require more frequent inspections. Documented inspection reports shall be available for Owner review upon request.
- 5.3.4 Contractor shall provide all bulk storage containers of oil/fuel equal to or greater than 55 gallons capacity with secondary containment for the entire contents of the largest single container and sufficient freeboard for precipitation. Contractor shall remove accumulated rainwater to allow their secondary containment to function as designed. Contractor shall inspect all of its secondary containments for the presence of oil/fuel and/or sheens, and remove all oil/fuel and/or sheens prior to discharge and manage the removed materials in compliance with all applicable regulations, statutes, and Owner's requirements. Owner shall be notified if the presence of oil/fuel and/or sheens is observed.
- 5.3.5 Oil-filled equipment which has not been initially placed into service (i.e. not connected to Owner's facilities) fall under section 5.3.1 until it becomes actively connected (i.e. placed into service and connected for its designed purpose), unless otherwise directed by Owner. An example of this would be an oil-filled transformer that has not yet been energized or an oil-filled gearbox still sitting in the lay down yard.
- 5.3.6 Unless prior written permission is given by Owner, Contractor shall not perform any repairs, modifications, and/or maintenance activities on any bulk fuel tanks on-site if such activities relate to corrosion, damage, interior inspections, and/or pressure testing for integrity.
- 5.3.7 The filling of all bulk storage containers and all equipment refueling by Contractors shall be attended to at all times by an environmentally Competent Person and/or trained worker(s), to minimize the potential for spillage. All fuel storage containers shall be marked accordingly with appropriate labeling made of Ultra-Violet resistant material which will include Contractor identification, contact information, and chemical hazards. Contractor shall maintain adequate spill supplies onsite to respond to the largest potential spill.

5.4 Storm Water Pollution Prevention

- 5.4.1 Work performed on Owner's property may require a Storm Water Pollution Prevention Plan (SWPPP). Contractor may be required to develop and maintain a SWPPP, comply with, and/or obtain a storm water permit as indicated on the EWCA. If required to obtain a storm water permit, develop, and/or comply with a SWPPP; Contractor will coordinate all such activities within the required time frame before earthwork or other regulated activities commence.
- 5.4.2 If Owner develops a SWPPP, Contractor shall comply with Owner's plan. In addition, Contractor may be required to maintain the SWPPP as indicated on the EWCA.
- 5.4.3 Storm water and/or erosion and sediment control inspections are to be performed as specified within the SWPPP. These inspections may be initiated and be the responsibility of the Owner or Contractor, as defined in the scope of work documents.
- 5.4.3.1 The designated and/or chosen inspection frequency as allowed per the SWPPP shall be maintained by the responsible party and not deviated from.
- 5.4.3.2 If the Contractor does not have workers on site during or after a qualifying rain event per the approved SWPPP, then the Owner may elect to have the Contractor provide such

coverage in order to perform SWPPP inspection and/or maintenance work. Owner will pay Contractor for these additional inspections as they occur.

- 5.4.4 If any storm water and/or erosion & sediment control repairs and modifications are required, they shall be made in accordance with the SWPPP.
- 5.4.5 Storm water Best Management Practices (BMP) are physical, structural or managerial practices employed before, during, and/or after the Work that have been proven and accepted to help reduce or prevent pollution. BMP(s) may need to be implemented wherever possible to minimize potential environmental impacts to Owner's operations. BMP(s) can vary between sites and may be at the Owner's discretion.
- 5.4.5.1 Owner will reimburse Contractor for the cost of any required storm water BMP(s) to be implemented resulting from a Federal, State, and/or Local agency inspection or as directed by Owner's Environmental Coordinator for the Work to be performed under an Owner-supplied Industrial or Construction SWPPP.
- 5.4.5.2 Contractor shall be responsible for the cost of any required storm water BMP(s) to be implemented resulting from a Federal, State, and/or Local agency inspection or as directed by Owner's Environmental Coordinator for Work to be performed under a Contractor-supplied Construction SWPPP.
- 5.4.5.3 Contractor shall be responsible for the cost of any required storm water BMP(s) to be implemented resulting from a Federal, State, and/or Local agency inspection or as directed by Owner's Environmental Coordinator when no SWPPP has been required for Work at Owner's work-site.

5.5 Fugitive Dust Control and Air Emissions

- 5.5.1 Owner and Contractor have a general obligation to minimize or eliminate fugitive dust/emissions in accordance with Federal, State, and/or Local air permits (e.g. Title V) or nuisance law requirements. At some of Owner's work-sites, Contractor may be required to comply with similar Mining Safety & Health Administration fugitive dust requirements as indicated on the EWCA.
- 5.5.2 Fugitive dust control shall be in accordance with the EWCA. All measures Contractor intends to use in the performance of its Work shall be approved by Owner prior to use, including the application of water. Contractor shall only apply enough water to control dust and to not generate uncontrolled run-off or discharge.
- 5.5.3 Fugitive dust is to be controlled throughout the performance of Work. Contractor shall be responsible for supplying and implementing all control measures for the fugitive dust it creates during the performance of its Work, unless otherwise indicated by Owner on the EWCA. Owner will notify Contractor if it will have additional dust control responsibilities for Work other than its own.
- 5.5.4 Contractor shall only use designated construction entrance/exits when performing Work at Owner's work-sites. In addition, when designated on the EWCA, Contractor shall be responsible for limiting the track-out of sediment on Owner or public roadways to reduce or eliminate fugitive dust.
- 5.5.5 Equipment such as, but not limited to batch plants, rock crushers, screeners, limestone/gypsum handling equipment, and in particular situations, large stockpiles of material; can require special air permits prior to their mobilization, setup, and/or usage. All intentions to use such equipment and/or any other large sources of fugitive emissions must be reviewed and pre-approved by Owner before mobilizing such equipment on-site. Contractor shall obtain and pay for all necessary permits prior to the on-site mobilization and operation of this equipment and shall follow all permit and/or exemption requirements to maintain environmental compliance.
- 5.5.6 Contractors shall provide Owner the liquid capacity of all bulk storage fuel containers in use or planned for use by Contractor. On a monthly basis, Contractor shall provide Owner the fuel quantities consumed that have been removed from these containers. Contractor shall ensure all

- fuel storage containers are closed and sealed when not actively conducting filling operations per the requirements of 40 CFR Part 63 and other applicable regulations and statutes. Contractor shall also comply with all submerged filling (i.e. nozzle actually in liquid, fill tube at bottom of tank, etc.) requirements applicable to their temporary, bulk fuel containers per applicable state laws and regulations.
- 5.5.7 Prior to commencing any demolition activities of the Owner's permanent structures, Contractor and Owner shall jointly agree who will submit and pay for all inspections and notifications required by Federal, State, and/or Local agencies.
- 5.5.8 Contractor is not permitted to conduct any open burning activities until receiving written permission from Owner and any permits required by Federal, State, and/or Local agencies. Contractor and Owner shall jointly agree who will submit any required notifications or applications to Federal, State, and/or Local agencies, as well as pay for the permit.
- 5.5.9 Contractors performing Work in Michigan may be required to follow Michigan's Administrative Rules (336.1201) for air pollution control by tracking and reporting information on certain mobile equipment that produce air emissions.

5.6 Temporary Sewage Permitting and Other Requirements

- 5.6.1 Prior to beginning Work, Contractor shall review with Owner all site specific needs for temporary sewage systems such as septic tank systems, sewage holding tanks, Dropbox/Tankbox(s), portalets, office trailer restrooms, and temporary connections to Owner's Waste Water Treatment Plant (WWTP) or public sanitary sewer system. Additionally, this review will include who is planned to supply such sewage systems.
- 5.6.2 If Contractor is providing temporary sewage systems, Contractor shall provide Owner with a Sewage Waste Procedure or Guideline as part of its overall Waste Management Plan, as required below in section 5.7.2. This will be noted in the EWCA. This shall be provided upon mobilization and prior to the commencement of its use. Such a plan may include listing the Owner as part of its overall disposal process for such wastes (i.e. temporary connections to the WWTP, public sanitary sewer system, etc.), if such an agreement is reached.
- 5.6.3 If Contractor is providing temporary sewage systems, Contractor shall obtain any required temporary sewage permits as needed by the State or Local agencies prior to bringing such systems on-site. All requirements set forth in the permit shall be enforced by Contractor's environmentally Competent Person.
- 5.6.4 Whether or not a temporary sewage system permit is required for the sewage option implemented by Contractor, all associated sewage pumping and removal records shall be maintained on-site and copies shall be turned over to Owner upon completion of Contractor's Work.

5.7 Waste Management

- 5.7.1 Unless specified otherwise within the EWCA, Owner shall be considered the Generator for all waste (both hazardous and non-hazardous) produced at its work-sites and resulting from the Work. Contractor shall follow all of Owner's Waste Management Plans, procedures, and/or guidelines (e.g. Used Oil, Universal Waste, Construction & Demolition Debris, etc.). A waste includes, but is not limited to a discarded material or inherently waste-like material as defined by the EPA per 40 CFR 261.2. Wastes can be, but are not limited to hazardous or non-hazardous, solid, liquid, and/or containerized gaseous materials.
- 5.7.2 Before mobilization, Contractor shall provide Owner a copy of its plans, procedures, and/or guidelines detailing their intended waste management practices. This will include using Owner's facilities (if allowed) and any planned disposal/recycling vendors for wastes not expected to be handled by Owner. Contractor shall attempt to minimize quantities of hazardous waste generated through such practices as the segregation of materials, proper selection of raw materials and products, etc. Owner may accept or reject for revision Contractor's waste management practices at its discretion.

- 5.7.3 Contractor is responsible for compliance with all Federal, State, and/or Local requirements for all of its waste generation until Owner accepts it at a pre-approved transfer point. Contractor may be required by Owner to recycle certain waste streams, where practical.
- 5.7.4 If Contractor is designated by the EWCA to be the Co-Generator of any hazardous or non-hazardous waste, Contractor shall be responsible for managing all aspects of the waste compliance and disposal process. If Owner determines that the Contractor's environmentally Competent Person is not qualified to perform such duties, then Owner may require via the EWCA that a qualified waste management subcontractor be hired to perform such tasks. Owner's facility identification numbers and work-site address/name will be recorded on all tracking documentation. Additionally, all waste transporters, along with the final disposal facilities, will be reviewed and pre-approved by Owner. Documents shall indicate that the Contractor is acting as agent for Owner with respect to waste transportation and disposal.
- 5.7.4.1 If any waste is determined to be hazardous, Contractor shall track and report to Owner the amount generated on a weekly basis.
- 5.7.4.2 Contractor shall ensure all hazardous waste remains segregated from other forms of waste and do not become mixed, thus increasing the amount of hazardous waste to be disposed.
- 5.7.4.3 Contractor shall review with Owner, prior to having any waste transported off-site, all draft transportation documentation (i.e. manifests, bills of lading, etc.).
- 5.7.4.4 Contractor shall supply Owner with completed copies of all hazardous and non-hazardous waste transportation documentation at the completion of its Work.
- 5.7.5 Contractor shall supply all waste determination documentation that it initiates. Owner shall approve all waste determinations as to whether a waste is hazardous or non-hazardous in nature (i.e. using analytical data, process knowledge, Safety Data Sheets, etc.).
- 5.7.6 Contractor shall not mix its Used Oil with any solvents, chemicals or waste and will segregate them, as appropriate. Under no circumstance shall Contractor land-apply Used Oil on Owner's work-sites or anywhere else not authorized by law.
- 5.7.7 Contractor may be required to submit an updated Waste Management Plan if Owner requires revisions based upon scope of work changes, etc. that requires additional wastes be disposed of.
- 5.7.8 Prior to Contractor demobilizing, any remaining substances, chemicals, materials or products (not yet determined to be a waste by Owner) must be removed by Contractor, including any partially used containers. No substances, chemicals, materials or products shall be left on Owner's work-site without written authorization. Any substances, chemicals, materials or products found to be left on-site will be returned to Contractor and Contractor billed for shipping and handling.
- 5.7.8.1 For any substances, chemicals, materials or products left behind without prior approval by Owner and are determined to be a waste incapable of being returned to Contractor because of Federal, State, and/or Local regulation or law; Owner will properly dispose of this waste and Contractor will be billed for this service or else notify Contractor to come back and properly dispose of the waste itself. Owner will decide which option is in the best interest of the corporation.
- 5.7.9 For additional requirements on Hazardous Communication and Hazardous Materials Management, refer to Owner's document on Contractor Safety & Health Requirements.

5.8 Environmentally-Sensitive Areas

- 5.8.1 All known jurisdictional wetlands or streams at Owner's work-site will be identified to Contractor. Contractor shall bring to Owner's attention any such areas which have not yet been identified and which may be impacted by the Work.
- 5.8.2 Contractor shall not disturb or impact a Jurisdictional Wetland, Stream, Critical Dune or other Environmentally-Sensitive Area, as identified in the EWCA, without the proper permit(s) in place. Contractor shall follow all such permit requirements as applicable to the Work.

- 5.8.3 Contractor shall ensure that all Owner site-specific protection requirements are maintained in regards to any Wetland, Stream, Critical Dune or other Environmentally-Sensitive Area.
- 5.8.4 Contractor shall ensure that environmentally sensitive areas such as wetland or stream areas, that are not permitted, are clearly marked in the field (e.g. orange fencing with signage) unless otherwise approved by Owner. Whenever temporary barricades are erected and/or maintained by Contractor near Environmentally-Sensitive Areas, Contractor shall post barricade signs around the perimeter that identify the nature of the environmental issue (e.g. NOTICE – Wetland Boundary Keep Out). This signage shall be made of Ultra-Violet and weather resistant material.

5.9 Species Protection

- 5.9.1 Contractor shall bring no harm to protected birds such as raptors, waterfowl, eagles, and other birds native to North America on the Owner's Work site. Contractor shall notify Owner if protected birds, nests, or dead or injured birds are identified on Owner's Work site. Contractor shall not touch or move any such active nest, large inactive nest, or dead or injured protected bird unless permission has been obtained from Owner's Avian Program Coordinator. Exemptions are available for situations of imminent danger or public safety.
- 5.9.2 Owner will notify Contractor if there is a known presence of a Protected, Endangered, Rare, Threatened species, and/or their dwellings and provide training on AEP's Avian Protection Plan as required by the scope of work. Contractor shall comply with all Federal, State, and/or Local rules and regulations if such a species and/or their dwellings exist on or near Owner's work-site, as identified on the EWCA. Contractor shall notify Owner immediately if such species and/or dwellings are observed so they can be documented and protective measures established, if necessary.

5.10 Protection of Archeological and Cultural Resources

- 5.10.1 Work on Owner's sites has the potential to uncover pre-historic, historic, and/or cultural artifacts. If during the performance of its Work, Contractor discovers pre-historic, historic, and/or cultural artifacts (e.g. arrow heads, pottery shards, bones, jewelry, etc), Contractor must immediately stop work, contact Owner, preserve and protect any items discovered to Owner's satisfaction while complying with all Federal, State, and/or Local requirements. If Contractor acquires knowledge of such an incident from a third party, Contractor shall immediately inform Owner so that Owner may investigate the legitimacy of such claims. Any impact to these areas is strictly prohibited, other than by archeological investigation and preservation activities that may be specifically included in Contractor's scope of Work.
- 5.10.2 For pre-historic, historic, and/or cultural areas already identified, as listed within the EWCA, additional requirements to protect these areas may be required from Contractor (e.g. fencing, signage, periodic inspections, training, restrictive work requirements, etc.). Contractor shall comply with all such requirements.

<h2>6.0 DEFINITIONS</h2>

- 6.1 **Assessment** – A physical walk down of the work-site(s) using checklists or other methods to record compliance of the Work with environmental laws, policies, and Best Management Practices.
- 6.2 **Contractor Reimbursement** – The term “Owner will pay for” or “Owner will reimburse Contractor the cost of” will be in accordance with the “Extra Work” or “Cost-Plus Work” provisions of any resulting contract.
- 6.3 **Discharge** – Includes, but is not limited to any spilling, leaking, releasing, pumping, pouring, emitting, emptying or dumping of oil, chemicals or process waters, etc. into the environment (e.g., land, water or air).

- 6.4 **Emergency Environmental Situation** – An event that demands immediate action to protect the health, wellbeing, and/or condition of the surrounding environment and community including ground water, surface water, land, and air.
- 6.5 **environmentally Competent Person (eCP)** – Contractor-designated person(s) is one who by way of training and/or experience:
- 6.10.1 Is capable of identifying existing and predictable environmental risks in regards to the Work, surroundings or working conditions that may be non-compliant, unsanitary, hazardous or dangerous to employees, the public or the environment.
 - 6.10.2 Understands the required engineering controls to mitigate such risk and has the authorization to take prompt corrective measures to initiate, minimize, and/or remedy environmental issue(s).
 - 6.10.3 Has completed all of Owner required training as described in section 5.1, including any additional training as specified in the Environmental Work Compliance Assessment (EWCA). In addition, the environmentally Competent Person shall be able to clearly communicate to the workers, Owner’s environmental requirements and the environmental controls they are expected to utilize in the performance of their Work.
- 6.6 **Environmental Event Report** – Owner’s environmental incident reporting form that Contractor is required to complete in regard to environmental incidents, corrective actions and preventive actions jointly agreed upon, along with what will be or has been implemented to ensure a similar environmental incident will not be repeated.
- 6.7 **Environmental Management Plan** – A document prepared by Owner that outlines certain environmental activities, planning, responsibilities, practices, procedures, processes, resources or standards to be carried out to meet Owner's environmental policy and to achieve its compliance objectives.
- 6.8 **Environmentally-Sensitive Area** – Place where even minor disturbances to the natural order can impact the ecological balance and/or place the Owner at environmental risk. Such areas can include, but are not limited to wetlands, water bodies, designated conservation areas, parks, preserves, and recreational areas.
- 6.9 **Environmental Management System** – A series of plans or documents consisting of proven processes to conduct, monitor, and correct all environmental activities within an organization. These processes can either be written, verbal or a combination of both.
- 6.10 **HAZWOPER** – Training requirements under OSHA’s Hazardous Waste Operations and Emergency Response regulation. For additional information on this requirement, reference 29 CFR 1910.120 and/or 1926.65. A summation of the training that Owner requires is outlined below:
- 6.10.1 **First Responder – Awareness** spill and emergency training; personnel may report a leak, release, spill, and/or suspicious puddle to their environmentally Competent Person who handles such calls, can identify the type of material if they can do so at a safe distance from it, can keep others from approaching the spill area, and who can do all of this without any additional Personal Protective Equipment (PPE).
 - 6.10.2 **First Responder – Operations** spill and emergency training; personnel may stop spills remotely by closing valves, turning off equipment, etc. and/or prevent the spread of spills by covering drains, placing dikes, booms or other absorbents at a safe distance. However, they may not approach the spill/release area unless it has been determined by authorized personnel in charge that it is safe to do so, have been taught, and are qualified to use PPE appropriate for the situation. First Responder - Operations training should take approximately 8 hours to perform depending upon knowledge of the chemicals being used and is subject to review and acceptance by Owner. Higher levels of HAZWOPER training may be requested by Owner, if deemed necessary.
 - 6.10.3 **On Scene Incident Commander** – An Owner, Contractor or government person who directs the emergency response options during an Emergency Environmental Situation. Topics addressed in this person’s training to assume this position include Emergency Operations Centers, Incident Management System implementation, structure and function of a command,

communications, team leadership, managing responder safety, and site characterization. Per OSHA’s HAZWOPER Standard, this person typically receives 24 hours training plus any additional training needed to achieve competency all other areas mentioned above.

- 6.11 **Jurisdictional Wetland or Stream** – Areas determined by the U.S. Army Corps of Engineers and/or U.S. EPA that are subject to Section 404 of the Clean Water Act of 1977 or Section 10 of the Rivers and Harbors Act of 1899. Isolated wetlands or streams subject to state environmental agency jurisdiction are included in this definition.
- 6.12 **Minor Spill** – A discharge of oil, chemicals or process waters to the environment in quantities below any regulatory reporting threshold amount. This threshold amount is dependent on the environmental media the spill occurs in and the type of material spilled.
- 6.13 **Negative Environmental Impact** – A determination that the Work is having a negative impact on the environment that might affect the local population, endangered species, biodiversity, archeological artifacts, historical significance, community beauty, environmentally-sensitive areas, etc.
- 6.14 **Oil** – Oil of any kind or in any form, as defined by 40 CFR 112.2, including, but not limited to fats, oils or greases of animal, fish or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits or kernels; and other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse or oil mixed with wastes other than dredged spoil.
- 6.15 **Records** – Documents of an environmental nature to record compliance with this specification and/or Federal, State, and/or Local rules and regulations. Records may include, but are not limited to permits, reports, studies, evaluations, logbooks, photographs, plans, employee training, and material classifications. The requirements to maintain this documentation are usually outlined within regulations, permits, training, etc.
- 6.16 **Waste Determination** – A recorded communication process by which a waste (i.e. solid, liquid or gas) is classified to be a Solid Waste or Hazardous Waste, and why, for the purpose of disposal in accordance with Resource Conservation and Recovery Act (RCRA) rules and regulations. A waste can also be excluded from this process and be specifically covered under other rules and regulations.

7.0 REVIEW AND MINOR REVISION HISTORY			
DATE	REV #	CHANGES (e.g. paragraph #, scope of change, etc.)	REVIEWER
3-6-13	1	Too numerous to list. Most were minor clarifications to CERD sections: 3.1.3 (new EWCA form), 3.3.1 (new audit form), 5.1.3.1, 5.1.4, 5.1.5 (new EER form), 6.1.1, 6.1.2, 6.2.6.1, and 6.7.8.1	S. Austin & M. McCallin
9/13/16	2	<ul style="list-style-type: none"> • Moved definitions from Section 1 to Section 6; • Added EPCRA reporting (4.3); • Specified timeframe for completing training requirements (5.1.1 & 5.1.2); • Defined time for submittal of contractor required plans; • Removed numeric value for HAZWOPER training; • Clarified SPCC requirements (5.3), Environmentally Sensitive Areas (5.8), and Species Protection (5.9) ; • Revised EWCA, Audit Form, and EER. 	Melinda Stahl

PUBLIC VERSION
ATTACHMENT A - ENVIRONMENTAL WORK COMPLIANCE ASSESSMENT

AEP Generation's Environmental Work Compliance Assessment (EWCA)				
CONSULT THE PEC, CEC, AND/OR ENVIRONMENTAL SERVICES REPRESENTATIVES FOR MORE DETAILS ON ALL ITEMS LISTED BELOW The EWCA or any other equivalent forms are informational documents for initial and subsequent environmental planning purposes. No claim or representation is expressed or implied that the EWCA is comprehensive, all-inclusive, accurate, and complete or that items not listed will not be present or pose a threat to environmental compliance. The EWCA is a working document and may be revised throughout the term of the Contract.				
Location/Work-Site: Click here to enter text.		Start Date: Click here to enter a date.		End Date: Click here to enter a date.
Contractor/Work Description: Click here to enter text.				
Work Contacts (Owner & Contractor): Click here to enter text.				
Date Form Completed, Rev 0: Click here to enter a date.			Date Form Revised (Rev #): Click here to enter a date.	
Signature Process				
EWCA Completed By: Click here to enter a date.			EWCA Completed By: Click here to enter a date.	
EWCA Reviewed By: Click here to enter a date.			EWCA Reviewed By: Click here to enter a date.	
Environmental Aspects and Impacts of the Work				
*Check mark the red N/A box in each section's Environmental Impacts Header to inactivate a whole segment if Not Applicable				Contractor &/or Owner to be Responsible?
Rev 0	Rev	Air/Water/Land Aspects	Environmental Impacts	N/A
		Soil: Call Before You Dig (i.e. 811) Excavation Trenching Grading	Notes:	C O
		Contaminated Media Removal Soil Water	Notes:	C O
		Drilling Boring Pile Driving	Notes:	C O
		Use of Explosives Blasting	Notes:	C O
		Working on a Dam	Notes:	C O
		Working: Over Water On it Near it	Notes:	C O
		Erosion Sediment Controls	Notes:	C O
		Rock or Concrete: Crushing Screening Washout	Notes:	C O
		Ozone Depleting Substances (ODS),	Notes:	C O
		Asphalt Pesticides Special Coatings	Notes:	C O
		Dust Control/s	Notes:	C O
		Other:	Notes:	C O
Rev 0	Rev	Oil & Chemical Aspects	Environmental Impacts	N/A
		Used Oil: Plant Contractor Recycling	Notes:	C O
		Oil Storage (in gallons): <1,320 >1,320	Notes:	C O
		Chemicals: Storage Labeling Use Handling	Notes:	C O
		Other:	Notes:	C O

PUBLIC VERSION
ATTACHMENT A - ENVIRONMENTAL WORK COMPLIANCE ASSESSMENT

Rev 0	Rev	Waste Aspects	Environmental Impacts	N/A	C / O
		Construction & Demolition Debris	Notes:		C O
		Lead Abatement Waste	Notes:		C O
		Asbestos Waste	Notes:		C O
		Electrical Work: PCB's Oils Wire Transformer Capacitor Asbestos Ballasts Mercury Switches	Notes:		C O
		Grinding Cutting Drilling Waste	Notes:		C O
		Recycling of: Wood Metal Plastic Vegetation Other:	Notes:		C O
		Special Notifications: Demolition Asbestos Air Permit Water Permit Waste Permit	Notes:		C O
		Radioactive Materials	Notes:		C O
		Hazardous Waste: PCB's (Paint, Caulk, Oil) Hydrostatic Testing Water Rinse Water Chemical Cleaning Spent Solvent Other:	Notes:		C O
		Non-Hazardous Waste: Rinse Water Hydrostatic Testing Water Chemical Cleaning Spent Solvent Other:	Notes:		C O
		Partially Used, Unused, and/or Expired Chemical Products Left Behind	Notes:		C O
		Universal Waste: Lamps Batteries Other:	Notes:		C O
		Aerosol Cans	Notes:		C O
		Pollution Prevention (P2)	Notes:		C O
		Sewage Concerns: Portalets Holding Tanks Septic System WWTP Hook-up POTW Hook-up	Notes:		C O
		Other:	Notes:		C O
Rev 0	Rev	Sensitive Aspects	Environmental Impacts	N/A	C / O
		Species Protection: Vertebrates (birds, mammals, fishes, reptiles, etc.) Invertebrates (clams, snails, insects, etc.) Plants (flowering plants, ferns, etc.)	Notes:		C O
		Protected Areas: Cultural Historical Prehistoric Other:	Notes:		C O
		Preservation Areas: Wetland Stream Woods Dune Other:	Notes:		C O
		Other:	Notes:		C O

PUBLIC VERSION

ATTACHMENT A - ENVIRONMENTAL WORK COMPLIANCE ASSESSMENT

Rev 0	Rev	Plans, Policies, Permits, & Permissions	Comments	N/A	C / O
		Site Specific Operational Controls, Procedures, and/or Policies	Yes	No; Notes:	C O
		AEP Safety Services Corporate Operational Controls, Procedures, & Policies ESH = Environmental, Safety & Health Policy	Yes	No; Notes: ESH0000013876 – Hex. Chrome Exp. Control ESH0000013879 – Mercury Exposure Control ESH0000014349 – Methylene Chloride Policy ESH0000013825 – HAZWOPER/Emer. Resp. Other:	ESH0000013995 – Asbestos Management ESH0000013882 – Lead Exposure Control ESH0000013821 – Cadmium Exp. Control ESH0000013998 – Hazard Communication C O
		AEP Environmental Services Corporate Operational Controls, Procedures, & Policies EP – Environmental Policy	Yes	No; Notes: EP-92-05 Archeological Artifacts Encountered EP-92-07 PCB Management Policy EP-92-8.5 Asbestos Management Policy EP-93-09 Wetlands Policy	EP-95-11 Used Oil/Solvent Mixture EP-97-12 Treated Wood Give-Away EP-08-14 Avian Protection Policy EP-08-15 PCB Insulation/Capacitors C O
		AEP Environmental Documents Provided	Yes	No; Notes: 404 Permit 401 Permit Industrial NPDES Permit Construction Storm Water Permit Industrial Storm Water Permit Pollution Prevention (P2) Plan	Title V Air Permit Sewage Holding Tank Permit Septic System Permit Portalet Permit Groundwater Protection Plan Other: C O
		Plans Required For Work	Yes	No; Notes: Site Drainage Plan SPCC Plan Hydrostatic Plan Demobilization Plan Archeological Evaluation Erosion & Sediment Control (E&SC) Plan	Chemical Management Plan Waste Management Plan Sewage Management Plan Spill Response Plan Fugitive Dust / Emissions Plan Other: C O
		Other:	Notes:		C O

Special Instructions

*Check this box to spell check document

Name of Contractor's eCP:	eCP Will Be:	Full-time	Part-time (%)	On-site	Off-site
eCP Training Requirements: (to be completed prior to mobilization)	Spill Response HAZWOPER Choose an item.	Erosion & Sediment Control SPCC Other:	Fugitive Dust	Solid Waste: Hazardous Department of Transportation / Materials of Trade (For Transportation of Hazardous Materials)	Non-Haz Department of Transportation / Materials of Trade (For Transportation of Hazardous Materials)
Worker Training Requirements: (to be completed ASAP)	Spill Awareness HAZWOPER Choose an item.	E&S Awareness SPCC Awareness Other:	Fugitive Dust	Solid Waste: Hazardous Department of Transportation / Materials of Trade (For Transportation of Hazardous Materials)	Non-Haz Department of Transportation / Materials of Trade (For Transportation of Hazardous Materials)
Env. Event Notification Authority:	Owner Only	Contractor, if Owner is Unavailable within: Enter time Hr/Min.		Owner to Provide Notification Training	
Spill Kits Required:	Around the work-site	Vehicles	Equipment	Other:	Notes:
Solid Waste Generator Will Be:	Owner	Contractor is Co-Generator – List special instructions:			
Week Day SWP3 Inspections:	Owner	Contractor	Week End SWP3 Inspections:	Owner	Contractor
Sediment Track-out Clean-up:	Owner	Contractor	If Contractor – List other areas responsible for:		

AEP Generation's Contractor Environmental Requirements Document (CERD)

Contractor Environmental Evaluation

Date: _____ Contractor: _____

Project Name: _____ Superintendent: _____

eCP: _____ # of Contractor Employees On-Site Today: _____

Questions for Contractor's environmentally Competent Person (eCP):

A. CERD / EWCA			
1	Do you have a CERD/ EWCA for this project?	<input type="checkbox"/>	<input type="checkbox"/>
	If yes, is it current?	<input type="checkbox"/>	<input type="checkbox"/>
	Who is responsible for maintaining the CERD/ EWCA?	<input type="checkbox"/>	<input type="checkbox"/>
B. Training			
1	Do you have training for your employees?	<input type="checkbox"/>	<input type="checkbox"/>
	If yes, how often?	<input type="checkbox"/>	<input type="checkbox"/>
	Do you have training for your subcontractors?	<input type="checkbox"/>	<input type="checkbox"/>
	If yes, how often?	<input type="checkbox"/>	<input type="checkbox"/>
C. Procedures / Best Management Practices			
1	Do you have procedures for environmental protection?	<input type="checkbox"/>	<input type="checkbox"/>
	If yes, are they current?	<input type="checkbox"/>	<input type="checkbox"/>
	Do you have procedures for spill response?	<input type="checkbox"/>	<input type="checkbox"/>
	If yes, are they current?	<input type="checkbox"/>	<input type="checkbox"/>
	Do you have procedures for air quality?	<input type="checkbox"/>	<input type="checkbox"/>
	If yes, are they current?	<input type="checkbox"/>	<input type="checkbox"/>
	Do you have procedures for water quality?	<input type="checkbox"/>	<input type="checkbox"/>
	If yes, are they current?	<input type="checkbox"/>	<input type="checkbox"/>
D. Environmental Plans			
1	Do you have an environmental plan for this project?	<input type="checkbox"/>	<input type="checkbox"/>
	If yes, is it current?	<input type="checkbox"/>	<input type="checkbox"/>
	Who is responsible for maintaining the environmental plan?	<input type="checkbox"/>	<input type="checkbox"/>
	Do you have a spill response plan?	<input type="checkbox"/>	<input type="checkbox"/>
	If yes, is it current?	<input type="checkbox"/>	<input type="checkbox"/>
	Do you have an air quality plan?	<input type="checkbox"/>	<input type="checkbox"/>
	If yes, is it current?	<input type="checkbox"/>	<input type="checkbox"/>
	Do you have a water quality plan?	<input type="checkbox"/>	<input type="checkbox"/>
	If yes, is it current?	<input type="checkbox"/>	<input type="checkbox"/>

E. Conduct a Work-Site Environmental Compliance Assessment:				
1		Yes	No	N/A
2				
3				
F. Questions for a Small Sample of Contractor's Employees/Craft:				
1				
2				
3				
4				
5				
6				
7				
G. Corrective Action Plan:				
#	Description of the corrective action	Responsible Party	Due Date	Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

AEP's Environmental Event Report (EER)

Title of Event:	Click here to enter text.		
Event Date & Time:	Click here to enter a date.		
Point of Contact (include cell #):	Click here to enter text.		
Location Name (i.e. Plant/Project):	Click here to enter text.		
Operating Company (e.g. APCo):	Click here to enter text.		
Environmental Discipline:	Air	Land	Water
Environmental Aspect:	Click here to enter text.		
Environmental Impact:	Click here to enter text.		
Event Type:	Enforcement Action NPDES TSS NPDES Metals NPDES Temperature NPDES pH Near Miss Stack Opacity Exceedance >2%	Permit Issue NPDES Chlorine NPDES BOD NPDES Fecal Coliform Oil Spill MESH Nonconformance Describe Other: Click here to enter text.	Complaint NPDES O&G NPDES Flow NPDES Other Chemical Spill/Release Lessons Learned
ICP Metric Event:	Check if this is a NPDES, Oil Spill or Chemical Spill/Release Reportable Event		
Description of Event and Immediate Actions Taken:	Click here to enter text.		
Root Cause or Event Analysis:	Click here to enter text.		
Corrective Action or Mitigation Plan:	Click here to enter text.		
Root Cause Codes:	Roles/Responsibilities Not Defined Budget Communication Emergency Planning Software Work Practices Fitness for Duty Management System Inadequate Documentation External Factors (e.g. weather, emergency, etc.) Describe Other: Click here to enter text.	New Process, Procedure or Guidance Change Management Contractor Operational Equipment Failure Human Performance Improvement Work Planning/Scheduling Training/Competency Inadequate Procedure or Guidance	
Human Performance Improvement (HPI) Error Traps Contributing to the Event (Check all that apply):	Time Pressures Distractive Environment High Workload 1st Time Evolution/Task Unfamiliarity Day Prior To/1st Day After Days Off	Half Hour After Waking Up or Meal Vague or Incorrect Guidance Overconfidence / Complacency Imprecise Communication Work Stress / Fatigue	
Which HPI Tools Could Have Prevented the Event? (Check all that apply):	Pre-Job Briefing/JSA Process S.T.A.R. (Stop, Think, Act, & Review) Peer Checking & Coaching Questioning Attitude Qualify, Validate, & Verify (Q,V, &V)	Two-Minute Rule Stop when Uncertain Procedure Use Three-Way Communication Phonetic Alphabet	
Other Links (e.g. attachments, file locations, web-sites, pictures, etc.):	Type in the web address/file location: Type in the link description: Click here to enter text.		
AEP Corporate Comments: <i>Corporate Determination for ICP Metric</i>	NPDES Controllable Event Comments: Click here to enter text.	Spill Controllable Event	



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PC&C's Environmental Work Compliance Assessment (EWCA)

This EWCA has been prepared for environmental planning purposes. No claim or representation is expressed or implied that the EWCA is comprehensive, all-inclusive, accurate, and complete or that items not listed will not be present or pose a threat to environmental compliance.

The EWCA is a working document and may be revised throughout the term of the Contract.

Consult with the PEC, CEC, and/or Environmental Services Representatives to review, clarify and approve.

Date: 2-Nov-2018

Location / Project: Granger, Indiana / South Bend Solar Project Contractor: TBD

Project Start Date: 1-Apr-2019

Project End Date: 31-Dec-2020

Work Description: Construction of 20 MW solar power generation facility and interconnect to substation

Contacts (Owner & Contractor):

Brandy Kellom, Melinda Stahl

EWCA Completed By: Ryan Vasel 2-Nov-2018

EWCA Reviewed By: Melinda Stahl, Brandy Kellom (emailed) 2-Nov-2018

Plans Required: (Prior to Mobilization)

Environmental Work Compliance Plan shall include spill response and waste management procedures.

Training (eCP): (Prior to Mobilization)

◆ Spill Response ◆ Erosion and Sediment Control ◆ SPCC ◆ Fugitive Dust ◆ Solid Waste (RCRA)

Training (Worker): (within 14 days)

◆ Spill Awareness ◆ Erosion and Sediment Control Awareness ◆ SPCC Awareness ◆ Fugitive Dust ◆ Solid Waste (RCRA) Awareness

AEP Plans and Permits: (Available on request) * Permit(s) maybe pending for the work - consult with CEC.

◆ Construction Stormwater Permit ◆ Storm Water Pollution Prevention Plan ◆ Seasonal Clearing Restrictions Apply to Project, please consult with CEC for more information.

AEP Policies: (Available on request)

See Additional Comments on next page

◆ CG 751.00.01 Controlling Fugitive Dust Emissions ◆ CG 751.00.02 Managing Universal Waste ◆ CG 751.00.04 Implementing Spill Prevention Control and Countermeasures ◆ CG 751.00.05 Preventing Storm Water Pollution ◆ CG 751.00.07 Protecting Wetland Resources ◆ CG 751.00.09 Managing Construction and Demolition Debris ◆ CG 751.00.10 Managing Hazardous Waste ◆ CG 751.00.11 Documenting Ozone Depleting Substances ◆ CG 751.00.13 Environmental Discharge, Spills or Releases during Construction or Commissioning Activities ◆ JA CG 751.00.04 AST Set Up ◆ JA CG 751.00.11 HVAC / MVAC ◆ JA CG 751.00.13 Cleaning Up Sewage Spills ◆ CE-007 Specifications for Erosion and Sediment Controls ◆ MEA Spoils from Hydro-excavation ◆ EP-93-09 Wetlands Policy ◆ EP-97-12 Treated Wood Give-away Policy

General Project Notes: The eCP is expected to dedicate 30% of their time to environmental duties at the project site.

-Spill kits are required to be kept: ◆ around the general work-site and Near fuel tanks

-The Contractor is the Co-Generator of Solid Waste generated from the work. Waste will be shipped off-site using both the host facility and the Contractors EPA ID numbers.

-The Project has an active Storm Water Pollution Prevention Plan (SWPPP). The Contractor is responsible for conducting and recording the inspections from the SWPPP. Copies of the inspection reports must be provided to AEP within 24-hours of the inspection. Weekend and rain event inspections will be conducted by the Contractor.

-The Contractor is responsible to monitor for and clean-up any sediment track-out from the project-site. Additionally the Contractor is responsible for: All public roadways

PUBLIC VERSION

Additional Comments:

- ◆ EPCRA reportable chemicals are anticipated to be used for this work. Please consult with the CEC to incorporate requirements with the requested environmental plans.
- ◆ An Environmental Record Management Plan is required for this work. Please consult with the CEC to identify the records required for the project and process for turning them over to AEP. **No records are to be removed from the Project site without written authorization from the CEC or PEC.**
- ◆ DOT/MOT training may be required, please discuss with the CEC.
- ◆ The Contractor is to ensure that all aerosol cans are completely emptied prior to disposal. Check with the CEC for site specific instructions regarding the disposal of empty and defective aerosol cans, if available. Useable cans must be taken with the Contractor upon demobilization.
- ◆ - The Contractor will alert AEP before any transformers are brought on site. An SPCC plan may be required for oil-filled transformers.
- Any solar panels broken during construction shall be disposed of according to the manufacturers recommendation and in accordance to any local, state, and federal regulations.
- ◆ No food containers shall be reused for chemical storage/use (e.g., soda/water bottles, milk jugs, etc.)

EWCA Questions and Comments

Air	
A1	Will the contractor bring any portable (oil, fuel or gas powered) equipment on-site? Mobile equipment includes, but is not limited to: portable generators, pumps of any kind, light plants, welders, etc. Yes: Contractor shall provide a complete list of all portable equipment prior to the mobilization of equipment on-site. Each piece shall have a unique equipment ID number and the location/usage tracked monthly by the ECP.
A2	Does the work require the use of any specialized equipment such as rock crushers, soil screeners, grout plants/mixers, or other types of equipment that may require an air permit to operate? No: N/A when issued. Notify the CEC if the scope changes or condition is applicable
A3	Will there be any activities that could potentially create fugitive dust (excavating, blowdowns, blasting, etc.)? Yes: Contractor is expected to minimize fugitive dust using approved best management practices. Chemical dust suppressants must be approved by AEP prior to use. Monitoring and water usage logs shall be maintained.
A4	Is there any brush/woody debris that would require open burning? No: N/A when issued. Notify the CEC if the scope changes or condition is applicable
A5	Is there any refrigerant (CFC) work or the potential for service on equipment (A/C, MVAC, water fountains, refrigerators, etc.)? Yes: Any work on ODS (A/C, MVAC, refrigerators, etc.) shall be done by a qualified technician and proper documentation on the
A6	Will the work activities involve the demolition of any structures? No: N/A when issued. Notify the CEC if the scope changes or condition is applicable
A7	Will blasting or the use of explosives be necessary for the work? No: N/A when issued. Notify the CEC if the scope changes or condition is applicable
Water	
W1	Are there any earth disturbance (clearing, grubbing, or excavation) activities associated with the project? Yes: Erosion and sediment controls are expected to be utilized and properly maintained.
W2	Has a Storm Water Pollution Prevention Plan for the project been developed? Yes: A copy of the SWPPP will be available for review. The Contractor is expected to comply with all conditions in the plan. The CEC will provide training to the eCP on the SWPPP.
W3	Does the Contractor need to develop an Erosion and Sediment Control Plan for the work? Yes: Submit the Erosion and Sediment Control Plan to the CEC for review and comment prior to mobilization.
W4	Is a Site Drainage Plan necessary for managing/controlling water discharges at the site? No: N/A when issued. Notify the CEC if the scope changes or condition is applicable
W5	Are there vacuum trucks or spray systems (pressure washers) involved that could leak waste water to drainage systems? Yes: Review process with CEC to determine if controls or further planning is necessary.
W6	Does the work involve hydro-excavating? Yes: Review process with CEC to discuss handling of spoils and to determine if controls or further planning is necessary.
W7	Will there be heavy equipment or other equipment involved with the work that can leak oil (oil, fuel, hydraulic fluid, etc.)? Yes: The potential for contaminated media exists with incidental spills associated with refueling and other construction activities. Care should be exercised to prevent any spills. The Contractor shall be ready to respond to such incidents, clean them up per CEC direction and report the incident using an EIB. Notify the CEC should any materials become contaminated.
W8	Will concrete be placed for the project? Yes: A wash-out pit is required to be installed (with signage), utilized, and maintained by the contractor. An area for the wash-out pit will be designated for the work. The eCP shall ensure that drivers understand the wash-out procedures at the site and comply.

PUBLIC VERSION

Water - Continued

IURC DR 1-2 Attachment 2

W9 Will raw materials (soil, fly or bottom ash, limestone, etc.) be hauled in or off-site for the work?

Yes: Ensure all trucks are maintained and hydraulic hose connections checked for leaks. Leaky hoses or poorly maintained equipment are to be taken off-site. Trucks hauling raw materials may be required to cover or tarp the load to prevent fugitive emissions or the spilling of materials on the road.

W10 Is a laydown area needed for construction materials (steel, pipe, stockpiles, etc.)?

Yes: Laydown areas are to be designed and maintained to minimize stormwater runoff pollution. Including tarping, silt fencing, renewal of gravels, and repair of traffic damage when job is completed.

W11 Will pesticides or herbicides be applied?

Yes: The use of any pesticide or herbicide must be approved by AEP prior to use. Some applications may require licensed personnel.

W12 Does the work require working over, in or near waterways (river, stream, wetland, pond, etc.)?

Yes: Review process with CEC to determine if controls or further planning is necessary.

W13 Will asphalt or special coatings be applied?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

W14 Will the project require any drilling, boring or pile driving?

Yes: Review locations with the CEC, some may require the use of sediment and erosion control measures.

W15 Will any equipment/vehicles be washed at the project site?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

W16 Will hydrostatic tests be performed as a result of the work?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

Oil / Chemicals

O1 Will oil (of any kind; e.g. petroleum, fuel oil, synthetic oil, grease, etc.) or chemicals (solvents, paints, acids or bases) be stored on site as a result of the activity?

Yes: Provide SDS to CEC prior to mobilization. All containers shall be properly stored and labeled. Material usage information may be required to be submitted to the CEC monthly.

O2 Will any oil or chemical containers larger than 5 gallons need to be transported or moved to a different location once on-site?

No: N/A when issued. Notify the CEC immediately if any containers will be relocated once placed at the job site.

O3 Will more than 55 gallons of oil (petroleum/fuel oil, etc.) be stored on site?

Yes: An approved SPCC Plan is required prior to the mobilization of the tanks on site (see CG). Proof of tank registration with the State may be required, if applicable.

O4 Will more than 55 gallons of chemicals be stored on site?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

O5 Are any of the chemicals considered hazardous by DOT, OSHA, or the EPA?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

O6 Will there be any grinding, cutting or drilling that will use fluids as coolants or lubricants?

Yes: Grinding, cutting, and/or drilling waste will be collected, containerized and properly disposed. Secondary containment shall be used

O7 Will any containers or tanks be drained of oil (e.g. booster fans, transformers, ASTs)?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

O8 Will chemical metal cleaning be required on any tanks, structures, equipment?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

O9 Will any surfaces need to be painted?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

O10 Will any special coatings be applied?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

O11 Has written permission been given to leave partially used or unused chemical products behind?

No: The Contractor will not leave any unused, partially used or expired chemical or material product(s) behind without AEP's written permission. Any such products left behind after demobilization will be shipped back to the Contractor or disposed (if shipment is not an option) at the expense of the Contractor.

Land - Waste / Recycling

L1 Is the contractor responsible for disposal of general trash generated from the work?

Yes: All trash should be promptly placed in appropriate collection bins and covered when not in use.

L2 Will the work activities generate any construction and demolition debris (C&DD)?

Yes: C&DD shall only be disposed of in an AEP approved landfill.

L3 Does the work require the use of blasting media (blasting grit, sand, glass beads, aluminum oxide, corn cob, etc.)?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

L4 Will the work involve any known asbestos (caulking, tiles, fireproofing, insulation, wallboard, etc.) materials?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

PUBLIC VERSION

Land - Waste / Recycling Continued

IURC DR 1-2 Attachment 2

L5 Will the work involve any known lead (batteries, building materials and plumbing (pipe/solder), lamps, paint, painted materials, blasting grit waste, etc.)?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

L6 Will any work involve transformers, T/R sets, dielectric fluid filled equipment, or any known PCB containing equipment/materials (wires, caulking, paint, etc.)?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

L7 Will any work occur on any known mercury containing devices (batteries, lamps, manometers, mercoide pressure switches, mercury-wetted relays, mercury-filled switches, site gauges, thermometers, thermostats, etc.)?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

L8 Will the work involve Smoke Detectors, Tritium Exit Signs, Level Indicators (ash hoppers, belt lines, ash silos), Density Indicators (slurry lines, limestone piping), or Crossbelt Coal Analyzers?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

L9 Will the work involve an Electrostatic Precipitator, Coal Yard Steel, or Flyash Piping?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

L10 Is there the potential to generate non-hazardous waste (rinse water, hydrostatic test water, chemical metal cleaning waste, spent solvent, oily debris, etc.)?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

L11 Is there the potential to generate hazardous waste (Listed or Characteristic: ignitability, reactivity, corrosivity, toxicity)?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

L12 Will used oil be generated as a result of the work (equipment flushing, maintenance or repair)?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

L13 Will the Contractor be required to have an aerosol puncturing device for the disposal of aerosol cans?

Yes: The Contractor will be responsible for the disposal of the hazardous waste generated from the residue of puncturing the cans. Please consult with the CEC and include details with the Waste Management Plan.

L14 Is recycling of metal, plastics or wood required?

Yes: Containers shall be clearly labeled and designated for recycling. Recycling materials shall not be mixed with trash. The Contractor is expected to participate in the facilities recycling program (aluminum cans/plastic bottles), if applicable.

L15 Will the work activities generate universal wastes (batteries, spent pesticides, mercury thermostats, lamps/bulbs, etc.)?

Yes: All Universal Waste will be managed in accordance with state law and any guidance provided. Check with the CEC for a State list of potential items. All such waste will be the responsibility of the Contractor to properly containerize, label and transfer to the Plant for disposal. Instances where there are no options for Plant disposal the Contractor shall properly dispose of the waste and provide proper documentation of the waste to the CEC.

Sanitary Waste

S1 Will the Contractor be responsible for portalets at the project site?

Yes: The Contractor is to provide and maintain portalets and hand washing facilities, as necessary. Documentation (Contract, dump letter, haul tickets) shall be provided to the CEC prior to demobilization. Grey water is prohibited from being discharged on-site.

S2 Can holding tanks be used at the project site?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

S3 Is there hookup available to WWTP or POTW?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

S4 Will a septic system be installed as a result of the project and can it be utilized during construction?

No: N/A when issued. Notify the CEC if the scope changes or condition is applicable

Environmentally Sensitive Areas

E1 Have any surface waters (rivers, streams, wetlands, ponds, etc.) been identified within or near the project limits?

Yes: The Contractor shall coordinate work activities near environmentally sensitive areas with the CEC.

E2 Have any rare, threatened or endangered species or habitat been identified within or near the project limits?

No: There are no known rare, threatened or endangered species are near the project site.

E3 Are there any known historic or culturally significant areas near the project site?

No: There are no known archaeological sites are near the project site. Notify AEP Construction immediately in the event any artifacts are uncovered/discovered during the work.

E4 Are there any known preservation areas near the project site (prairie/meadow, woods, dune, stream, wetland, etc.)?

No: There are no known preservation areas near the project site.

E5 Is there a risk of bird mortality (power lines, transformers, towers, structures that can support nests, etc.) with the work?

No: Report any injured or dead animals to AEP construction.



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NEW GENERATION ENGINEERING SPECIFICATION COVER SHEET

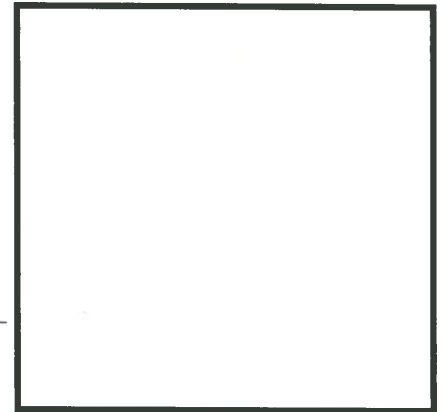
Specification Number: GEN4550
Revision: Rev 3
Date: 10/12/2018

TITLE: Solar Facility Technical Specification and Design Criteria

Scope of Changes:

Revision (Full Procedure)

Change Sheet, Affected pages: _____



P. E. Stamp, if required.

Summary of Changes: Added approved suppliers for solar panels and inverters

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Specification Owner (Organization): Electrical Systems & Equipment Eng.

Prepared by:	<u>C.A. Pérez</u> <i>CAKPj</i>	Date:	<u>10/12/18</u>
Reviewed by:	<u>Mark D. Shingleton</u> <i>msd.</i>	Date:	<u>10/12/18</u>
Reviewed by:	<u>D.C. Kehres</u> <i>D.C. Kehres</i>	Date:	<u>10/15/18</u>
Reviewed by:	<u>B.R. Puckett</u> <i>B.R. Puckett</i>	Date:	<u>10/12/18</u>

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1. The Commission shall determine whether the proposed rate of return is reasonable and consistent with the public interest. The Commission shall also determine whether the proposed rate of return is consistent with the rate of return on the equity capital of the utility.

2. The Commission shall determine whether the proposed rate of return is consistent with the rate of return on the equity capital of the utility. The Commission shall also determine whether the proposed rate of return is consistent with the public interest.

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6. The Commission shall determine whether the proposed rate of return is consistent with the public interest. The Commission shall also determine whether the proposed rate of return is consistent with the rate of return on the equity capital of the utility.

7. The Commission shall determine whether the proposed rate of return is consistent with the public interest. The Commission shall also determine whether the proposed rate of return is consistent with the rate of return on the equity capital of the utility. The Commission shall also determine whether the proposed rate of return is consistent with the public interest.

8. The Commission shall determine whether the proposed rate of return is consistent with the public interest. The Commission shall also determine whether the proposed rate of return is consistent with the rate of return on the equity capital of the utility.

9. The Commission shall determine whether the proposed rate of return is consistent with the public interest. The Commission shall also determine whether the proposed rate of return is consistent with the rate of return on the equity capital of the utility. The Commission shall also determine whether the proposed rate of return is consistent with the public interest. The Commission shall also determine whether the proposed rate of return is consistent with the rate of return on the equity capital of the utility.

10. The Commission shall determine whether the proposed rate of return is consistent with the public interest.

11. The Commission shall determine whether the proposed rate of return is consistent with the public interest. The Commission shall also determine whether the proposed rate of return is consistent with the rate of return on the equity capital of the utility.

12. The Commission shall determine whether the proposed rate of return is consistent with the public interest.

13. The Commission shall determine whether the proposed rate of return is consistent with the public interest. The Commission shall also determine whether the proposed rate of return is consistent with the rate of return on the equity capital of the utility.

Description of the Proposed Rate of Return	Rate of Return	Comments
The proposed rate of return is based on the rate of return on the equity capital of the utility.	The proposed rate of return is 10.0%.	The proposed rate of return is consistent with the public interest.



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- The Commission should consider the following factors when reviewing the proposed rate schedule:
 - The Commission should consider the proposed rate schedule's ability to recover the utility's reasonable costs of service.
 - The Commission should consider the proposed rate schedule's ability to provide a reasonable return on investment.
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The Commission should also consider the proposed rate schedule's ability to provide a reasonable rate of return on investment.

Item	Rate	Notes
Electricity
Gas
Water
Sewer
Waste
Telephone
Internet
Cable
Other



1.0 Introduction

The purpose of this report is to provide a detailed description of the project and its objectives. The project is a comprehensive study of the current state of the industry and to identify key areas for improvement. The study will involve a thorough review of existing data and a series of interviews with industry experts. The findings of the study will be used to develop a strategic plan that will guide the company's operations over the next five years. The plan will focus on increasing efficiency, reducing costs, and improving customer service. The study will also identify potential risks and opportunities and provide recommendations for how to address them. The results of the study will be presented in a series of reports and a final summary report. The study is being conducted by a team of experienced professionals who have a deep understanding of the industry and its challenges. The study is being conducted in a confidential and unbiased manner and the results will be made available to all stakeholders. The study is a critical component of the company's strategic planning process and will provide valuable insights into the future of the industry.

2.0 Background

The project is a result of a strategic initiative to improve the company's performance and competitiveness. The initiative was developed by the senior management team and is being implemented across all business units. The project is a key component of the company's long-term strategy and is expected to have a significant impact on the company's financial performance and market position.

3.0 Objectives and Scope

3.1 Objectives

The primary objective of the project is to identify the key areas for improvement and to develop a strategic plan that will address these areas. The project will also aim to identify potential risks and opportunities and provide recommendations for how to address them. The project will be conducted in a confidential and unbiased manner and the results will be made available to all stakeholders. The project is a critical component of the company's strategic planning process and will provide valuable insights into the future of the industry. The project will involve a thorough review of existing data and a series of interviews with industry experts. The findings of the study will be used to develop a strategic plan that will guide the company's operations over the next five years. The plan will focus on increasing efficiency, reducing costs, and improving customer service. The study will also identify potential risks and opportunities and provide recommendations for how to address them. The results of the study will be presented in a series of reports and a final summary report. The study is being conducted by a team of experienced professionals who have a deep understanding of the industry and its challenges. The study is being conducted in a confidential and unbiased manner and the results will be made available to all stakeholders. The study is a critical component of the company's strategic planning process and will provide valuable insights into the future of the industry.

3.2 Scope

The project will focus on the following areas: (1) Review of existing data and analysis of trends; (2) Interviews with industry experts; (3) Identification of key areas for improvement; (4) Development of a strategic plan; (5) Identification of potential risks and opportunities; (6) Recommendations for addressing risks and opportunities.

3.3 Methodology

The project will be conducted using a combination of qualitative and quantitative methods. The qualitative methods will include interviews with industry experts and a review of existing data. The quantitative methods will include statistical analysis of the data. The project will be conducted in a confidential and unbiased manner and the results will be made available to all stakeholders. The project is a critical component of the company's strategic planning process and will provide valuable insights into the future of the industry. The project will involve a thorough review of existing data and a series of interviews with industry experts. The findings of the study will be used to develop a strategic plan that will guide the company's operations over the next five years. The plan will focus on increasing efficiency, reducing costs, and improving customer service. The study will also identify potential risks and opportunities and provide recommendations for how to address them. The results of the study will be presented in a series of reports and a final summary report. The study is being conducted by a team of experienced professionals who have a deep understanding of the industry and its challenges. The study is being conducted in a confidential and unbiased manner and the results will be made available to all stakeholders. The study is a critical component of the company's strategic planning process and will provide valuable insights into the future of the industry.

Project Name	Report Title	Page 1 of 1
Project Name	Report Title	Page 1 of 1



1. Introduction

The following information is provided for your information. It is not intended to constitute an offer or a recommendation to buy or sell any securities. It is not intended to be used as a basis for investment decisions. It is not intended to be used as a substitute for professional advice. It is not intended to be used as a basis for any legal or tax advice. It is not intended to be used as a basis for any other financial or business advice.

2. Description of the Offering

The offering consists of the following securities: (a) Common Stock, (b) Preferred Stock, (c) Convertible Preferred Stock, (d) Warrants, (e) Units, (f) Bonds, (g) Debentures, (h) Notes, (i) Other securities. The offering is being made by the Company and is subject to the terms and conditions set forth in the prospectus.

The offering is being made for the purpose of raising capital for the Company's operations and expansion. The offering is being made on a non-exclusive basis and the Company reserves the right to offer additional securities in the future.

3. Risk Factors

The following are the principal risks that you should be aware of in connection with the offering: (a) Market risk, (b) Credit risk, (c) Liquidity risk, (d) Operational risk, (e) Regulatory risk, (f) Financial risk, (g) Other risks. The risks are described in detail in the prospectus.

4. Management and Directors

The following are the members of the Company's management and directors: (a) Name, (b) Position, (c) Business address, (d) Other positions held. The names and positions of the members of the Company's management and directors are listed in the prospectus.

5. Financial Information

The following is a summary of the Company's financial information: (a) Balance sheet, (b) Income statement, (c) Cash flow statement, (d) Other financial information. The financial information is presented in the prospectus.

The financial information is presented for the periods indicated in the prospectus. The financial information is presented on a consolidated basis and is subject to audit.

6. Dividend Policy

The Company's dividend policy is to pay dividends to the common stockholders of the Company. The dividends are paid on a quarterly basis and are subject to the discretion of the Board of Directors.

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7. Regulatory and Other Information

The following is a summary of the regulatory and other information: (a) Regulatory requirements, (b) Other information. The regulatory and other information is presented in the prospectus.

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Item	Amount	Percentage
Common Stock	\$100,000,000	100%
Preferred Stock	\$0	0%
Convertible Preferred Stock	\$0	0%
Warrants	\$0	0%
Units	\$0	0%
Bonds	\$0	0%
Debentures	\$0	0%
Notes	\$0	0%
Other securities	\$0	0%



**ELECTRICAL ENGINEERING
SPECIFICATION
COVER SHEET**

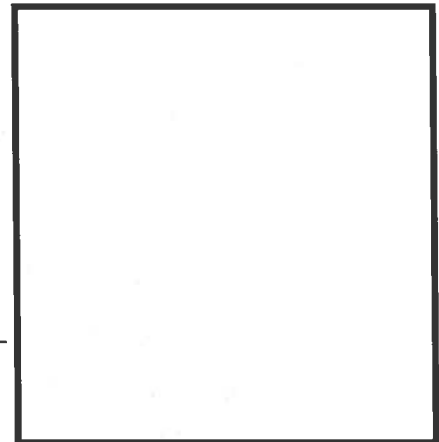
Specification Number: GEN-4018
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TITLE: General Specification for Power Transformers

Scope of Changes:

Revision (Full Procedure)

Change Sheet, Affected pages: _____



P. E. Stamp, if required.

Summary of Changes: Updated items throughout the entire specification.

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Specification Owner (Organization): Electrical Systems & Equipment Eng.

Prepared by: Aaron Hinze

Date: December 12, 2013

Reviewed by: Mark Samborsky

Date: December 12, 2013

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1. SCOPE

This specification covers all generator step-up and plant auxiliary transformers rated 100 MVA and above. This specification shall also apply to other transformers when cited by the Ordering Specification or contract documents.

This specification defines minimum requirements for design, construction, and performance. Seller shall follow good engineering and manufacturing practices to produce a transformer, including accessories, which in conjunction with normal maintenance will provide safe and reliable service through a 40-year life under the rigors of service in an electric utility power system.

2. TERMINOLOGY

2.1 Multi-Winding Transformer

A transformer that has more than two windings per phase. A transformer with a tertiary winding is considered to be a multi-winding transformer.

2.2 Split Winding Transformer

A multi-winding transformer that has at least two windings of identical voltage and power ratings.

2.3 Prototype Transformer

The first transformer of a series having identical design.

2.4 Abbreviations

P.U.	Per Unit
GSUT	Generator Step-up Transformer
AUTO	Autotransformer
OE	Owner's Engineer
EHV	Extra High Voltage (345 kV and Above)
MFR	Manufacturer
DETC	De-energized Tap Changer
IPB	Isolated phase Bus
LTC	Load Tap Changer

3. STANDARDS, OWNER'S SPECIFICATIONS AND REFERENCES

3.1 Industry Standards

3.1.1 Transformer Standards

Standards that apply (in order of precedence) shall be the latest revisions of ANSI/IEEE C57, NEMA TR-1, and IEC 76. The standard revision that applies shall be the latest edition published on the date the contract becomes effective.

NEMA TR-1 shall apply only to details not specified by ANSI/IEEE C57, and IEC shall apply to details not specified by ANSI/IEEE C57 or NEMA TR-1. Additional standards referenced by the three standards cited above shall apply in the same order of precedence, i.e. those standards referenced by ANSI/IEEE C57 precede those referenced by NEMA TR-1 and IEC 76.

3.1.2 Standards for Auxiliary, Control and Protection (ACP) Equipment

Standards, which apply, include the latest revisions of ANSI/IEEE C37.90, C37.90.1 and 37.90.2.

3.1.3 Other Standards

Other standards referenced within this specification shall apply with precedence over the IEC Standards only.

3.2 Owner's Specifications

All additional specifications provided by Owner in the request for quotation package shall apply. These shall always include the following AEP specifications and other requirements:

- 1) "Technical Requirements for Power Apparatus Bushings," No. SS-797001 dated August 30, 2013
- 2) AEP Ordering Specification
- 3) "EPFS Operating Instruction Vendor Document Submittal," Rev.0, dated June 8, 2011

3.3 Other References:

Other references in this specification include:

O. Petersons and S. P. Mehta, "Calibration of Test Systems for Measuring Power Losses of Transformers," National Bureau of Standards (NBS) Technical Note 1204, 1985.

4. SERVICE CONDITIONS

4.1 General

Service conditions shall be in accordance with 3.1.1 except as amended in Sections 4.2, 4.3, 4.4, and Ordering Specification.

4.2 Loading Above Nameplate MVA Rating

4.2.1 Loading Conditions

All transformers shall be capable of loading above nameplate MVA rating in accordance with the latest revision of IEEE C57.91. GSUTs shall be capable of loading at 1.1 times their nameplate MVA rating at maximum ambient temperature

required in **Section 4.6** for at least 8 hours with a preload of 100% at thermal equilibrium of the nameplate MVA rating. All other transformers shall be capable of loading in accordance with **Table 1**. These loading capabilities shall apply to all transformers for the following conditions: a preload of 90% at thermal equilibrium of nameplate MVA rating, a hottest spot temperature not to exceed 140 °C (referring to long time loading), a top oil temperature not to exceed 110 °C, and a 2 month loss of life per incident.

Table 1
Short Time Minimum Acceptable Loading Capability
P.U. of Nameplate MVA Rating

Ambient Temperature °C	Load in Per Unit of Nameplate Rating (Load Duration in Hours)				
	0.5	1.0	2.0	4.0	8.0
10	1.50	1.45	1.39	1.34	1.31
40	1.26	1.23	1.19	1.15	1.13
50	1.18	1.14	1.12	1.11	1.10

4.2.2 Ancillary Equipment

Ancillary equipment, such as bushings, tap changers, leads, etc. shall not limit the loading capability of the transformer. Seller shall provide Owner with derated MVA rating for loss of a cooler bank.

4.2.3 Loading of Multi-Winding Transformers

4.2.3.1 Input and Output Windings

Multi-winding transformers shall be capable of operation with any combination of winding loads and power flow directions, with the following limitations:

- 1) The arithmetic sum of loading capability(ies) of output winding(s) shall not exceed the arithmetic sum of the loading capability(ies) of input winding(s), as specified in **4.2.1**.
- 2) The loading capability of each output winding shall not be less than the loading capability specified in **4.2.1**.
- 3) Stabilizing delta windings (such as tertiary windings) with external terminals shall be designed for loading capabilities specified in **4.2.1**.

4.2.3.2 Load Phase Angles

For purposes of determining transformer-loading capabilities, all MVA loads shall be considered as in phase with one another. In addition, tertiary windings shall be capable to carry their rated MVA load at any load phase angle between -90° and 90°.

4.2.4 Power Flow Direction

Multi-winding transformers shall be designed for power flow in the step down or step up direction with loading capabilities and conditions as defined by 4.2.1 and 4.2.3.

4.3 GSUT Special Service Conditions

4.3.1 Back-Feed Operation

In addition to the usual step-up operation, GSUTs shall be capable of back feed (step down) operation with the high voltage terminals connected to the power grid. During back feed, the low voltage windings and terminals shall be capable of operation under the following non-simultaneous conditions:

- 1) Ungrounded low voltage terminals, disconnected from the generator bus;
- 2) Ungrounded low voltage terminals, connected to the generator bus and associated auxiliary devices (e.g., auxiliary power transformers, potential transformers, etc.), with the ground capacitance of the connected elements (typically 3000 pF per phase) providing the only coupling to ground;
- 3) One low voltage line terminal connected to ground and the remaining low voltage terminal(s) ungrounded and surge arrester terminated.

Conditions (1) and (2) above apply to three phase operation, and (3) applies to either three phase or single-phase operation. Conditions (2) and (3) above shall also be met with step down loading through a range of 0% to 30% of the nameplate MVA rating.

4.3.2 Low Voltage Bus Connection

Unless otherwise specified, GSUT low voltage bushing terminals shall be designed for connection to self-cooled or forced-cooled isolated phase bus (IPB), with the following maximum hottest spot temperatures:

- 1) IPB conductor: 105 °C
- 2) IPB duct air: 90 °C
- 3) IPB enclosure: 110 °C

4.3.3 Operating Capability at Voltages and Frequencies Different from the Nominal Values

Transformers shall be capable of continuous and short time operation at voltages above nameplate rated voltages and at frequencies below nominal 60 Hz. **Table 2** lists minimum acceptable continuous MVA ratings of the primary and secondary windings at V/Hz ratios above 1.0 P.U. for different MVA loads and power factors. Table 3 shows the minimum acceptable short time V/Hz ratios for unloaded and fully loaded conditions.

The tables specify minimum acceptable MVA operating capabilities at several possible V/Hz ratios in order to define a general curve for the operating capability at V/Hz ratios different of 1.0 P.U. The Seller shall insure the required MVA operating capabilities through all possible V/Hz ratios. The frequency range for which the tables apply is 5-66 Hz.

The following example illustrates application of **Tables 2 and 3**. For a load of 1.00 P.U. of maximum nameplate MVA at 0.8 lagging power factor, the overall V/Hz P.U. capability shall be 1.04 for five minutes (**Table 3**, column 3). This value multiplied by 1.125 or 1.07 (**Table 2**, columns 3 and 4) gives the primary or secondary V/Hz P.U. capabilities, respectively. Under this condition, the minimum V/Hz operating capability of the primary (supply) winding and secondary (load) winding shall be $1.04 \times 1.125 = 1.17$ P.U. and $1.04 \times 1.07 = 1.11$ P.U., respectively.

Table 2
Minimum Acceptable MVA Capabilities of the Primary and Secondary Windings of GSUTs for Continuous Operation at V/Hz Ratios above 1.0 P.U.

P. U. Load (x Max Rating)	Load Power Factor	Primary V/Hz (1) (x Tap Rating)	Secondary V/Hz(1) (x Tap Rating)
1	0.707 lag	1.125	1.06
1	0.8 lag	1.125	1.07
1	0.9 lag	1.125	1.085
1	0.95 lag	1.125	1.095
1	1	1.125	1.12
0	--	1.125	1.125
1	0.95 lead	1.1	1.125
1	0.9 lead	1.09	1.125
1	0.8 lead	1.075	1.125
1	0.707 lead	1.065	1.125

Table 3
Minimum Acceptable Short Time V/Hz Ratios for No-Load and Full Load Conditions

Duration (Minutes)	No-Load Condition (x Tap Rating)	Full Load Condition (x Table 2 Values)
0.1	1.4	1.24
0.25	1.325	1.18
0.5	1.275	1.13
1	1.235	1.1
2	1.2	1.07
5	1.175	1.04
10	1.16	1.03
30	1.15	1.02
60	1.14	1.015
120	1.135	1.01
300	1.13	1.005
≥600	1.125(1)	1

(1) Maximum Continuous Voltage shall be limited to values given in **Table 5**

4.4 Energization and De-energization

Transformers shall be capable of being energized or de-energized from any set of terminals as dictated by system operation requirements with or without load connected. The latter case will occur during system protective maneuvers such as line fault interruption and/or reclosing operations. Transformers shall also be capable of withstanding transients that may occur when fault currents are interrupted and/or chopped by the switching device used for transformer protection. Arresters will be connected at transmission line terminals during transformer operation. The characteristic of the switching device(s) to be used in conjunction with the transformer is available from OE upon request.

4.5 Through-Fault Withstand Capability:

The transformer will experience numerous through faults during its service life. The through fault withstand capability shall be in accordance with ANSI/IEEE C57.12.00. Data provided in Table 4 shall be used in the calculation of the transient and steady state values of the through faults. The X_1/R_1 ratio used in the through-fault calculations shall be equal to the transformer X_1/R_1 ratio or the values given in Table 4, whichever is greater. The fault at one terminal may be supplied from one or both unfaulted terminals of a multi-winding transformer.

**Table 4
System Parameters Specification for Through-Fault Conditions**

Nominal System, kV	Minimum X_1/R_1 Ratio	Asymmetrical Peak Factor, K	X_0/X Ratio
765	65	2.762	0.6
500	65	2.762	0.6
345	50	2.743	0.6
230	65	2.762	0.6
161	65	2.762	0.4
≤138	65	2.762	0.4

4.6 Ambient Temperature

The transformer shall be capable of operation through an ambient temperature range of -30 °C to +50 °C unless modified by Ordering Specification.

5. NAMEPLATE RATINGS**5.1 Frequency**

The rated (nominal) frequency shall be 60 Hz.

5.2 Temperature Rise and Loading Conditions**5.2.1 Winding Rise**

The average winding rise over ambient at nameplate MVA shall not exceed 65 °C. The winding hottest spot temperature rise shall not exceed 15 °C above the measured average winding rise. Hottest spot of internal leads and crossovers shall not exceed the winding hottest spot.

5.2.2 Oil Rise

The top oil temperature rise over ambient shall not exceed 65 °C.

5.2.3 Temperature Rise of Metallic Parts

The hottest spot temperature rise above ambient of metallic parts in contact with solid insulation other than those covered by 5.2.1 shall not exceed 80 °C. LV connections and bushing turrets shall not exceed maximum IPB temperatures described in 4.3.2. The rise above ambient of other metallic parts in contact with oil, including the tank, shall not exceed 100 °C at rated MVA.

5.2.4 Loading Conditions for Temperature Rise Limits

The loading conditions for which the above temperature limits apply shall be as described in applicable standards. The above temperature limits shall also apply for the operating conditions described in 4.3.3.

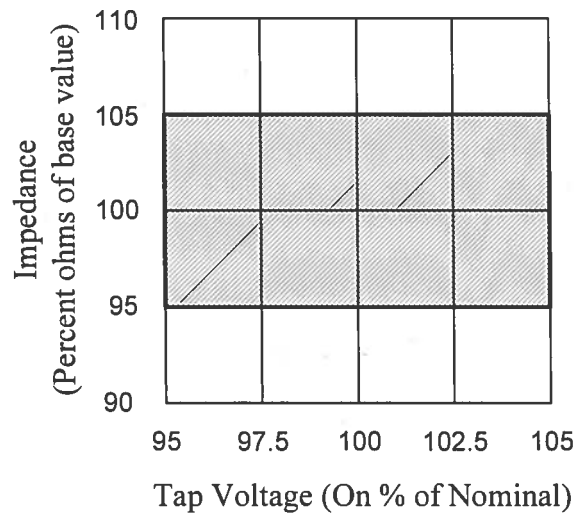
5.3 Nameplate Ratings in the Ordering Specification

The Ordering Specification shall indicate at least the following nameplate ratings:

1. Cooling Class
2. Number of phases
3. Number of windings per phase
4. MVA rating for each type of cooling
5. Voltage ratings and taps
6. Connections
7. Impedance value at each voltage tap position
8. CT ratio and ANSI accuracy

5.4 Tolerances on Impedance

The following requirement shall be met if specified either in the Ordering Specification or the request for bid letter: For any given tap voltage, the measured ohmic values of the HV/LV short-circuit impedance shall be within the 5% tolerance range specified **Figure 1**. The ohmic value of the HV/LV impedance at center tap in the Ordering Specification is the base impedance (the 100% value at the rated tap). For instance, a 450 MVA, 339/137.5 kV transformer with 10.5 % impedance has a HV/LV base impedance of 26.8 ohms at rated tap.



Allowable Tolerance Range for HV/LV Impedance

Figure 1

5.5 Polarity, Angular Displacement and Terminal Arrangement

5.5.1 General

Same phase winding polarity shall be subtractive. Angular displacement between phase voltages and the physical arrangement of the terminals (bushings) shall conform to applicable standards.

5.5.2 Single Phase Rating

Transformers with high voltage winding ratings 500 kV and above shall be of single-phase construction.

5.6 Insulation Levels

Table 5 specifies the relationship between minimum acceptable winding and bushing insulation levels and nominal system voltage. Minimum BIL of all neutral terminals and their bushings shall be 200 kV for grounded wye connected windings.

Table 5
Minimum Acceptable Insulation Levels at Line Terminals

Nominal System Voltage (kV rms, ω-ω)	Maximum Continuous Voltage (kV rms, ω-ω)	Minimum Winding/Bushing BIL (kV crest)
765	840	2050
500	551	1550
345	381	1050
230	253	900
161	177	750
138	152	650
69		350
46		250
34.5		200
25		200 ⁽¹⁾
≤15		200 ⁽¹⁾

(1) Applies to GSUTs with this nominal LV rating. These terminals shall be capable of 27.5 kV rms, continuous line-ground. Transformers other than GSUTs with nominal 25 kV windings/bushings shall have a 150 kV BIL, and 15kV or less windings/bushings shall have 110 kV BIL.

6. CONSTRUCTION REQUIREMENTS

6.1 General

This section describes general construction requirements. Construction requirements, in general, and accessories, in particular, be specified in the latest revision of ANSI C57.12.10, exceptions being when this specification, the Ordering Specification or ANSI C57.12.00 specifies different requirements. **Section 7** covers requirements for control and protection equipment and associated enclosures. In some specific cases, **Section 6** allows for the substitution of specified material by the term "or approved equivalent." If Seller proposes use of an equivalent, OE must be advised of the proposed change in writing. OE will either approve or disapprove the substitution in a written response. All material used or proposed for use in the transformer shall be tested and shall have passed the transformer oil compatibility test using the method outlined in ASTM D3455. All material shall be subject to rigid quality assurance and control standards and material quality assurance reports shall be made available upon request. The Seller shall have complete traceability on all material from receiving until final installation in the transformer.

6.2 Windings and Conductors

6.2.1 Materials and Winding type

Aluminum conductor material shall not be used for the windings or leads. Copper conductor is required for all windings. Windings shall be round, including disk, helical and layer. Layer windings shall have cooling liquid in direct contact with all turns.

6.2.2 Joints in Windings

Joints are permissible at locations external to the windings, specifically at crossovers between layers or disks. A joint is defined in this context as the physical joining of two or more separate winding conductors by means of welding, brazing, soldering, and crimping. Internal joints, i.e., joints made within the body of the winding layer or winding disk, are not permissible unless the joint involves a single strand of a multiple (at least five) strand conductor.

Seller shall have an effective quality assurance procedure for verifying that conductors are free from defects in joints and that conductor burr, nicks or indentations, dimensional tolerances and mechanical strength are within acceptable limits for the application.

Design of conductor joints and connections shall limit circulating currents and overheating such that abnormal aging or deterioration does not occur when the apparatus is operated within the scope of service conditions specified.

6.3 Tap Changer (TC)

The TC(s) design and application shall provide for the utmost reliability under all service conditions.

6.3.1 Dielectric Requirements.

The voltage withstand capability between TC contacts and between any contact and ground shall be greater than the worst case stress which would appear across the same points during impulse tests specified in **Section 9.6**. This design requirement applies to the condition where specified tests are performed at a tap position that results in the greatest stress in the TC. The power frequency voltage withstand capability of the tap changer between contacts and from each contact to ground shall likewise take into account the tap position during induced tests which results in the greatest stress between points.

6.3.2 Ampacity Requirements

The TC ampacity shall exceed that of the transformer under the service conditions specified in **Section 4**.

6.3.3 Thermal Requirements.

Insulation materials used in the TC shall be capable of operation in oil temperatures commensurate with the loading conditions specified in **Section 4**, without abnormal deterioration of their mechanical or dielectric properties.

6.3.4 Mechanical Requirements

TCs shall not be mounted on the tank wall, cover, or other location subject to deflection due to vacuum evacuation of the tank, or mechanical forces encountered in transport or service.

The drive mechanism shall have the following characteristics: operates easily, prevents incomplete tap change or movement beyond highest/lowest positions, prevents operation while energized, provides clear indication of current tap position, and provides for padlocking of the drive mechanism. A single tap changer operating mechanism is preferred. The drive mechanism handle shall be easily accessible, clearly visible and located at a practical height. If more than one drive mechanism is necessary, warning plates shall be located on or near each mechanism advising the operator that both mechanisms must be changed. Bolted connections to the tap changer shall be made with multiple hole pad connectors. Single or slotted hole connections are not acceptable. A notice on the main transformer nameplate is also required.

The TC design shall be such that contact pressure is not diminished during through-fault events.

6.4 Leads and Supports

Leads and lead supports shall be designed for all dielectric, mechanical, and thermal effects that could be encountered. The design shall not permit permanent deflection of supports and leads due to forces acting on the lead during transport or service. Tap leads and series or parallel crossover leads and supports shall be designed to provide significant safety margins above the worst case dielectric stresses which would occur during specified impulse and power frequency tests, as though specified tests were performed at each tap position. Similarly, line leads shall be designed to provide reasonable safety margins during these conditions.

Wooden members used for core, coil or lead supports shall be free from knots and other defects.

6.5 Clamping Structures

Clamping structures shall be designed for all dielectric, mechanical, and thermal effects that could be encountered. All transformer board required for the clamping structure shall be a composite material. Laminated wood is not acceptable.

6.6 Core Requirements

6.6.1 Burr Size

Maximum allowable burrs on a slit or cut edge of the electrical steel used in the core shall be less than the thickness of the insulation on the electrical steel laminations. Excessive slit edge damage during manufacture may result in rejection of the core.

6.6.2 Maximum Temperature

Maximum core temperature rise above top oil temperature rise is 20°C at rated voltage.

6.6.3 Grounding

Magnetic cores shall be directly grounded without any impedance or fuse-like elements connected in series.

All transformers shall have core grounds established outside the tank using a bushing with removable external ground connection. The main core shall be independently grounded. Auxiliary cores shall be tied together internally and the ground lead extended through a single separate bushing.

Either a NEMA 3R terminal box with removable cover or a suitable guard structure shall be used to protect core ground bushings and connections located on the tank wall from environmental and physical damage. The core ground bushing stud shall be at least 0.5 inch diameter. An easily removable copper strap shall be provided for the external ground connection. A warning plate shall be provided near this bushing stating, "Core Ground Must Always Be Connected When Equipment Is Energized."

6.7 Bushings

6.7.1 Applicable Specifications and Standards

Bushings shall conform to AEP Specification No. SS-797001 - Technical Requirements for Power Apparatus Bushings, and the latest versions of ANSI/IEEE Standards C57.19.00 and C57.19.01. For bushings less than 34.5 kV, minimum acceptable winding and bushings insulation levels listed in Table 5 shall be used.

6.7.2 Bushing Draw Lead Capability above Nameplate Rating

The MVA capability of bushing draw leads shall be at least 110 % of the transformer's maximum MVA nameplate rating and shall not limit the ability of the transformer's loading above nameplate MVA, as specified in **Section 4**. Seller shall provide information pertaining to draw leads per **Section 8.6**.

6.7.3 Lower End Connections

Bolted connections to the lower end of bushings shall be made with multiple hole terminals, tangs or spades. Single or slotted hole connections are not acceptable.

6.7.4 Draw Lead Conductor

The minimum draw lead conductor size shall be in accordance with the curves shown in **Figure 2**.

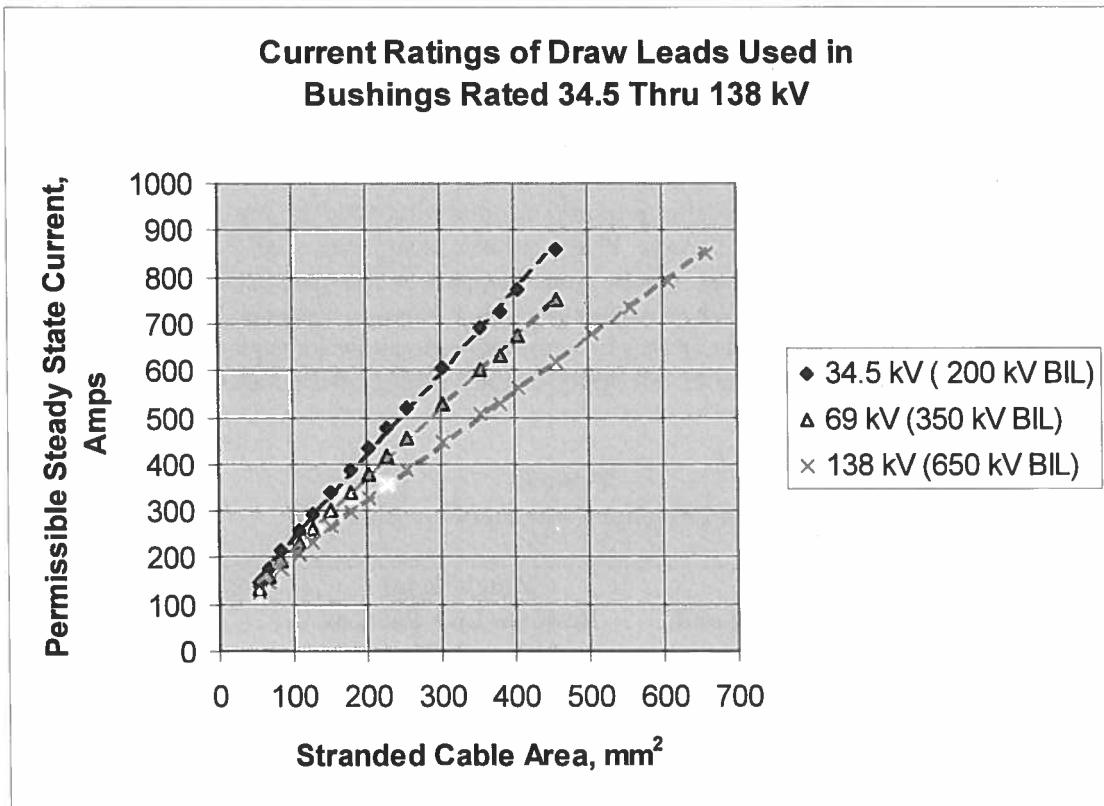


Figure 2
Recommended Cable Current vs. Cable Area

6.7.5 Top Terminal

The top terminal of all bushings rated 138 kV and above shall be capable of withstanding a moment of 800 ft-lbs applied while the terminal is installed on the bushing. The resultant loading shall not cause permanent deflection of the terminal or the bushing.

All top terminals with threaded studs on bushings rated greater than 1600 A shall have top terminals with 4 in. (102 mm) minimum useable thread length.

6.7.6 Bushing Stud Connectors

A NEMA 4-hole bushing stud connector, tin-plated, shall be supplied with each bushing. Exception: stud connectors not required for low voltage terminals on GSUTs.

6.8 Bushing Current Transformers (BCTs)

BCTs shall conform to ANSI/IEEE C57.13. They shall be mounted inside the transformer and shall be 5-tap multi-ratio unless otherwise specified.

Conductor for BCT secondary windings and leads shall have continuous ampacity of 10 amps on any tap for all anticipated top oil temperatures during loading conditions specified in **Section 4**. Further details of wire gauge and insulation are specified in **7.7.2**.

6.9 External Clearances and Dimensions

Table 6 specifies phase-ground and phase-phase clearances for each nominal operating voltage. This table also specifies required clearance between the top shed of the insulator of bushings of different phases. Phase-ground clearances shall also apply between terminals of different voltage levels, from live-part to live-part between the higher and lower voltage bushings. When calculating this clearance, assume the top of the lower voltage bushing cap extends 18 in. (457mm) higher to allow for typical cable connections to that bushing. **Table 6** does not apply to the bushing strike distances, which are the Seller's responsibility.

**Table 6
Minimum External Clearances for Bushings**

Nominal System Voltage	Metal-Metal Between Live Part and Ground		Metal-Metal Between Live Parts of Different Phases		Between Top Sheds of Bushing Sheds of Different Phases	
	(in)	(mm)	(in)	(mm)	(in)	(mm)
(kV)						
765	188	4775				
500	144	3658				
345	89	2261	100	2540	95	2413
230	63	1600	89	2261	71	1803
161	44	1118	57	1448	52	1321
138	37	939	(3)	(3)	(3)	(3)
69	23	585	(3)	(3)	(3)	(3)
46	15	381	(3)	(3)	(3)	(3)
34.5	12	305	(3)	(3)	(3)	(3)
25	8	203	(3)	(3)	(3)	(3)
15	6	153	(3)	(3)	5	127
≤5			(3)	(3)	(3)	(3)

- NOTES: 1. The values in column two will also apply for clearances between bushings of different voltage levels.
 2. The values in columns three and four shall be met simultaneously.
 3. These values shall be per Table 11 of IEEE Std. C57.12.00 for power transformers.

6.10 Surge Arrester (SA) Provisions

SAs shall not be supplied with the transformer. However, the related items specified in **6.10.1** through **6.10.3** below shall be provided.

6.10.1 Mounting Brackets

Tank mounted brackets for SAs shall be supplied on all high voltage side bushing terminals for GSUTs of all voltage classes. This requirement does not apply to

terminals that are specified to be within a bus duct enclosure or low voltage terminals of GSUTs.

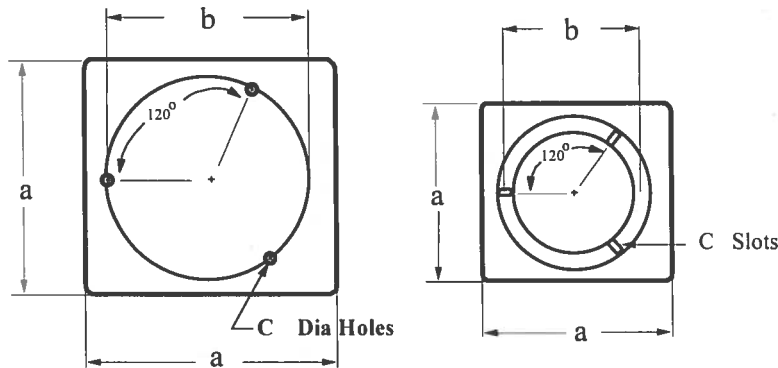
SA mounting brackets shall be spaced to provide phase-to-phase (centerline-centerline) and phase-to-ground (metal-metal) clearances specified in **Table 7**. **Table 7** also specifies minimum arrester heights (live part to ground). The bracket shall be positioned to ensure that the top terminal of the associated bushing is not higher than the minimum SA height.

Table 7
Minimum Clearances for Arresters

Nominal System Voltage (kV)	Phase-Phase		Phase-Ground		Minimum Arrester Height	
	(in)	(mm)	(in)	(mm)	(in)	(mm)
765			195	4953		
500			147	3602		
345	120	3048	95	2413	115	2921
230	92	2337	72	1829	86	2184
161	87	2210	60	1524	81	2057
138	70	1778	60	1524	60	1524
88	60	1524	50	1270	50	1270
69	40	1016	30	762	31	787
46	30	762	25	635	25	635
34.5	25	635	20	508	20	508
23	20	508	18	457	18	457
15	16	406	15	381	15	381
4	15	381	9	229	12	304

NOTE: The above clearances are for the arrester top metal terminals. Arresters for 345 kV and higher voltage systems may be made up of sections in which case the arrester column would have metal flanges equally spaced along the arrester.

Mounting brackets and plates shall be fabricated and drilled by Seller per **Figure 3** and **Table 8** to accommodate the SA's bolt circle diameter and support the arrester's weight. **Figure 3(a)** applies to terminals rated 500 kV and above and **Figure 3(b)** for all other terminal ratings. **Table 8** specifies minimum mounting base plate size and weight capacity for a given nominal operating voltage.



a) 500 kV and above (b) 345 kV and below
Arrester Mounting Bracket Detail
Figure 3

Table 8
Arrester Mounting Plate Size and Weight Capability

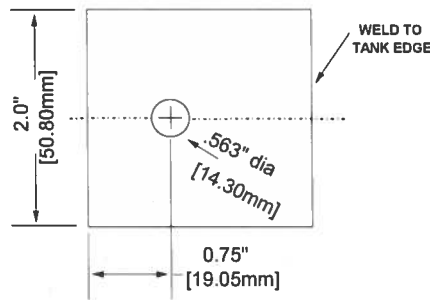
Nominal System Voltage (kV)	Minimum Plate Square, a		Mounting Flange Figure	Bolt Circle Diameter, b		Hole/Slot Size, c		Minimum Weight Capacity	
	(in)	(mm)		(in)	(mm)	(in)	(mm)	(lbs)	(kg)
765	25	635	2a	20	508	0.81	21	4000	1814
500	21.5	546	2a	16.5	419	0.81	21	2400	1089
345	18	457	2b	10	254	0.62 x 1.18	16 x 30	1250	568
230	18	457	2b	9.38	238	0.62 x 1.44	16 x 37	600	273
161	12	305	2b	9.38	238	0.62 x 1.44	16 x 37	575	263
138	12	305	2b	9.38	238	0.62 x 1.44	16 x 37	560	255
88	12	305	2b	9.38	238	0.62 x 1.44	16 x 37	425	194
69	12	305	2b	9.38	238	0.62 x 1.44	16 x 37	420	191
46	12	305	2b	9.38	238	0.62 x 1.44	16 x 37	196	90
23 & 34.5	12	305	2b	9.38	238	0.62 x 1.44	16 x 37	113	52
4 & 15	12	305	2b	9.38	238	0.62 x 1.44	16 x 37	70	32

6.10.2 Arrester Ground Pads

Transformers shall have one two hole NEMA ground pad located on the tank cover near each SA mounting bracket. Holes in pads shall be 1/2" UNC. Stainless steel pads are acceptable.

6.10.3 Cable Clamps

Clamps sized for #4/0 AWG cable shall be provided for each SA for Owner's installation of ground lead. The preferred method is to provide the 2" square tang, drilled to accommodate mounting clamps shown in **Figure 4**. These clamps should be located toward the right edge of the tank wall on which the SA brackets are mounted and spaced no more than 24 in (610 mm) apart.



Cable Clamp for Mounting Cable Figure 4

6.11 Bushing Potential Device (BPD) Brackets

Brackets for BPDs shall be supplied on transformers for each phase rated 138 kV and above. Brackets shall accommodate General Electric type KA-108 BPD and shall be located such that the centerline of the BPD is 60 ± 6 in. above the transformer base.

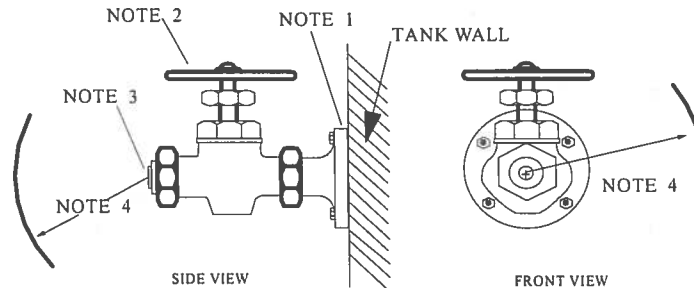
6.12 Dissolved Gas Monitor (DGM)

Plant auxiliary transformers shall require the Calisto 2 or GE Hydran M2, while generator step-up transformers require the Kelman Transfix/Hydran M2 system. The associated part numbers are listed below. The Calisto 2 and Kelman Transfix shall be located on the same side of the transformer as the control cabinet and the centerline of the DGM shall be 60 ± 6 inches or can be located on a separate stand provided by the OEM.

Model	Part Number	Description
Calisto 2	020-CALIS	Dissolved Gas Monitor
	003-PROBE	Precision Oil Temperature Probe
	SCAL-005	Isolation Valves
	HOS-00020	S.S. All Metal 3/8" ID Flexible Hose XX' Inlet and 20' Outlet Hose
Hydran M2	Hydran M2	Dissolved Gas Monitor
	16529	Qty. 2, 4-20mA Output Cards
	17046	Serial Ethernet Port (10/100T)

Transfix	Transfix 1.6	Dissolved Gas Monitor
		Ambient Temperature Sensor
	COMM01018	DNP3 over RS485
	COMM01010	Modbus ASCII/RTU over RS485 (2 or 4 wires)
	13-0256-01	Qty. 1, Analog input card PT1000 Temp Sensor
	12398	External Magnetic Mount Temp Sensor (4-20mA)
	24-0316-01	Sun Canopy
	COMM010087	16 Analog Outputs, 4-20mA

Seller shall provide two entry ports for the Kelman Transfix and Calisto 2, one for supply and the other for return. The supply port shall be located near the top of the transformer, while the return port shall be located near the bottom of the transformer. Seller shall provide one entry port for the Hydran M2. The ports shall allow access through the tank wall by means of an external cut coupling with 1 1/2 in. NPT threads and a matching pipe plug. The ports shall be located in a safely and easily accessible area when the transformer is energized, in an area of low electrical stress and of moderate to low, but not stagnant, oil flow. A 1 1/2 in. gate type valve shall be provided for each entry port. **Figure 5** illustrates the required arrangement of the entry ports and valves. At least 9 in. (229 mm) clearance to other transformer components shall be provided to allow for installation, removal or maintenance.



NOTES:

1. VALVE MAY BE MOUNTED VIA FLANGE OR ON MINIMUM LENGTH NIPPLE
2. 1 1/2" (BRONZE) GATE VALVE
3. 1 1/2" NPT PIPE PLUG
4. 9" MINIMUM CLEARANCE TO OTHER COMPONENTS

**Dissolved Gas Monitor Entry Port Detail
Figure 5**

6.13 Ground Connections

6.13.1 Tank Ground Pads

Four NEMA two hole ground pads for #4/0 AWG bare copper conductor shall be provided for tank grounding. A pad shall be located near each corner of the tank not more than 15 in. (381 mm) above the base. Holes in pads shall be 1/2" UNC. Stainless steel pads are acceptable.

6.13.2 Neutral Lead Clamping

For three phase units, clamps shall be provided to support Owner supplied #4/0 AWG bare copper conductor from neutral bushing down the tank wall. Single-phase transformers shall have clamps equally spaced but for use with an insulated neutral cable of #4/0 AWG size. 0.5 in. diameter threaded studs with 13 threads per inch, at least 1 in. (26 mm) long and spaced not more than 24 in. (610 mm) apart shall be used to allow adequate flexibility for various applications. These clamps should be located on the tank wall immediately below the neutral bushing or near a corner of the tank. Clamps can be mounted using tangs described in 6.10.3.

6.14 Valves and Fittings

Gate type valves shall be used for all valve applications except as described below. For radiators without pumps, flapper type valves are permissible on individual radiators provided that they allow complete isolation from the tank even when frequently used. Flapper valves are not acceptable for applications where multiple radiators feed into a manifold. Globe type fill and drain valves are permissible. Flapper valves are acceptable for isolating Buchholz relays.

Valves and fittings used for oil and gas piping shall be applied to retain their functional integrity throughout the life of the transformer even with frequent use. Pipe fittings and connectors shall be reusable and of heavy-duty construction. Valves shall be mounted on flanges with grooved retainers for gasketing. All valves shall have metal-to-metal internal seats. Valves and fittings shall have English unit dimensions and shall be manufactured in the USA.

6.15 Gaskets

Compressible gaskets shall be suitably retained in machined grooves. Metal stops or wire type gasket retainers shall not be used. Gaskets shall be Nitrile rubber except for the following special applications: Gaskets for high temperature flanges (above 110 °C maximum), flanges for bushings which are connected to a bus enclosure, or flanges for high current bushings (above 3000 Amps) shall be of fluorocarbon or fluorosilicone material, such as "Viton" or "Fluorel."

Gaskets shall maintain proper compression and effective seal throughout all operating temperatures and pressures that may be experienced under the service conditions specified in **Section 4**. Gaskets shall be made without joints. However, if a one-piece gasket is not available, the gasket shall have a vulcanized scarf joint. Butt splice joints are not acceptable.

6.16 Tank Construction

6.16.1 Tank Cover

The tank cover shall be welded to the main tank in combination with a suitable means to provide a complete seal at the tank/cover interface.

6.16.2 Tank Base

The tank base shall be designed to allow the transformer to be supported permanently by wood ties, steel beams, or concrete piers of 8 in. (203 mm) minimum width and spaced in a parallel fashion on a flat concrete foundation or directly upon a flat concrete foundation. Specific details will be identified in Ordering Specification.

6.16.3 Shipping Height Restrictions

Preferred maximum shipping height of transformers is 150 inches (3810mm). Exceptions must be approved by the OE. In order to obtain minimum practical shipping height, accessories located on top of the transformer should be removed or removable. Items such as: Arrestor brackets, CT termination boxes and core ground bushings shall not become the item that determines shipping height.

6.16.4 Jacking Points

Jacking points shall be in accordance with ANSI C57.12.10 except for transformers of weights over 200,000 lbs. (90,718 kg), the dimensions in Figure 3 of C57.12.10 shall be changed to A = 16 in. (406 mm) and B = 5.5 in. (140 mm). Pads shall be conveniently located, free of interference with ground connections, base supports, etc. Pads shall be supported against the main tank by at least two structural supports and shall be designed to support a fully assembled, oil-filled transformer. Transformer design shall be such that jacking points shall be accessible when the transformer is completely assembled.

6.16.5 Tank Shielding

Transformers that have currents in leads or bushings in excess of 3000 A shall have special provisions to shield the tank from the magnetic flux due to these high currents. Flux shunts, conducting screens or special tank wall construction shall be considered and the best solution to mitigate tank overheating shall be implemented.

6.16.6 Manholes

Manholes shall be provided for access into the tank. These manholes shall provide an opening of at least 20 in. (508 mm) diameter. If the manhole is not round, the minor and major dimensions shall be at least 18 in. (457 mm) and 22 in. (559 mm), respectively.

Manholes shall be located to provide reasonable access for internal inspection and maintenance, and to permit replacement of LV bushings without requiring personnel to entering tank.

6.16.7 Mounting for Fall Protection or Confined Space Rescue Equipment

Two (2) 9 in. x 9 in. plates with details and dimensions per **Figure 6** shall be welded to the tank cover for the purpose of attaching tether poles or confined space rescue equipment. Whenever possible, these plates shall be located near the manholes in the manner shown in **Figure 7**.

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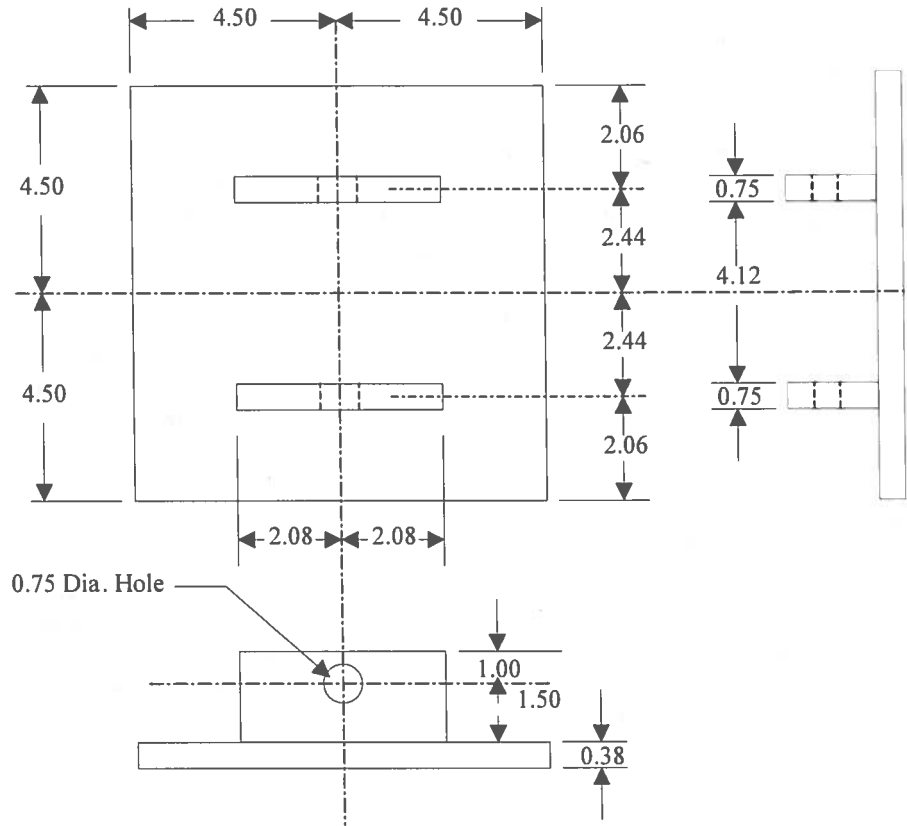


Figure 6
Plate Welded to Tank Cover for Attaching Tether Pole
or Confined Space Rescue Equipment

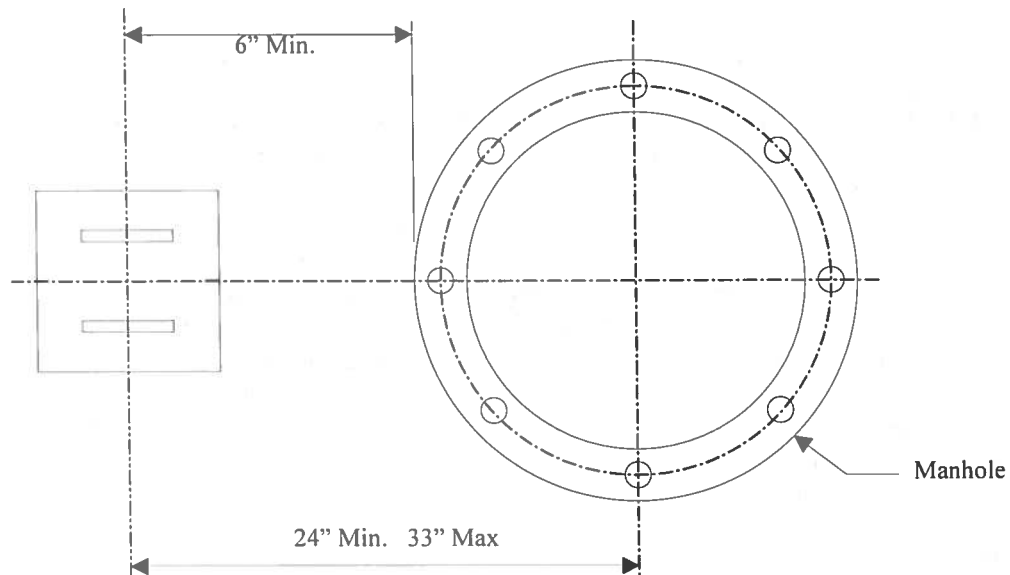


Figure 7
Placement of Welded Bracket Shown in Figure 6

6.17 Insulating Oil

6.17.1 Oil Characteristics

Seller shall certify that: 1) the insulating oil used in factory testing of the apparatus contains no detectable PCBs; and 2) the unit is PCB free. In addition, when Seller releases separate orders for delivery of oil for the subject apparatus, Seller must require the oil supplier to certify, upon delivery to the Owner's site, that the fluid contains less than 1.0 mg/kg (1.0 ppm) PCB. Certification shall be determined in accordance with Method ASTM D4059-86, Analysis of Polychlorinated Biphenyls in Mineral Insulating Oils by Gas Chromatography, or latest revision. Upon request, Seller shall provide a report of all cleaning and filling procedures including analytical tests and quality control measures to assure conformance to such specification.

6.17.2 Oil Specification

Approved suppliers of oil are identified in the Ordering Specification. Oil shall meet DOBLE Transformer Oil Purchase Specification which is more specific than Appendix D of ANSI C57.12.12. The Doble modified corrosive sulfur test, ASTM D 1275-03 shall be performed. Seller shall also provide a copy of their oil specification in the Instruction Book.

6.17.3 Oil Specimen

Upon OE's request, seller shall ship an oil sample, taken from each tanker truck prior to oil fill of transformer, in a four quart, non-returnable glass containers for test at the Owner's Laboratory or Laboratory of choice

6.18 Insulating Oil Preservation System (IOPS)

The IOPS shall function over a top oil temperature range of at least -30 °C to +120 °C and shall accommodate oil volume changes during all operating conditions cited in **Section 4.2**. All transformers shall be equipped with a conservator/diaphragm IOPS with an air cell and dehydrating breather. The IOPS shall maintain an oil level under the above conditions such that the transformer's highest oil-filled points (e.g., bushing adapters, gas detector, mechanical relief, etc.) are kept at atmospheric or greater pressure at all times.

The minimum diameter of the pipe connecting the expansion tank to the main tank shall be 3 in. (77 mm). Nonmetallic flexible hose is not acceptable. The air cell mounting shall permit access, especially during initial installation and oil filling, by a 0.375 in. (10 mm) diameter wooden rod used to confirm the oil level. Seller shall provide temperature correction curves for the proper oil level below the air cell flange in the instruction book/assembly instructions. The conservator shall not be located on the same segment as the line terminals.

6.19 Paint

Tanks and fittings shall be painted "Sky Blue Gray" as described by Munsell No. 5.0 BG 7.0/0.4 or ANSI 70. The surface shall be prepared to remove all contamination or residue

by solvent washing. The following paint applications are required (in order): One rust inhibiting prime coat, 0.002 in. (0.05 mm) dry thickness; two finish coats, 0.002 in. (0.05 mm) dry thickness each. Hence, the aggregate film thickness of primer and finish coats shall be 0.006 in. (0.15 mm). Contamination of the paint with water, oil or other materials shall be avoided. Paint shall not be applied to surfaces which are above 50 °C, or when ambient air temperature is below 5 °C during painting or expected to fall below 0 °C before the paint dries.

Touch-up paint shall be provided along with the appropriate MSDS(s) for post installation.

6.20 Factory Assembly

The transformer shall be completely assembled in the factory to: insure that all parts are available, functional and fit correctly; to verify adequate electrical clearances during testing; and to allow OE to inspect the assembled transformer at the time of factory test.

7. AUXILIARIES, CONTROL AND PROTECTION (ACP)

7.1 General

ACP accessories and devices shall be made in the United States or Canada, with English units, so that replacement parts can be easily obtained. Sellers wishing to use other accessories and devices shall prepare a written request to OE including a proposed substitute and a brief description of the reason for substitution. The OE shall then approve or deny the requested substitution within a reasonable time. Since substitutions may be rejected by OE, it is recommended that Seller submit such a proposal at the bid stage or as early as possible after he has received a contract.

Removal of any ACP equipment (except for oil level indicators) shall not require draining oil from the main tank. All items in contact with the oil shall have isolating (gate) valves such that minimal oil is lost in order to remove the item.

7.2 Auxiliary and Control Power

Owner will supply two sources of auxiliary ac power for fans and pumps externally. The Ordering Specification will indicate the power source configuration available. Each supply shall be of sufficient capacity to supply all coolers and associated control circuitry. Seller's ac auxiliary equipment shall be suitable for operation through a range of $\pm 10\%$ of the auxiliary supply voltage specified by the Ordering Specification. Seller shall include on control schematic maximum power requirements and starting currents that power sources must supply.

The Ordering Specification shall state the available dc control and annunciation power provided by Owner. Seller's dc equipment shall be suitable for operation through a range of 80 to 112 % of the voltage specified in the Ordering Specification.

A separate 120VAC source shall be supplied by customer to power ancillary equipment such as temperature and gas monitoring systems.

7.3 Cooling Controls

Seller shall provide a control scheme (see Figure 8 for an example) as specified in the Owner's control elementary drawing identified in the Ordering Specification. If cooling class is not specified, the Seller shall indicate the proposed type of cooling and request the appropriate cooling schematic drawing from the Owner.

Owner will provide a second (or emergency) source of auxiliary power (per **Section 7.2**). Seller shall supply suitable controls for time-delayed automatic transfer, in the event of loss of one of the power sources. The automatic transfer switch shall be mechanically interlocked, with undervoltage and overcurrent protection, and fault isolation in accordance with the latest revision of the Owner's control elementary. The time delay shall be provided by an Agastat type 7012 relay provided by the Seller.

The control circuit shall be arranged both electrically and physically such that a single fault shall not cause the loss of more than half the cooling system. Alarms shall be provided to indicate loss of either power supply at any time. A barrier will separate the duplicate power supplies.

The cooling equipment shall be controlled by the winding hot-spot temperature relays as specified in **7.5.3.2**. No dc relays shall be used in the cooling control circuits.

One-half of the cooler groups, "Group 1", shall have as its normal supply the first Owner supplied power source. The other half of the cooler groups, "Group 2", shall have as its normal supply the second Owner supplied power source. Each cooling group's fans shall be divided into subgroups with breakers provided for each subgroup. The subgroup cannot exceed one-fourth of the cooling group. When less than four fans are used per cooling group, each fan shall have its own breaker.

Each pump or fan motor 2.0 Horsepower (HP), or larger, must have its own individual NEMA rated full-voltage, non-reversing (FVNR) magnetic motor starter with integral thermal overload relay. Each starter must be supplied with two N.O. and two N.C. auxiliary contacts.

A three position selector switch shall be provided by the Seller for cooling fan and pump operation and shall be mounted at a convenient elevation in the control cabinet, 45 to 66 in. (1145 to 1675 mm) above the base of the transformer. This switch shall be provided with "Group 1", "Manual", and "Group 2" positions such that it allows the Owner flexibility in what cooling banks are in operation. For instance, if "Group 1" were selected, Group 1 cooling group would be operational and Group 2 would be triggered from the winding hot spot and top oil temperature monitor in **7.5.3.3** and vice versa. "Manual" shall allow both Group 1 and Group 2 cooling banks to be operated simultaneously. The selector switch shall be operable by hand with no tools required

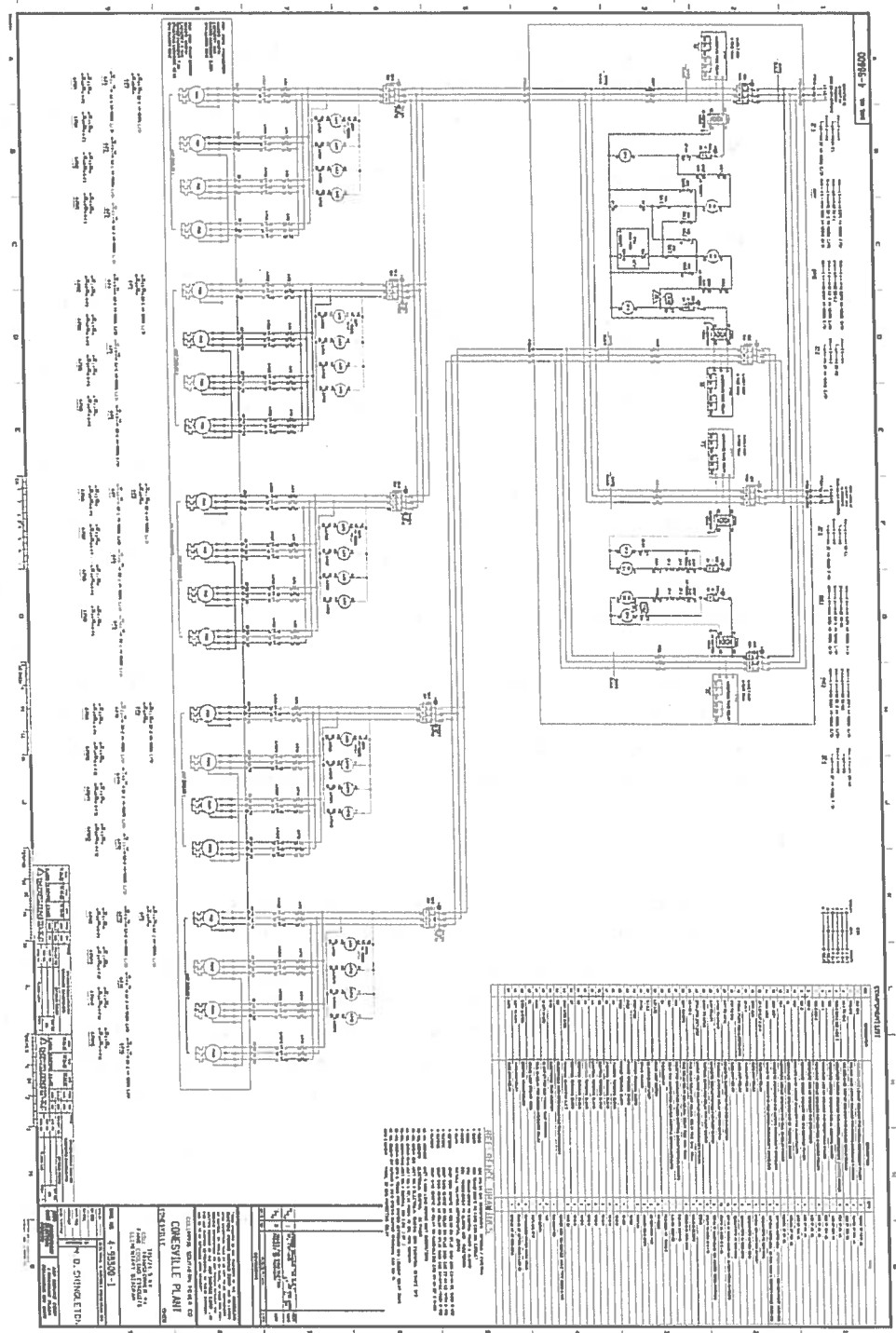


Figure 8
Typical Cooling Elementary

7.4 Cooling Equipment

7.4.1 General

All cooling equipment shall be suitably designed and applied for both continuous and intermittent operation, outdoors, in a harsh environment, rated for 50°C ambient temperature, and shall be capable of simultaneous operation at any time without restrictions. All fan and pump motors shall be "across the line" start induction motors.

7.4.2 Fans and Fan Motors

Fan motors shall conform to the latest revision of NEMA MG-1-10.37 and shall have these physical features: NEMA frame sizes with unaltered mounting dimensions and shaft extensions; totally enclosed, fan-cooled (TEFC) construction; steel end bells; corrosion resistant paint; copper conductors in both rotor and stator windings; service factor of 1.15 or greater; class F insulation or better; heavy duty external leads with crimped connections to stator winding leads; ball bearings with a V-ring shaft slinger and a shaft lip seal. If vertically mounted, they shall be designed for the added thrust loading which results. Fan motors shall not have centrifugal switches or internal thermal protection elements. Fans shall be mounted on a hinged swing panel for ease of maintenance. Unifin, ForZair™ or OE approved equivalent shall be provided.

Fan blades shall not be subject to fatigue or deterioration from the operating environment described in 7.4.1. Blades of an epoxy bonded fiber material or similar synthetic compound shall not be used unless suitable means have been made to protect them from ultraviolet light degradation.

7.4.3 Pumps

When forced oil cooling is used, Seller shall supply a valve on either side of each pump which allows the pump to be isolated without removing main tank oil or the oil in the remainder of the cooler and piping connected to each pump. Pumps shall have metallic sleeve bearings and shall be located at the inlet side (top) of the coolers. Preferred pump designs are J.W. Harley or Harley by Cardinal with a TecSonics bearing wear-indicating system. Pumps shall be designed to run continuously to avoid wear from cycling the pumps on and off.

7.4.4 Motor Connections

Power cables from pump and fan motors shall be provided with connectors that allow simple disconnection and are located not higher than 72 in. (1830 mm) above the tank base.

7.4.5 Coolers and Radiators

Valves shall be provided for isolating and removing each cooler or radiator and, where applicable, the cooling pumps.

7.5 Tank Mounted Indicators and Devices

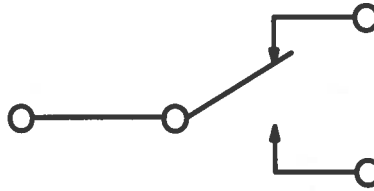
Table 9 specifies ACP devices that Seller shall provide as well as requirements for contacts and mounting heights of device gauges. The design, location, mounting and wiring of tank mounted indicators and devices shall be such that vibration does not result in their damage or malfunction. Temperature indicators shall have quick disconnection cables located at an accessible height. Terminal points shall be provided for each contact in the control box. All indicators shall be installed in such a manner that they are unobstructed by coolers or other devices and are readable from ground elevation.

Capillary tube devices shall be suitably mounted and guarded to avoid damage during transport, installation, maintenance, and service conditions.

Some devices are specified in **Table 9** to have a form "C" contact. A schematic description of this contact is shown in **Figure 9**. If a "C" contact is not available, one A (Normally Open, N.O.) and one B (Normally Closed, N.C.) contact can be substituted to provide the functionality of **Figure 9**.

Table 9
Control and Protection Device Requirements

Device	Contact Description	Mounting Height of Gauge Face	
		(in)	(mm)
Oil level gauge	1 - Form C	On conservator	
Oil flow indicators (forced-oil cooling only)	1 - Form C	At Cooler Port	
Oil temperature gauge	1 - Form C	45-70	1143-1778
Winding temperature gauge	4 - Form C	45-70	1143-1778
Winding hot spot and top oil temperature monitor	10 Relays Programmable	45-70	1143-1778
Mechanical pressure relief device	1 - Form C	Top cover	
Bucholz relay	1 - Form C	N/A	
Calisto 2	5 - NO/NC	N/A	
Hydran M2	4 - NO/NC	N/A	
Kelman Transfix	8 - NO/NC	N/A	



**Form "C" Contact
Schematic Description
Figure 9**

7.5.1 Oil Level Gauge

Contacts shall be wired directly into the control cabinet. QUALITROL is the preferred brand.

7.5.2 Oil Flow Indicators

Vane type oil flow indicators are required for transformers with forced oil cooling and shall be located at the bottom (discharge) end of the coolers. Differential pressure flow indicators are not acceptable. Flow indicators shall be selected and applied such that they provide correct flow indication throughout all ranges of service conditions specified. QUALITROL is the preferred supplier.

7.5.3 Temperature Indicators

7.5.3.1 Oil Temperature Gauge

Oil temperature gauge shall have two separate adjustable output contacts for "high" alarm and "extra high" alarm temperature indication. QUALITROL is the preferred supplier. This gauge shall also be used to alarm as described in 7.6.5.

7.5.3.2 Winding Temperature Gauge

Winding temperature gauge shall have at least two separate adjustable output contacts for "high" alarm and "extra high" alarm temperature indication. QUALITROL is the preferred supplier. This gauge shall also be used to alarm as described in 7.6.5.

7.5.3.3 Winding Hot Spot and Top Oil Temperature Monitor

The required winding hot spot and top oil temperature monitor is a QUALITROL ITM (Intelligent Transformer Monitor) with 120 Vac supply, 4 to 20 mA analog output range, and analog readout. ITMs shall be either separate enclosures or mounted in the control cabinet with a glass in the control cabinet door such that the readout can be read without opening the door. Model numbers are shown in **Table 10**. Winding

temperature indicators shall be provided in each phase of GSUT bank comprised of single-phase transformers or in the center phase of three-phase transformers. Multi-winding transformers shall have one winding temperature indication for each winding. Calculated winding temperature is preferred using CT compensation.

The QUALITROL ITM shall be used to initiate the cooling groups as prescribed in **Section 7.3**. The QUALITROL ITM shall also be used to alarm as described in **7.6.5**.

Table 10
Style Numbers for QUALITROL Analog Display, 120 VAC Supply Electronic Temperature Monitors

Type of Transformer		Number of Currents	Panel Mount	Separate Enclosure
Three Winding	1 and 3 Phase Multi-winding	3	ITM509-00047577	ITM509-00047581
Two Winding	1 Phase and 3 Phase GSUs, Two Winding Transformers	1	ITM509-00047578	ITM509-00047584

Note: All monitors have 4-20 mA output

7.5.3.4 Temperature Settings

Set points and temperature settings of the contacts associated with temperature indicators shall be as shown in **Table 11**.

Table 11
Set Points and Settings of Contacts Associated with Temperature Indicators

Set point	Description	Temperature Settings (°C)	
		ONAN/ONAF/ONAF	OFAF/OFAF
1	Liquid Temperature High	95	
2	Liquid Temperature Extremely High	105	
3	Cooling Group 1	80	
4	Cooling Group 2	90	75
5	Winding Temperature High	115	
6	Winding Temperature Extremely High	130	

7.5.4 Mechanical Pressure Relief Device

QUALITROL Type XPRD is the preferred device.

7.5.5 Buchholz Relay

Approved Buchholz relay types are QUALITROL VEM-EMB Type 9-25-315 or a Siemens Buchholz. Buchholz relays shall have an 80 mm bore, 160 mm mounting

bolt circle with 18 mm bolt holes and shall have one normally open and one normally closed contact on the lower switching system.

The device shall be furnished without seal-in relays, and mounted in accordance with the relay manufacturer's recommendations.

7.6 Devices in Control Cabinets

7.6.1 General

Design, location, mounting and wiring of ACP devices in the control cabinet shall be such that vibration does not cause damage to or malfunction of the devices. The power supply connections shall be either guarded or suitably located to prevent a shock hazard to personnel working on the control box. To accomplish this, devices shall be grouped together according to their voltage and the ampacity of their associated cables such that higher voltage devices and high ampacity conductors/terminations are grouped together in one section of the cabinet away from the low power devices operating at lower voltages. Additionally, devices that are energized at 260 V and above shall be shielded by transparent barriers which facilitates visual inspection of the equipment but yet guards against accidental contact or flashover initiation while working on the low power or low voltage equipment.

7.6.2 Device Mounting

No control and protection equipment shall be mounted directly on the cabinet's external walls. Suitable mounting plates shall be provided for mounting all equipment. These plates shall not be mounted with fasteners that penetrate the cabinet wall. All devices, wiring and terminals in the cabinet shall be accessible while the transformer is in operation. As much as practicable, the devices and terminals should be within reach from the ground level, without a ladder.

7.6.3 Device Characteristics

All devices are subject to approval by OE. Some relays and other devices are specified by the Owner's control elementary, 7.6.4, 7.6.5, and Table 13. The following additional device characteristics are specified:

- 1) Circuit breakers shall be thermal magnetic type. Motor circuit protectors (MCPs) are acceptable alternatives to circuit breakers for individual motor loads.
- 2) Motor starters for loads above 2 kW shall be NEMA rated full-voltage, non-reversing (FVNR) magnetic starters and shall have eutectic type thermal overloads.

7.6.4 Control Switches

GE SB1 or Electroswitch 24 Series shall be provided.

7.6.5 Fuses

All fuses shall be Bussman Superlag renewable type. Minimum current rating shall be 5 A except for protection of electronic components. Glass cartridge type fuses to 10 A may be used in electronic panels for non-critical applications.

7.6.6 Auxiliary Relays

GE Century type HGA auxiliary relays shall be provided for all of devices listed in **Section 7.5** except the oil flow switches and the sudden pressure switches.

An Agastat type 7012 \underline{x} D (where \underline{x} is a variable dependent of the voltage specified in Ordering Specification) relay shall be provided for the flow switches. A flow switch for each pump shall be wired in series with a N.O. contact from the respective pump. This series combination for each pump shall then be paralleled with all other pumps for the transformer. This parallel combination shall be wired in series with the coil of the Agastat relay mentioned above.

A GE Century type HGA auxiliary relay shall be provided to monitor the voltage of the power sources for the cooling control. N.C. contacts from each of the Normal and Emergency voltage relays shown in Owner's control elementary drawing shall be used to alarm on loss of either power supply discussed in **Section 7.3**.

HGA Century type auxiliary relays shall be provided for each of the winding temperature, oil temperature, and system state outputs of the ITM device provided for under **7.5.3.2**.

HGA Century type auxiliary relays shall be provided for alarm outputs, including system fail, of the gas monitor device that is specified in the Ordering Specification.

All of the above mentioned HGA and Agastat relays shall have a contact wired in parallel to form an alarm bus. A GE Century type HGA auxiliary relay shall be provided to monitor the alarm bus voltage. A two (2) pole breaker shall be provided for supply of this alarm bus. Customer will provide the power source for the alarm bus. One (1) N.C. contact from each of the HGA and Agastat relays shall be wired in parallel and then this parallel combination shall be wired in series with a red indicating light for alarm indication. This light is to be located locally at the control panel. In addition, terminal points are to be provided for remote alarm indication. The second N.C. contact from each of the HGA and Agastat relays is to be wired to terminal blocks for use with the plant annunciators. Voltage rating of the relays will be specified in the Ordering Specification.

7.7 Wiring and Terminations

7.7.1 General

All wiring shall be brought to a central control cabinet, in a neat and orderly arrangement, suitably protected from weather, dust, vibration, electric and magnetic fields (EMF), mechanical and thermal damage. Control and instrument wiring, alarm leads and BCT tap leads shall be terminated at terminal blocks

located in the cabinet. No splices are permitted in the BCT or control circuits. All wiring for transformer mounted devices shall be installed in rigid galvanized conduit or shall be interlocked armor.

7.7.2 Wire Gauge

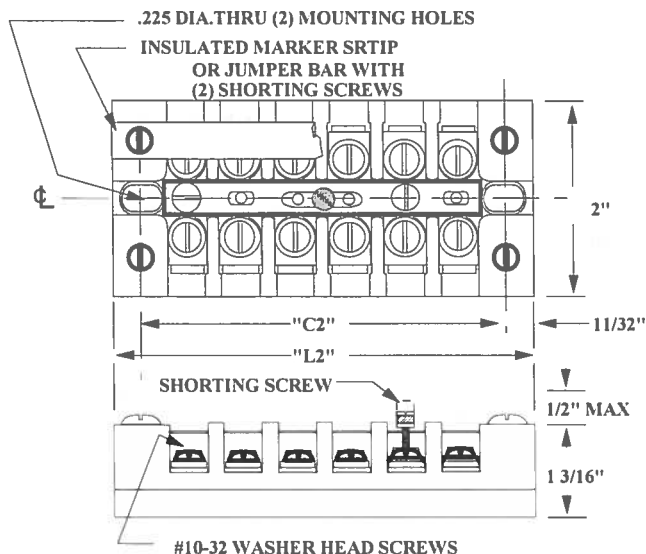
BCT secondary leads and wiring shall be 600 V, stranded copper, 125 °C, Tefzel, or approved equivalent insulation. Minimum acceptable wire size shall 14 AWG for BCT secondary leads. Other power wiring shall be 600 V, stranded copper, 90 °C, cross-linked polyethylene (XLP), or approved equivalent insulation. Minimum acceptable wire size shall be #12 AWG for power wiring. All other protection and control wiring shall be 600 V, stranded copper, 90 °C SIS or approved equivalent. Minimum acceptable wire size shall be # 16 AWG for electronic devices. Note that these are minimum sizes. Proper sizing must consider loading and ambient conditions. The National Electrical Code (NFPA 70) is recommended for guidance.

7.7.3 Connection Terminals

All terminations shall be made with insulated, eye type, extruded barrel, and compression connectors. Required connection terminals are Burndy type YAEV-10 or their approved equivalent. Should smaller conductor be permitted for special applications YAEV-14 terminals or approved equivalent shall be used. Connectors with split barrels, or for light duty, or of appliance or fork type terminals are never acceptable. All compression terminations shall be made with the tool specified by the connector supplier.

7.7.4 Terminal Blocks

All terminal blocks shall be removable screw or stud type. Compression type blocks are not acceptable. Short-circuiting type terminal blocks shall be furnished for shorting and grounding all BCT leads. Non-short circuiting type terminal blocks shall be furnished for terminating all control and protection leads. Only approved terminal blocks, as listed in **Table 12**, are permitted for control and protection. Substitutions will not be accepted unless approved in writing by OE. **Figure 10** details the physical dimensions of the approved control terminal blocks.



Number of Points	Dimensions (in)	
	C2	L2
4	3-1/8	3-3/16
6	4-7/16	5-1/8
8	5-3/4	6-7/16
12	8-3/8	9-1/16

**Terminal Block Dimensions
Figure 10**

Three-phase power terminal blocks for maximum loads above 30 A shall be Marathon type 1433561-CU, 3-pole, 230 A block with a 3/8" stud on the source side and a 1/4" stud on the load side with clear plastic cover.

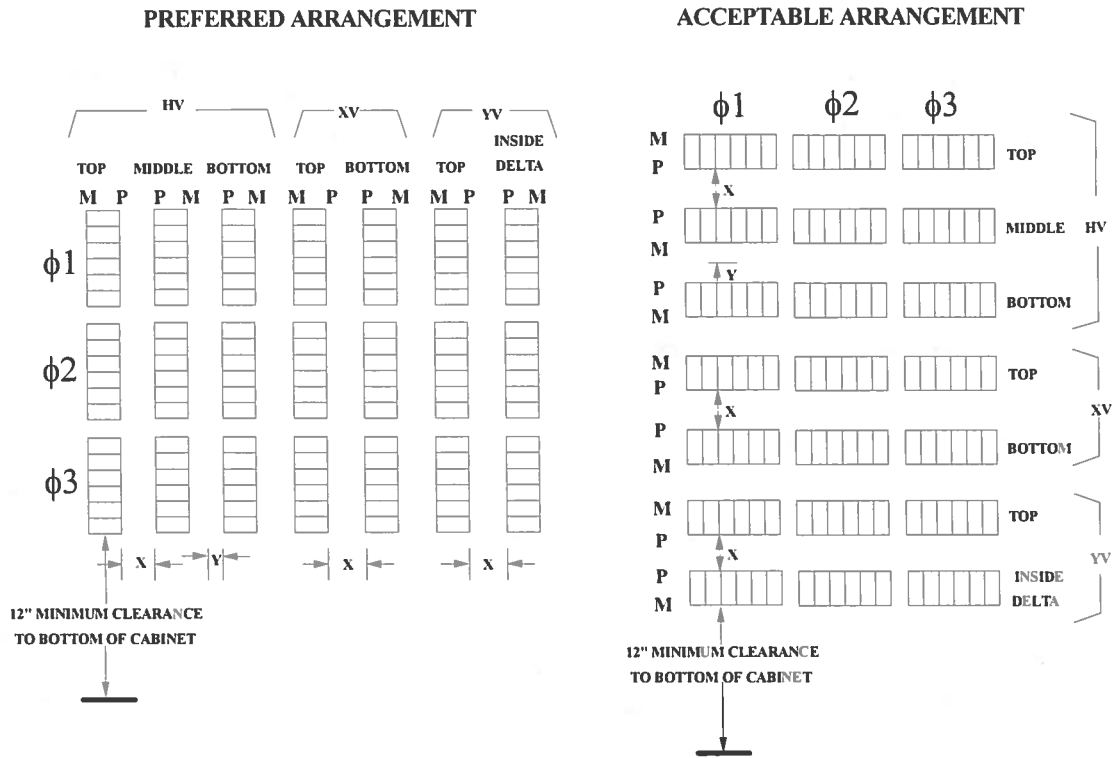
**Table 12
Approved Control Terminal Blocks**

Number of Points	BCT Leads (Short-Circuiting Type)		Control and Protection Leads (Non-Short-Circuiting Type)	
	Penn-Union Catalog Number	Marathon Catalog Number	Penn-Union Catalog Number	Marathon Catalog Number
4	6004-SCS	1604920	6004	1604921
6	6006-SCS	1606920	6006	1606921
8	6008-SCS	1608920	6008	1608921
12	6012-SCS	1612920	6012	1612921

Note: Figure 10 shows the physical detail of terminal blocks with the above catalog numbers.

7.7.5 Terminal Block Arrangement

BCT blocks shall be assigned specific locations and have individual identifications in the control cabinet and shall be arranged in one of the two acceptable methods shown in Figure 11, preferably in the arrangement shown on the left-hand side. The "top" BCT position is the one nearest to the external terminal and the "bottom" position is nearest the winding. A minimum clearance of 12 in. (305 mm) is required between the bottom of the terminal blocks (specified in Section 7.6.4) and the bottom of the control box. Minimum clearance between terminal blocks shall be as specified in the table of Figure 11.



M indicates the side for Seller's connections to terminal blocks.
P indicates the side for Owner's connections to terminal blocks.
X is the clearance required for Owner's connections when Owner's sides of parallel terminal blocks are adjacent.
Y is the clearance required between the Manufacturer's wiring and the end of terminal block used for Owner's connections.
X and **Y** are specified below:

No. of Terminal Points in Column/Row	Minimum Allowable Dimensions			
	"X"		"Y"	
	In	mm	In	Mm
Less or equal to 18	6	155	4	105
19 - 36	6	205	5	130
Greater than 36	10	255	6	155

BCT Terminal Block Arrangement in Control Cabinet
Figure 11

7.8 Control Cabinet (CC) and Terminal Boxes (TB).

7.8.1 General Requirements

The Seller shall abide by IEEE C57.148 Standard for Control Cabinets for Power Transformers. If there is a conflict between this specification and IEEE C57.148 this specification shall take precedence. The CC and TB shall be NEMA 3R ventilated enclosures with dust filters. The enclosure shall be large enough for unclamped wiring with sufficient heat rejection capability.

The CC shall be shock mounted if the peak-to-peak vibration of the wall on which it is mounted exceeds 100 microns.

The bottom of CC must have a gasketed removable solid plate covering an opening of at least 6 x 12 in. (152 x 305 mm). No valves or other devices shall be located under this plate. This area is reserved for control and power cable conduits entry into the CC.

7.8.2 Heaters and Lights

All CCs shall be provided with strip heaters centrally located in the lower quarter of the cabinet to evenly distribute the heat within CC. For extended life, heaters shall operate at 50% of their 240 V rating. Heaters shall be sized to provide an output of 2 W/ft² (22 W/m²) of exterior cabinet surface area while operating at 120 V. Heaters shall be guarded, equipped with reflective backing and protected with fuses per 7.6.4. Heaters shall be thermostatically controlled to operate whenever the cabinet temperature is 30 °C or below. The thermostat shall be located near the middle height of the CC.

Door actuated, incandescent, convenience lights and GFI protected power receptacles shall be provided for operation at 120 Vac. Fluorescent lights are not acceptable. The lights and heaters shall be brought to terminal points. Owner will supply power from an external source.

7.9 Dielectric Capabilities

In addition to the requirements specified by ANSI/IEEE Standards C37.90, C37.90.1 and C37.90.2, ACP equipment shall have dielectric capabilities commensurate with 9.16.

8. DESIGN, PERFORMANCE AND MANUFACTURING REVIEWS

8.1 General

Seller shall design the transformer such that it performs satisfactorily under all the service conditions specified in **Section 4** with its referenced standards and guides in addition to any further service capabilities specified in the Ordering Specification. Seller shall also define the actual performance characteristics of the transformer to demonstrate that it meets or exceeds these requirements.

Information required in this chapter shall be submitted according to the following schedule:

- 1) At Design Review: All data specified in **8.3-8.11, 8.15-8.18**
- 2) Within 8 weeks after Design Review: Design Review report specified in **8.2**, modeling parameter portions of **8.12**; the model of **8.13**; and any additional clarifications requested during Design Review.
- 3) Within six weeks after shipment: Verification and evaluation requirements of **8.9, 8.12.2, and 8.14.**

8.2 Design Review (DR)

A Design Review (DR) is required for all prototype transformers within the scope of this specification. Seller's designer(s) shall meet with OE to review the basic design of the transformer. This DR meeting shall be held after the basic design has been established, but before manufacturing begins.

The primary intent of the DR is to allow OE to gain an understanding of design practices applied to transformers being supplied to Owner by Seller. All information obtained in the DR will be held in strict confidence. It is not intended that the DR would cause modifications to the design. However, should it be discovered that Seller has not complied with the specified requirements in the contract, the Seller must make those changes necessary to comply with all contract specifications.

Seller's representative shall notify OE of a reasonable date for a DR meeting at least two weeks in advance for Sellers in the continental U.S. and four weeks for others. Pre-design contract reviews are encouraged in order to clarify requirements for both parties. At OE's discretion, Seller shall, in lieu of a DR meeting, provide a written submittal of the required information subject to OE's review and comment.

Further requirements covered within this Specification or the Ordering Specification may be discussed at the DR, and Seller shall be prepared with details of how they will meet or exceed such requirements. Seller shall prepare a written report summarizing the details covered at the meeting and submit them to OE for review within eight (8) weeks of the date of DR. Tabulations of all data shall be included.

Seller shall identify procedures that ensure dry air is maintained during transport at the DR.

8.3 Magnetic Circuit

Seller shall provide the following data at the DR:

- 1) Number of core limbs
- 2) Core window dimensions
- 3) Spacing of core limbs
- 4) Equivalent diameter or cross-sectional area of limbs/yokes
- 5) Material description: thickness, grade, supplier, laser-etched, etc.
- 6) General description of core manufacture and assembly

- 7) General description of core face lamination design used to minimize temperatures in this region
- 8) Thickness and material of lamination insulation
- 9) Oil duct and/or solid insulation description
- 10) Method of binding limbs together and clamping yokes
- 11) Description of inactive part (clamps)
- 12) Grounding of active and inactive parts
- 13) Measures used to minimize circulating currents and stray losses in the inactive part
- 14) Total core weight
- 15) Flux density distribution in limb/yoke for nominal and maximum excitation
- 16) Core temperature rise and flux distribution in each core limb/yoke for nominal and maximum excitation
- 17) Flux shielding locations, design and construction
- 18) Maximum residual flux, in % of nominal excitation
- 19) Maximum burr height allowed on lamination edge.

8.4 Windings and Leads

Seller shall provide the following data at the DR:

- 1) Winding circuit schematic diagram
- 2) Winding layout, including coil types for each winding (disk, layer, helical, pancake, etc) Number of turns in each disc, layer, or pancake
- 3) Physical location of taps, crossovers, and static, turn and ground shields
- 4) Number of discs, layers or pancakes in each winding
- 5) General description of conductor arrangement in each disc, layer or pancake
- 6) General description of any transpositions and interleaving used
- 7) Number and size of axial and radial spacers used in circular windings
- 8) Inside and outside diameters, and compressed height of each circular winding
- 9) Inside and outside dimensions of each rectangular pancake section
- 10) Compressed height of each winding package in shell form transformers
- 11) Dimensional spacing between each winding package in shell form transformers
- 12) Diameters and physical description of each winding tube in core form transformers
- 13) Number of insulating barriers between windings and the thickness of each barrier and oil gap
- 14) Description of the cooling fluid path within the winding structure and a range of the fluid flow and heat transfer rates.
- 15) Identification of the special materials and methods, e.g., high strength, continuously transposed, or bonded conductors, high strength winding tubes, high density pre-compressed spacers, etc.
- 16) Clamping structure description, including materials used for phase blocking, end rings, pressure plates and special components or systems used
- 17) Basic description of static, ground and other dielectric shields
- 18) General description of where winding conductor joints are permitted and quality control procedures employed to ensure their integrity
- 19) Lead construction, including support, shields and barriers
- 20) Electrical and physical details of connections between adjacent windings, including connections between windings, crossover leads and connections to bushings
- 21) Variable resistors or semi-conducting elements used to protect the winding(s).

8.5 Major Accessories

Seller shall provide descriptions and data at the DR for major accessories:

- 1) Bushings, including shielding and the design tests that have been performed on the bushings
- 2) Details of connections to the bottom end of bushings, including the number of leads, bolt arrangement and sizes
- 3) Tap changer, including basic construction and dielectric, thermal, ampacity and mechanical capabilities
- 4) Current limiting reactors, including basic construction and impedance characteristics.

8.6 Bushing Draw Lead Conductors

Seller shall provide the following information regarding the bushing draw lead conductors:

- 1) Diameter of draw lead conductor
- 2) Thickness and material of insulation on draw lead conductor
- 3) Maximum continuous operating temperature of insulation on the draw lead conductor
- 4) Continuous loading capability of the draw lead conductor, with its insulation, inserted into the bushing.
- 5) CT's

8.7 Insulation Design Evaluation

Seller shall describe insulation design details at the DR. Calculated transient (high frequency) and low frequency dielectric stresses with commensurate design capabilities shall be provided for all tap positions for all operating conditions defined in **Section 4** for the locations listed below and all dielectric tests defined in **Sections 9.3 - 9.7** and **Section 9.9**. The basis of the calculations shall be stated for all analyses. Additional calculated values for conditions or tests required by the Ordering Specification shall be included in the insulation design evaluation analysis. If the prospective impulse wave shape voltages during testing do not meet the requirements stated in **Section 9**, then calculated data shall be provided for both the required and the prospective wave shapes. This information shall be used to determine the most stressful operating situations and the no-load tap settings required for dielectric tests. Under these conditions, the magnitude and location of dielectric stresses and the associated withstand capabilities shall be provided for the following regions or conditions:

- 1) Dielectric stresses in the most highly stressed regions of oil, including leads and bottom region of EHV bushings
- 2) Dielectric stresses in windings including the following:
 - a) kV to ground of each terminal
 - b) kV to ground of each node (defined below)
 - c) kV differential between adjacent nodes
 - d) kV differential across each high-low space
 - e) kV differential between adjacent line, crossover and tap leads
 - f) kV differential between critical leads and adjacent discs or layers

- 3) Voltage wave shapes producing the dielectric stresses in 1) and 2) above
- 4) Description of how design limits were developed and applied.

The nodes referred to in 2) are defined as follows: a) the winding terminals and the connection points between the layers for a layer type winding, b) the winding terminals and the connection points between the disks representing no more than 10 % of the total number of turns for a disk type winding, c) the winding terminals at the middle of the winding cylinder for a helical type winding.

Seller shall provide a cross-section sketch of the transformer assembly. Each major region of the insulation structure (i.e., main gap between windings, shielding and/or ground insulation at winding ends, inner winding to core, outer winding to tank, axially along windings, and around all EHV and tap leads) shall be identified with the test or operating condition which is most critical to its dimensioning and design. A brief summary of the dielectric stresses in the critical regions for each test or operating condition shall be included on or with the sketch.

Seller shall supply dielectric capability curves in graphic and Microsoft Excel spreadsheet form.

8.8 Through-Fault Design

Seller shall describe the through fault design at the DR as specified below:

8.8.1 Generated Forces

A summary of calculated forces generated during all possible external faults on each winding at all tap positions. For each type of fault, the total force acting in each direction and on each winding shall be given. Local maximum pressures shall also be given. All assumptions and estimated parameters used to compute these forces shall be included in the summary.

8.8.2 Failure Mode Analysis

A summary of the worst case mechanical stress in each winding, and a description of the design and construction used to withstand this stress, for each of the following mechanical failure modes: hoop buckling, axial compression, clamping failure, hoop tension, beam bending and mechanical resonance. A sketch shall be provided which shows the various regions of the windings and the type of fault that dictates the winding strength in that region.

8.8.3 Structural Support

Seller shall provide a description of the axial and radial loading of the windings and support structure.

8.8.4 Winding Preparation

Seller shall provide detailed description of all preliminary coil sizing and stabilization procedures, including preload clamping pressure applied to windings and the clamping system used. This description shall include pressures,

temperatures and drying processes, time, dimensional tolerances allowed, and the purpose for each step in the winding preparation.

8.8.5 Leads and Supports

A summary of worst case forces acting on all leads and crossovers. The ability of these leads and their supporting structures to withstand these forces shall be described.

8.8.6 Through-Fault Temperatures

The worst-case temperatures that occur in each winding, and the condition which causes these temperatures, and the mechanical properties of the conductor materials at these temperatures, shall be described.

8.8.7 Supporting Evidence

Evidence shall be provided to support the Seller's design approach. Certification of successful short-circuit test experiences with full-sized transformers shall be reviewed in detail as it relates to contemporary design practice. Design strength of materials used and design margins over the levels tested in the certified designs shall be presented. The effect of manufacturing processes on these materials' strength shall be described, e.g., the effect of conductor joints, use of epoxy bonded conductors, winding treatment during drying, preliminary winding compression, etc.

8.9 Thermal Design and Loading

Seller shall present a thorough description of the thermal design of the transformer. Information shall include the following at the maximum rating of the transformer:

- 1) Loss calculations for the core, windings and structural members.
- 2) Hydraulic design and directional controls for the oil flow, and calculated velocities and heat transfer rates of the oil flow,
- 3) Average and hot spot temperature calculations for each of the above components
- 4) Calculated top, average and bottom oil temperature rises
- 5) Locations of hottest spot temperatures within each winding
- 6) Location and magnitude of hottest oil temperature within each winding.

Seller shall substantiate these calculations by presenting plots of the magnetic field pattern to reveal where and how losses are generated, particularly as affected by the stray flux. Further substantiation shall be provided by showing results of measurements that confirm the calculations on previous transformers.

The load capability as a function of time shall be defined by Seller but shall meet the minimum requirements specified in **Section 4.1**. A plot of load-time capability shall be provided. Seller shall also define load capability as a function of time with partial and complete loss of cooling. Seller shall revise this data following temperature rise test if test results vary significantly from calculated values.

8.10 Insulation Processing

All steps of factory insulation processing shall be described for the specific transformer on order. Seller shall also provide recommended field processing procedures and the criteria used for determining adequacy of dryness for both factory and field processing.

8.11 Test Proposal

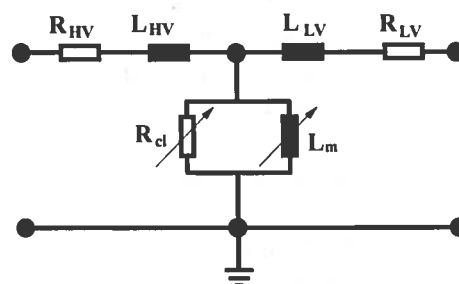
Seller shall provide a detailed test proposal at the time of the design review meeting. This proposal shall include an approximate schedule sequence and methodology for all required testing, as well as any deviation from this specification or the reference industry standards.

8.12 Equivalent Circuit Parameters

8.12.1 Single Phase 60 Hz Model

Seller shall provide a 60 Hz impedance network model that reasonably describes the 60 Hz steady-state operation of the transformer. Models shall be provided for center and extreme tap positions. Seller shall describe how the model was developed and shall advise what relationship the parameters have to actual physical quantities such as flux in core limbs and yokes. **Figure 11** shows the simplest acceptable 60 Hz impedance model for a GSUT. More accurate models are encouraged. For complicated winding arrangements, the model shall account for the increased complexity of the impedance network. As a minimum, the model shall include the following parameters, also shown in **Figure 12**:

- 1) Magnetizing inductance, L_m vs. applied voltage magnitude
- 2) Core loss resistance, R_{cl} vs. applied voltage magnitude
- 3) HV and LV winding leakage inductances, L_{lv} and L_{lv} , respectively
- 4) HV and LV winding loss resistances, R_{lv} and R_{lv} , respectively.



Single-Phase 60 Hz Impedance Model
Figure 12

The model shall be valid for voltages from 0.9 through 1.5 p.u., at GSUTs loads from 0.0 to 1.25 p.u. Parameters (1) and (2) shall be provided in the form of a table and/or plot of true crest amps versus true crest volts. The air-core reactance or leakage inductances shall be provided for each winding.

8.12.2 Equivalent Terminal Impedances

Equivalent terminal-terminal and terminal-ground inductances and capacitances (including bushings) shall be provided at 60 Hz, switching (10 kHz) and lightning impulse (250 kHz) frequencies. Seller shall verify these parameters by measurement in the factory on all transformers.

8.12.3 Saturation Curve

Seller shall provide an estimated saturation curve of the transformer to Owner.

8.13 Transient Model

When required in the Ordering Specification, seller shall provide a detailed transient model of the transformer for use by Owner to represent the transformer in system transient studies. The transient electrical model shall include damping due to losses and, as a minimum, contain all phases and terminals of the transformer and shall be applicable for a frequency bandwidth of 60 Hz to 100 kHz. The transient model shall consist of resistive, inductive and capacitive elements and shall be compatible with the Electromagnetic Transients Program (EMTP) input data. The transient model shall be provided for at least the center tap position. Transient model parameters shall be submitted in both hardcopy plot form and on magnetic disc compatible with an IBM PC, in ASCII format with the data specification identified in the submittal package.

8.14 Verification of Transient Model

The following frequency and time domain responses shall be calculated using the transient model specified in **Section 8.13** on the first transformer of a new design. In the case of frequency response calculations (**8.14.1 - 8.14.2**), the frequency range shall be from 60 Hz to 100 kHz and the frequency increment shall be sufficiently small to clearly reveal all maxima and minima.

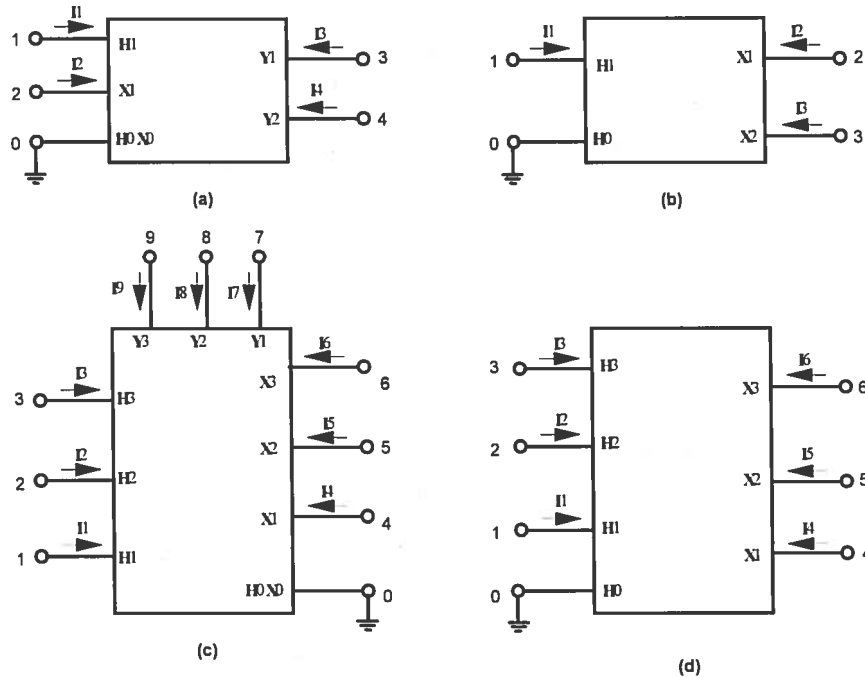
An electronic type sinusoidal voltage variable frequency generator shall be used to measure the required responses. Measurements shall be made on all terminals, tap points and accessible crossovers of each phase on a fully assembled, oil-filled transformer with the neutral terminal grounded. Data shall be submitted in the manner described in **8.13**.

8.14.1 Short-Circuit Admittance Functions

Seller shall make short-circuit admittance calculations and measurements (magnitude and phase angle vs. frequency) for the cases specified in **Table 13**. **Figure 13** shows the terminal designations for these calculations and measurements.

Table 13
Conditions for Short-Circuit Admittance Functions

Type of Transformer	Figure No.	Condition No.	Terminal Conditions		Admittance ($Y_{mn}=I_n/V_m$)
			Supply Terminal (m)	Shorted to Ground (n)	
1-Phase GSUT	11b	B1	1	2,3	Y_{11}, Y_{12}, Y_{13}
		B2	2	1,3	Y_{22}, Y_{23}
		B3	3	1,2	Y_{33}
3-Phase GSUT	11d	D1	1	All except 1	$Y_{11}, Y_{12}, \dots, Y_{16}$
		D2	2	All except 2	Y_{22}, \dots, Y_{26}
		D3	3	All except 3	Y_{33}, \dots, Y_{36}
		D4	4	All except 4	Y_{44}, Y_{45}, Y_{46}
		D5	5	All except 5	Y_{55}, Y_{56}
		D6	6	All except 6	Y_{66}



Terminal Identification for Short-Circuit Admittance Functions
Figure 13

8.14.2 Open-Circuit Voltage Transfer Functions

Open circuit voltage transfer functions (magnitude and phase angle vs. frequency) shall be calculated and measured for the combinations specified in **Table 14**. The voltage transfer function for an open-circuited terminal is defined as the ratio of voltage appearing on the open-circuited (O) terminal to input (I) voltage. In the case of delta-connected windings it is acceptable to give the voltage transfer functions between the delta-connected winding with one corner grounded and the other windings that would have one terminal grounded. The neutral terminal(s) shall be grounded.

8.14.3 Step Function Response

The voltage response at all open-circuited terminals, for each condition specified in **Table 14** shall be calculated and measured for a low voltage step wave applied to the input terminal. The applied step wave shall have a rise time of not more than 1.0 λ s. If a step generator is unavailable, a pulse generator may be substituted provided that the 1.0 λ s rise time is met and the transient due to the leading edge of the pulse damps out before application of the lagging edge. Neutral terminal(s) shall be grounded.

Table 14
Conditions for Open-Circuit Voltage Transfer Functions

Transformer	Condition	H1	H2	H3	X1	X2	X3	Y1	Y2	Y3
1- Φ GSUT	F1	I			O	O				
	F2	O			I	G				
3- Φ GSUT	H1	I	O	O	O	O	O			
	H2	O	O	O	I	O	O			

I= Input Terminal; O = Open; G = Grounded

8.14.4 Comparison of Calculated and Measured Results

Seller shall compare calculated and measured results described in **8.14.1** through **8.14.3** and based on this, assess the validity of the transient model supplied in **Section 8.13**. This assessment shall include an explanation of the causes of:

- 1) Any frequency, amplitude or phase discrepancies greater than 10 % between measured and calculated local maxima and minima in the required frequency responses; and
- 2) Amplitude and oscillation frequency discrepancies greater than 10 % between measured and calculated step function responses.

The Seller shall explain the implications of these discrepancies on insulation design safety margins.

NOTE: Depending on the transformer system operating conditions, the Seller may be asked to provide only partial information on the requirements in paragraphs **Sections 8.13** and **8.14**. Indication of such shall be noted on the Ordering Specification

8.15 Comparison with Design Criteria

Data calculated in **Section 8.7** for the dielectric stresses shall be compared with the design capabilities of the insulation structure. Seller shall identify which conditions result in dielectric stresses in excess of design recommended values and shall give the technical explanations to justify the disparity.

8.16 Loss Measurement Accuracy

Seller shall present information regarding the accuracy of equipment used for load, no-load and auxiliary loss measurements. Data shall be presented for magnitude error and phase angle error for the complete test system as well as for individual devices, including potential transformers, current transformers, voltage and current dividers, voltmeters and all other equipment in the measuring circuit. If certification by an independent testing service for the complete test system is unavailable, then the complete system error shall be calculated per Section 8 of NBS Technical Note 1204 (See Reference [1] in **Section 3.3**).

8.17 Geomagnetically Induced Current (GIC) Capability

Seller shall present information regarding the capability of the transformer to withstand GIC. Information shall include estimated flux, time constants and resulting temperatures at critical locations in the magnetic circuit and structural components at dc current levels of 10, 25, 50 and 100 Adc for a five-minute duration in the wye-connected windings. Seller shall also present information on past experience and testing of similar designs.

8.18 Inspections

OE shall be permitted to inspect the equipment during any stage of manufacture. Upon arrival at Seller's facility, Seller shall give OE a complete status report of all portions of the apparatus in question with respect to its location and expected procedures and assembly work which will occur during the visit. Notification requirements for specific production milestones are specified in **Section 11.24**.

9. TEST REQUIREMENTS

9.1 General

Tests on transformers and their bushings shall conform to the latest approved standards specified in **Section 3.1** unless otherwise specified herein or in the Ordering Specification. In many cases, additional "design" tests as described in this Chapter are required for a prototype unit. All required test values and measurements to be recorded in the test report (11.20). Test failures and troubles or failure to meet guaranteed values shall be reported per **Section 11.21**. All waveforms shall be recorded by digital devices.

9.2 Resistance and Turn Ratio

The dc ohmic resistance of all windings shall be measured at all tap positions for the prototype. The turn ratio shall be measured between all windings within each phase at all tap positions.

9.3 Dielectric Tests General Requirements

Dielectric tests shall comply with the latest standards referenced in **Section 3.1** except as specified herein, e.g. in **Sections 11.9 - 11.16**, or in the Ordering Specification. Transformers shall be fully assembled during dielectric tests per **Section 6.19**. Reduced FW and FW waveforms shall be shown on same trace and scales per ANSI guideline.

9.3.1 Test Sequence

Table 15 specifies the prototype and routine test sequences.

Table 15
Required Dielectric Test Sequence

Test Description	GST-1 Section	Prototype Sequence	Routine Sequence
Fast Front Switching Impulse (FFSI)	9.4	1	N/A
Switching Impulse (SI)	9.5	2	1
Special Termination Lightning Impulse (STLI)	9.6.2	3	N/A
Standard Lightning Impulse (LI)	9.6.1	4	2
Applied voltage (AV)	9.7	5	3
Induced voltage (IV)	9.8	7	4
Insulation Power Factor (IPF)	9.9	8	5

9.3.2 Test Voltage Magnitude and Waveshape

Impulse test voltage magnitudes are specified in **Table 16**. Crest voltage tolerance for impulse tests (**Sections 9.4 - 9.6**) shall be minus 0.5 %. The impulse circuit and measuring connections shall remain unchanged during calibration and full wave tests.

If Seller is unable to attain the required 1.2/50 μ s waveshape for the LI or STLI within the (+)30 % front or (-)20 % tail time tolerances, then they shall state in their quotation that they are unable to attain the standard waveshape, and shall also state the guaranteed attainable impulse waveshape for each test. Failure to obtain at least the guaranteed waveshape shall be grounds for rejection of the LI test.

The required crest voltage for the LI and STLI tests shall be increased if the actual front time exceeds 2.0 μ s or the actual tail time (time to 50% crest value) is less than 40 μ s. If the front time exceeds 2.0 μ s, then the crest test voltage of both the full and chopped waves shall be increased by 2 % per each additional 0.1 μ s above 2.0 μ s. The total increase will be limited to 15 % of the crest value in **Table 16**.

A generic electrical schematic of the impulse generator used for the impulse voltage tests shall be provided per **11.20.1**.

If the time to 50 % crest value is less than 40 μ s the crest test voltage of the full wave impulse shall be increased such that the kV-seconds above 80 % of the rated full wave voltage (e.g., as integrated by a digital oscilloscope) for the adjusted

impulse wave equals the kV-seconds above 80 % of the BIL for a 2.0/40 μ s (double exponential) wave. In the event that the front exceeds 2.0 μ s and the tail is less than 40 μ s, the increases in required test voltage shall be applied additively, e.g., a 10 % increase for the front and 4 % increase for the tail result in a required increase of 14 % in the crest test voltage.

Neutral terminal LI waveshapes shall have a maximum front time of 5.0 μ s and a minimum time to 50 % crest value of 40 μ s. The test voltage shall be adjusted in a similar manner as described above should these criteria not be met, with the exception that the front shall be increased 2% for each additional 0.1 μ s above 5.0 μ s. The total increase will be limited to 15 % of the crest value in **Table 16**.

Table 16
Dielectric Test Voltages

Nominal System Voltage (kV)	FFSI Crest Voltage (kV)	SI Phase-Gnd Crest (kV)	LI	
			Full Wave Crest (kV)	Chopped Wave Crest (kV)
Reference Section	9.4	9.5	9.6	9.6
765	1300	1700	2050	2255
500	900	1290	1550	1705
345	590	890	1050	1155
230	375	685	900	990
161	275	575	750	825
138	235	540	650	715
69	-	-	350	385
46	-	-	250	275
≤ 34.5	-	-	200	220

NOTES: The above requirements are to make certain that adequate efforts were made to obtain the proper impulse voltage wave shape. The OE shall be advised on all measures taken to obtain the proper impulse voltage wave shape during the impulse tests.

In case of a tail time less than 40 μ s, resistors up to 40 ohms may be allowed at the grounded terminal if the test results show that the peak value of the voltage across the winding and the resistor connected in series do not coincide with peak value of the current flowing into the series combination of the winding and resistor. Resistors at the grounded terminal may be used in case of low voltage windings with high BIL insulation level such as the series windings in the series transformers for transmission line MVA flow control.

9.3.3 Voltage Tap Position

OE shall select voltage tap positions for the dielectric tests. For the prototype unit, tap positions for each impulse voltage test will be specified following the Design Review based on data provided by Seller in accordance with **Section 8.7**. OE shall specify tap positions for subsequent units following successful completion of the tests on the prototype. OE may also require impulse tests for three-phase

transformers to be performed at different tap positions on each phase. Seller shall not proceed with tests until such notice has been provided for each transformer.

9.3.4 Procedures

The prototype of single phase units shall receive two complete sets of standard impulse tests on all terminals, including the neutral, at the voltage levels and the durations indicated in 9.3.2. The impulse tests shall be at tap positions selected by OE as described in 9.3.3. Different tap positions may be used for the individual phases on three phase transformers. The test sequence listed in Table 16 of 9.3.1 shall be followed.

The IV test shall be performed with the DETC in the highest voltage position when the voltage source supplies the LV winding.

The impedance at the winding's grounded terminal during impulse tests shall not exceed 2 Ohms. Increasing this impedance in order to increase the impulse voltage tail time is not permitted unless conditions in 9.3.2 NOTES are met.

The interval between the final impulse waves on any impulse test shall be as short as practicable and shall not exceed the durations specified below. Intentional delays are not permitted. For FFSI and SI tests (Sections 9.4 and 9.5), the interval between the final two full impulse waves shall not exceed ten minutes. For STLI and LI tests (Section 9.6), the test interval between the last full chopped wave (CW) and the last full LI wave shall not exceed three minutes.

In the case that the transformer fails any test in its test sequence and the transformer is reprocessed for any reason, all tests, including those that were successful prior to the failure, shall be repeated.

9.4 Fast Front Switching Impulse (FFSI) Tests

An FFSI test shall be performed on each terminal rated 138 kV and above of the prototype. The applied voltage waveshape shall have a 1.2 μ s virtual front and 4200 μ s actual time to the first voltage zero. One reduced and two full waves shall be applied. Neutral terminals shall be grounded. All other non-impulsed terminals shall be open-circuited. Oscilloscope traces of voltages at the non-impulsed terminals located on the same phase with the impulsed terminal are required.

9.5 Switching Impulse (SI) Tests

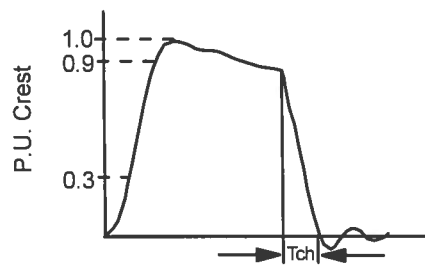
SI tests shall be performed on each high voltage terminal. Reduced and both full voltage waveshapes shall match until core saturation takes effect. Connections on three-phase transformers under test shall be such that 1.5 times the applied voltage is generated between phases.

9.6 Lightning Impulse Tests

9.6.1 Standard Lightning Impulse (LI) Tests

Standard LI tests (FW and CW) are required on all line and neutral terminals. Neutral terminals do not require chopped waves.

Special requirements for the chopped wave are: 1) Actual chopping time, T_{ch} , from the instant of chopping to the time of first voltage zero shall not exceed $0.65 \mu s$ as shown in **Figure 14**, 2) Overswing magnitude after chopping shall not be limited artificially to less than 40 % of the chopped wave crest value, 3) The current trace, with a sweep time of 10 to $25 \mu s$, shall be recorded and compared before and after the chop during the chopped wave tests.



T_{ch} = Allowable Chopping Time
Chopped Wave Characteristics
Figure 14

9.6.2 Special Termination LI (STLI) Tests

The prototype shall receive STLI tests in addition to the standard LI tests. STLI tests shall be performed in a similar manner to the standard LI tests except as described below. These tests shall be performed on each line terminal for: all single-phase transformers and at least the center phase and one outer phase of three-phase transformers. Non-impulsed line terminals shall have special terminations to simulate operating conditions not covered by ANSI standard test methods. **Table 17** specifies the terminations to be used on the non-impulsed terminals for the STLI tests. Voltage tap position selection is described in **9.3.3**.

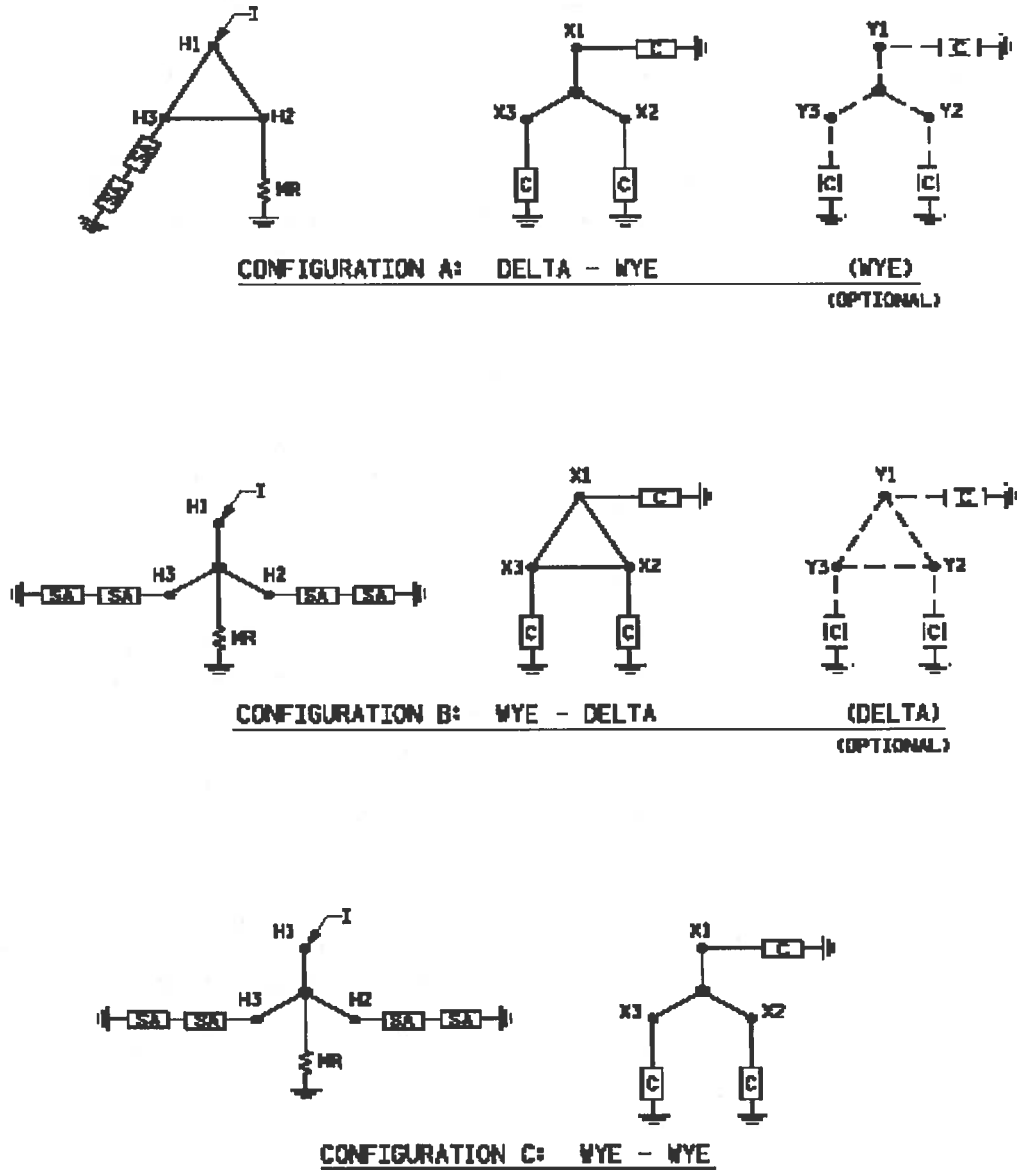
The proposed arrester connections for the STLI tests should be discussed with the OE. The OE will share with the MFG, the experience AEP has acquired with the STLI tests on previous similar units. For information, the arrester connections for the STLI tests on a three-phase 345/138-13.8 kV unit, which has been used in the past, is shown in **Figure 14**.

Table 17
Termination Requirements for Special Termination Lightning Impulse Tests
 (Only Phase 1 Test Given to Illustrate Method)

H1	H2, H3	H0	X1	X2, X3	X0, Y0	Y1	Y2, Y3
GSUTs							
I	SA	G	C	C	-	C	C
AUXs							
I	SA	G	C	C	G	C	C

I = Input, SA = Surge Arrester, G = Grounded, C = Capacitance

**CONNECTIONS FOR STLI TESTS ON HV WINDINGS FOR DIFFERENT
TRANSFORMER WINDING CONFIGURATIONS**



Example of Connections for STLI Tests on a 345/138-13.8 kV Auto
Figure 15

9.6.2.1 Surge Arrester Ratings

Maximum Continuous Operating Voltage (MCOV) ratings of SA terminations shall be as specified in Table 18. An open circuit is an acceptable substitute for a SA at Seller's option.

Table 18
Line Terminal Arrester Requirements for STLI Tests

Terminal Voltage kV Rating	765	500	345	230	161	138	69	34.5		13.8	
								Delta	Wye	Delta	Wye
Arrester MCOV kV Rating	700	525	336	252	193	168	117	31.5	58	17	31.5

NOTES: The arrester MCOV ratings in **Table 18** are for testing of single-phase units. For three phase units (345 kV and below) the ratings in **Table 18** are for the arresters to be installed on the non-impulsed winding terminals that are located on the same phase with the impulsed winding terminal. The arresters on the non-impulsed terminals on the other phases than the phase where the impulsed winding is located shall be approximately half of the MCOV ratings in **Table 18**.

9.6.2.2 Capacitance Values

The value of capacitance connected to the LV terminals of GSUTs during the STLI tests shall not exceed the value stated in the Ordering Specification, or if not stated therein, 3000 pF per phase

9.6.2.3 Test Procedures

The voltage waveform at the non-impulsed winding terminals located on the same phase with the impulsed winding and the current waveform in the corresponding SAs shall be measured and recorded. Test voltage shall be increased in steps of approximately 50, 70, 90 and 100 % of the required full crest value in order to distinguish between non-linear SA effects and a possible failure.

If projected voltage at non-impulsed terminals, based upon the incremental voltage method described in the foregoing paragraph, will exceed the BIL rating during the first 10 μ s or will exceed the SI rating thereafter, then the MCOV value of the SA may be reduced by modifying the sections composing the SA in order to compensate for this condition. OE must approve the revised composite MCOV value prior to proceeding with the test.

9.7 Applied Voltage (AV) Test

The AV test voltage shall be as defined in ANSI C57.12.00. Consideration should be given by the MFG to the test circuit to prevent self-excitation of the AV test generator that is supplying a capacitive load.

9.8 Induced Voltage (IV) Test

The IV test shall be performed on all transformers in accordance with applicable standards, including ANSI/IEEE C57.12.90, except as specified below and in the Ordering Specification.

9.8.1 Procedure

One complete IV test is required on all prototype or duplicate units as specified in Section 9.3.4. The test voltage shall be raised to the 1 hr test voltage for a period of at least 5 minutes before being raised to the enhancement level. PD shall be measured and recorded at the beginning and end of this pre-enhancement period. The voltage shall then be raised to the enhancement level for at least 1500 cycles or 5 seconds, whichever is greater. During the enhancement period, PD shall be measured at all line terminals. Measurements on terminals having bushings with no capacitance voltage taps shall be achieved with freestanding capacitive voltage dividers. The voltage shall then be reduced to not less than the 1 hr test voltage and held for the remainder of the test. During this long duration period of the test, PD measurements shall be made at 3-minute intervals. All results shall be recorded in the test report.

All RIV and apparent charge measurements shall be continuously recorded, where possible. A strip chart recorder is a suitable means for continuous recording. For three-phase transformers, simultaneous measurement of PD on all three phases should be available such that all readings are visible and recorded at the same time. The use of a single meter with a multiple position switch that limits observation to only one phase at a time is undesirable. If no other means for monitoring PD is available, the selector switch shall be operated frequently to observe PD activity in between the 3-minute intervals.

Transformers with forced oil cooling shall have all pumps running during IV test. Pumps shall be started prior to the test and continue running for the period of time required for leakage current to stabilize. This time period shall be determined as specified in 9.8. Pumps shall not be turned off prior to beginning of the test.

9.8.2 Test Voltage.

The test voltage is defined in P.U. of the voltage rating of the tap at which the test is performed. The 1 hr and enhancement test voltages shall be 1.8 P.U. and 2.0 P.U., respectively.

9.8.3 Acceptance Criteria

The PD acceptance criteria include apparent charge method. The PD results shall be considered acceptable provided that: 1) maximum PD measured on each line terminal during the 1 hr. period does not exceed 300 pC apparent charge; and 2) the increase in PD does not exceed 100 pC when compared to the corresponding PD measurement made just prior to the enhancement period. There is no guaranteed PD limit required at the enhancement level.

9.9 Insulation Power Factor (IPF) Test

Insulation power factor tests are required for each transformer and shall be performed per Method II (guard circuit method) of ANSI/IEEE C57.12.90, Table 1. This power factor shall be less than 0.5 %, when measured between 10 °C and 30 °C winding temperature. Results and a description of the method used shall be recorded in the Test Report.

9.10 No-load Loss and Excitation Current

No load loss and excitation current shall be measured at 70, 90, 100, 105, 110, 112.5, 115 and 120 % (or the highest possible value permitted by the source considering the transformer's capability) of rated voltage. Three-phase transformers shall be tested with three-phase excitation with the three-wattmeter method per Figure 15 of ANSI/IEEE C57.12.90-1999 and results shall be reported for all three phases. Maximum error of the complete test system, as determined and certified by an independent testing service or as calculated per Section 8 of NBS Technical Note 1204 [1], shall not exceed 3 %. Guaranteed no load losses and exciting current shall be at 20 °C and measurements for these quantities shall be performed with average oil temperature between 10 °C and 30 °C. In the case of three winding core-form transformers, voltage shall be applied to the winding physically located nearest to the core.

Harmonic analysis results shall be provided for the no-load voltage and excitation current time functions at the voltage levels specified above. Instead of harmonic analysis, source voltage and current waveforms shall be simultaneously measured on the prototype as a function of time and recorded with a digital oscilloscope. The magnitude scale shall be adjusted to obtain as near a full-scale deflection as possible. The time scale shall be selected to capture at least one full cycle but not more than three cycles of applied voltage. Data shall be submitted on both hard copy, plot form and on magnetic disk. For transformers with taps in the common winding, the no-load loss and the excitation current shall be measured at all tap positions. No-load test measurements shall include kW loss, peak Amperes, and average Volts. The test report shall present a table of all measured values.

9.11 Audible Sound

Audible sound level shall be measured on the prototype. The acceptance level shall be in accordance with NEMA standards.

9.12 Impedance and Load Loss

Impedance and load loss shall be measured at all tap positions. Losses in three-phase transformers shall be measured with the three-wattmeter method per Figure 20 of ANSI/IEEE C57.12.90-1987. Maximum error of the complete test system, as determined and certified by an independent testing service or as calculated per Section 8 of NBS Technical Note 1204 [1], shall not exceed 3 %. For multi-winding transformers, impedance and load loss shall be measured between each combination of two windings.

9.13 Zero Sequence Impedance

The zero sequence impedance (Z_0) shall be measured for all three-phase transformers. For multi-winding transformers, Z_0 shall be measured for each combination of two windings. Z_0 measurement is required at center tap and extreme tap positions. Z_0 values shall be expressed as P.U. quantities based on the transformer's nameplate MVA and center tap kV ratings. Actual voltage, current and power measurements used to derive Z_0 values shall be recorded in the Test Report in addition to the Z_0 values themselves. Seller shall compute the equivalent circuit of Z_0 impedances ($R_0 + jX_0$) in percent per ANSI C57.12.90 and include a copy of this figure in the test report, clearly stating the MVA and kV bases.

9.14 Temperature Rise (TR) Tests

Design tests shall be performed on each prototype transformer. An accelerated TR test shall be performed as a routine test on all subsequent units. In all cases, the tap connection(s) giving the highest winding rise shall be used. Dissolved gas analysis shall be performed before, during and after each TR test (9.15.3). A leakage current test (9.8) shall be performed immediately following the design TR tests.

9.14.1 Design Tests

The following design tests are required:

- 1) The standard TR test(s) shall be performed per ANSI Std. C57.12.90 and IEEE C57.119 (Draft 13.2) at 0.7, 1.0 and 1.25 p.u. of the maximum nameplate MVA rating, and where applicable due to the cooling classes on the nameplate (e.g., ONAN/ONAF/ONAF), also at the base MVA rating. Stabilized conditions shall be as defined in Section 11.2(1) of C57.12.90.
- 2) The following customer specified load cycle for temperature rise test, as specified by Section 11 of IEEE C57.119, shall be performed with full compensation for core losses:
 - a) **GSUTs.** 0.75, 1.0 and 1.1 p.u. of the maximum nameplate MVA rating for eight hours.
 - b) **RAT's and UAT's** 1.33 or 1.35 p.u. maximum nameplate MVA rating after a preload of 1.0 or 0.7 p.u. maximum nameplate MVA, at 10°C ambient temperature, for four hours. P.U. loading may be changed to suit available test conditions, i.e., ambient temperature and load duration, as specified in **Table 19**. Interpolations between these ambient temperatures may be used.

The following limitations apply to this load cycle test: Hottest spot temperature not to exceed 140°C, top oil temperature not to exceed 110°C and loss of life not to exceed 1.0% per incident.

Table 19
Minimum p.u. loading as a Function of
Ambient Temperature and Load Duration

Ambient Temperature	4-Hour Test		8-Hour Test	
	0.7 p.u Preload	1.0 p.u. Preload	0.7 p.u Preload	1.0 p.u. Preload
40	1.165	1.145	1.133	1.137
30	1.229	1.210	1.197	1.194
20	1.289	1.271	1.255	1.251
10	1.347	1.330	1.310	1.307
0	1.403	1.386	1.363	1.359

9.14.2 Routine Tests

An accelerated TR test is required for all units other than the prototype. A test current of 1.1 times the maximum nameplate rated current shall be circulated in the HV and LV windings in a short-circuit test arrangement for a period of four hours.

9.14.3 Infrared Scans

Infrared scans of the transformer shall be taken during the maximum loading condition of the TR test. Scans shall include each side of the transformer, all coolers, HV & LV connections, bushing, flanges, turrets and cover plates.

All hot spots shall be clearly identified on the scan. Each scan shall have time, date, ambient temperature and loading conditions during the test. No temperature shall exceed the maximum allowable temperature stated in **Section 5.2.3**.

An electronic copy of the IR scans shall be provided as well as snapshots included in the test reports.

Information about the IR scan software shall be provided in the test plan.

9.14.4 Dissolved Gas Analysis (DGA)

DGA samples shall be taken during all design and routine TR tests as follows:

- 1) At least seven samples are required for the standard TR test: one just prior to start of test, four at equally spaced intervals during test, one just prior to shutdown, and one after cool-down.
- 2) At least five samples are required for the overload TR test: one each just prior to 90 % preload, at the end of 90 % preload just prior to applying the overload, at two hours after overload is applied, just prior to shutdown and after cool-down.
- 3) At least four samples are required for the accelerated TR test: one each just prior to start of the test, in the middle of test, just prior to shutdown and after cool down.

9.14.5 Required Data

TR data which shall be reported for both standard and prototype tests include: measured top and bottom oil TR; calculated average oil TR; measured average winding TR for all windings; calculated (and measured, if possible) hot spot TR over average ambient temperature for all windings; time constants for each winding and the oil, and measured total Watts loss for the supply circuit used for test. These parameters shall all be determined at both, the maximum self-cooled and the maximum forced-cooled MVA ratings of each winding. The test report shall state whether the oil flow in each winding is directed or non-directed.

Load cycle data shall be recorded for both prototype and routine tests. This shall include all currents and the duration for which they were applied.

When TR data are based on a previous transformer of identical design, all above specified values shall be adjusted by calculation to reflect the difference in losses between the transformers unless total losses of the latter unit vary by less than 2 % from the prototype. TR data and serial number of the prototype shall be indicated on the test report.

9.15 Tests on Auxiliary, Control and Protection (ACP) Equipment

Seller shall test all ACP equipment for proper function before shipment. Improper function shall be reported to OE along with proposed remedial action. ACP equipment and their wiring shall withstand the following 60 Hz, 60 s, test voltages. Test voltages (to ground) shall be 2500 Vrms, for equipment rated 250 Vdc and 1500 Vrms for all other voltage ratings. Test voltages across open contacts shall be 1500 Vrms for contacts rated for tripping and 1000 Vrms for contacts not rated for tripping.

Proper phasing and phase sequence of both supplies to ACP equipment shall be verified.

CT testing shall be reported and include Saturation, Ratio, and Voltage Polarity tests.

9.16 Through-Fault Testing

When agreed upon during negotiations, through-fault testing and subsequent verification of satisfactory performance shall be performed per Section 12 of ANSI/IEEE C57.12.90, except that no visual signs of movement shall be present during the final inspection.

9.17 Sweep Frequency Response Analysis (SFRA)

SFRA testing shall be performed with a Doble Model M5100 prior to disassembly at the plant. Results of this test shall be recorded electronically and forwarded to Owner.

10. TRANSPORTS, HANDLING AND STORAGE

10.1 General

All criteria of this chapter must be met to ensure Owner's acceptance of the transformer. Seller shall follow IEEE C57.150 - Guide for the Transportation of Transformers and Reactors Rated 10,000KVA or Higher. If there is a conflict between this specification and IEEE C57.150 this specification shall take precedence. Approved Heavy Hauling and Rigging Contractors are identified in the AEP Ordering Specification. Transformers shall not be transported from the factory until all specified tests have been successfully performed and the OE has released the transformer for transport. Seller shall also provide transport notification and documentation. Transformers shall be delivered by rail unless otherwise authorized by Owner.

10.2 Factory Preparation for Transport

Seller shall prepare transformer and accessories for transport such that all parts are protected from damage or deterioration in transit to site and that Owner receives adequate equipment and instructions for complete and proper assembly on Site.

10.2.1 Insulation Condition

Seller shall take all precautions necessary to insure that the transformer insulation is as dry as practicable upon both departures from factory and arrival at Site. Transformers shall be filled with dry air for transport. Seller shall test internal pressure and moisture level immediately before departure from factory. Time from completion of dry air filling until these measurements are made shall be sufficient to allow equilibrium inside the tank between dry air and cellulose (24 hr minimum).

Upon departure from factory, internal pressure and dew point temperature shall meet the following conditions: Pressure shall be not less than 0.5 psig (105 kPa) and dew point shall not exceed -42 °C when corrected to 20 °C dry bulb temperature and measured between 0.5 and 2.0 psig (105 and 115 kPa). The measured dew point temperature, coincident dry bulb temperature, internal pressure, and date of measurement shall be permanently stenciled on the tank near the base or shown on a permanent, small information plate mounted on the tank before departure.

During transport, transformers shall maintain internal pressure and dew point level at all times such that the following conditions are met upon arrival: 1) internal pressure shall be between 0.5 and 2.0 psig (105 and 115 kPa); and 2) the dew point temperature shall not exceed -42 °C when corrected to 20 °C dry bulb temperature and measured between 0.5 and 2.0 psig (105 and 115 kPa). A valve, so designated on the Outline Drawing, shall be available for accomplishing pressure/vacuum measurements upon arrival.

10.2.2 Identification and Match-Marking

All parts shall have identifying tags or markings. All parts that require specific assembly orientation shall be match-marked. All identification or match marks shall be clear and legible when received on site.

10.2.3 Special Assembly Tools

If special assembly tools, not commercially available, must be used for transformer assembly, two sets of such tools shall be supplied per transformer.

10.3 Delivery of Accessories

All parts and accessories removed for transport to site shall arrive on Site at the same time as the transformer main tank. Seller shall coordinate this regardless of whether the accessories are shipped together with the transformer or by alternate means or routing. Regardless of the means of shipment, each container shall be clearly marked with at least the following markings:

- 1) Point of destination
- 2) Owner's Order number
- 3) Serial number of the transformer.

Each container shall have a detailed packing list identifying items and their quantities contained within. Packaging of critical accessories, for example, those that include insulation materials, shall be sufficient to avoid contamination or moisture absorption. Transport of such items shall be made with adequate environmental control.

10.4 Impact Recorder

Two (2), three way impact recorders shall be mounted on the transformer and one (1) on each rail car used for transport of bushings during all modes of transport to site. Seller shall discuss pros and cons of mounting recorder on the core of the transformer with Owner. Recorders shall be functional throughout the transport duration, be mounted and effectively guarded to prevent their damage en route and provide a complete record of the impact experience during transport. Owner shall have access to impact recorder records. Impact recorder charts that indicate rough handling shall be grounds for Owner's refusal to receive the transformer.

10.5 Special Transport Requirements

Transformers designed without the need for special bracing are preferred. Special bracing required to support internal or external parts during transport shall be reusable or easily and economically reproduced. Seller shall provide drawings and installation instructions including any bracing details for the event that Owner needs to relocate the transformer or return it for repair.

Special train, accompanied by a rider, shall deliver transformers and accessories traveling to site by rail. Seller shall submit a thorough written report to the OE detailing the rider's rail transport log of events.

Truck shipments of equipment to site shall be made with open top trucks.

10.6 Oil Delivery

Oil shall be delivered to site by tanker truck unless otherwise approved by OE. Oil shall conform to the requirements specified in Section 6.17. Seller shall notify Owner in writing at the time of placement of the order for oil.

10.7 Shortages and Delivery Delays

Equipment shortages and delivery delays shall be avoided by Seller with all reasonable means. In event that either should occur, Seller shall provide immediate notification to Owner. Seller shall provide revised shipment date(s).

Until the equipment has completed its required factory testing, notification of shipment delay and its cause shall be given to Owner immediately upon its discovery, even if there is a good chance the delay will be avoided. Delays after this point, due to shipping constraints, shall be reported to Owner's expeditor.

10.8 Storage

Transformers shall be capable of storage in dry air for up to six months after arrival on Site. Seller shall provide recommended maximum dry air storage time instructions. Seller shall also advise of any special insulation processing requirements following extended storage in dry air. Suitable packaging and instructions shall be provided for spare parts and accessories such that they can be stored indefinitely without deterioration.

10.9 Acceptance Inspections and Criteria

Seller is responsible for their representative's timely field inspections upon delivery to site, in coordination with Owner.

10.10 Uprighting/Rigging Requirements

Seller shall provide accessories required for uprighting and assembling transformer at site. For example, if a transformer requires transport in a laid down position, or other special rigging accessories, Seller shall provide all rockers or other accessories required for uprighting. This also applies to special cradles or jigs for installing bushings, insulation components and so-forth. These shall be delivered in the same manner specified for accessories in **Section 10.3** above.

10.11 Gaskets

A complete set of new gaskets other than those used for shipping to site shall be supplied for use at installation.

11. DOCUMENTATION

11.1 General

This section specifies documentation requirements for drawings (**Section 11.2-11.17**), instruction books (**Section 11.18**), photographs (**Section 11.19**), transformer and bushing test reports (**Section 11.20**), trouble reports (**Section 11.21**), special engineering reports (**Section 11.22**), schedules (**Section 11.23**) and notification requirements (**Section 11.24**).

All Seller's documents shall be written in English language. Documents other than approval drawings shall be printed on plain white paper, 8.5 X 11 in. (22 X 28 mm) in size, unless prior approval is obtained from OE. Additional requirements for documentation shall be as specified in the Contract or as mutually agreed upon by Seller and OE during the course of executing Contract.

11.2 General Drawing Requirements

Drawings shall be submitted in accordance with "EPFS Operating Instruction Vendor Document Submittal," Rev.0, dated June 8, 2011. In addition to the formats listed in "Engineering Guide Vendor Document Submittal," Rev.0, dated May 25, 2004, AutoCAD format (.dxf) is acceptable. Additional submittal requirements are specified below. Requirements for review and approval of drawings are specified in **Section 11.3**.

11.2.1 Transmittal Letter

The transmittal letter and the drawings shall be mailed to the OE. The Ordering Specification number shall also appear on the transmittal letter.

11.2.2 Required Drawings

Seller shall furnish the following drawings for each transformer order. Drawings marked by an asterisk (*) require no approvals by Owner. They are for record purposes only and shall be included in Instruction Books.

11.2.2.1 Physical Drawings

- 1) Outline (11.5)
- 2) List of Parts and Accessories (11.6)
- 3) Transport Outline (11.7)
- 4) Bushing(s) Outlines (11.8)
- 5) Nameplate (11.9)
- 6) Piping Schematic (11.10)
- * 7) Conservator Air Cell (11.11)
- * 8) Installation Details (11.12)

11.2.2.2 Electrical Drawings

- 1) Control Schematic (11.13)
- 2) Wiring Connection Diagram (11.14)
- 3) Cabling Diagram (11.15)
- 4) Control Panel Layout (11.16)
- 5) BCT Certified Test Curves (11.17)

11.2.3 Title Block

All drawings except standardized bushing and BCT drawings shall have Owner's title block that states the following:

- 1) Ordering Specification number and revision date
- 2) Contract number, or Purchase Order number if Contract is not used
- 3) Transformer Serial Number(s), if available
- 4) Transformer MVA and kV ratings, unless shown elsewhere on drawing
- 5) Seller's Shop Order Number

In addition to the Title Block, Seller shall provide a clear space, at least 4 in. wide by 5.25 in. high (105 x 135 mm) near the lower right hand corner of each drawing. This space is for Owner's internal routing and approval form that will be fixed to each drawing.

11.2.4 Required Information

Information required to appear on drawings is specified in Sections 11.5 - 11.17.

11.2.5 Physical and Electrical Units

Physical quantities such as mass (weight), length, area, volume, force, velocity, flow rate, etc., shall be given in English units with metric (SI system) units provided in parentheses. Electrical quantities shall be metric, except motor horsepower ratings are permissible when motor efficiency and power factor are also provided.

11.2.6 Lettering Height

Lettering shall be at least 0.125 in. (3 mm) tall.

11.3 Drawing Review

Seller shall submit drawings for OE approval as specified by the submittal procedure in 11.2.2. Information specified to appear on the specific drawing per Sections 11.5 - 11.17 will be supplied on initial approval drawings in order to minimize the need for OE to repeat specified requirements as comments. If Owner's review of Seller's approval drawings reveals disregard for specified requirements, the drawings may be considered "not approved" without further review. Delays caused by Seller's disregard for specification requirements shall be responsibility of Seller.

The submittal schedule and review procedure shall be as specified in 11.3.1 -11.3.5 below. OE will review approval drawings and will respond to seller, within four (4) weeks after receipt, in a Drawing Review Disposition letter.

11.3.1 Approval Drawing Submittal Schedule

Initial approval drawings shall arrive at the address designated by OE within 16 weeks after Seller's receipt of order. Initial submittal shall include all required physical approval drawings (11.2.2.1), except the Piping Schematic, together with the Control Schematic and calculated BCT curves.

The Piping Schematic shall arrive at the required address within six weeks after Outline drawing is "Approved in General" by Owner. The date of this approval shall be defined as the date of Owner's disposition letter. All remaining Electrical drawings (11.2.2.2) shall arrive at the designated address within six weeks after the Control Schematic has been "Approved in General" by Owner.

Seller shall revise, within six weeks of the date of disposition letter, all drawings that are "Not Approved" By Owner. Drawings, which are "Approved Except as Noted" by Owner, will be revised within five (5) weeks of the date of the disposition letter. Seller shall make all drawing revisions required in order to resolve "Not Approved" or "Approved Except as Noted" comments by Owner. Each drawing shall be resubmitted as many times as necessary until it has been "Approved in General" by Owner.

11.3.2 Final Drawing Submittal

Final Drawings are required within six weeks of the date of approval or two months before delivery, whichever is earlier. For duplicate transformers, Seller shall submit final drawings as specified in 11.3.4.

11.3.3 As Built Drawings

If, due to Seller's need or due to field modifications for which Seller is responsible, some change is required which will affect accuracy of final drawing(s), Seller shall issue revised drawings which shall be identified as "As Built" drawings and shall provide a clear written description summarizing what has been changed and for what purpose the change was required.

11.3.4 Drawings for Duplicate Transformers

When a transformer is ordered by Owner as a duplicate of one previously supplied by Seller, approval drawings are not required unless otherwise specified by Owner with the order, or if substantive changes in drawings are necessary for Seller. Duplicate drawings shall be issued as final drawings (11.3.2). The only change required on drawings shall be that a revised title block (11.2.3) must identify the duplicated transformer. In this case Seller shall submit final drawings within six weeks of Seller's receipt of an order.

Wherever possible duplicate designs shall have the same serial number with a unit specific number. If this is not possible a reference shall be made to the original design serial number on nameplate, drawings, and documents. If for some reason Seller's drawings will not be duplicates of prior drawings, Seller shall notify OE within one month of receipt of an order and approval drawings shall be required.

11.3.5 Changes

If drawing comments involve a price change, Seller must so advise OE in writing prior to implementation. Owner must approve the change.

11.4 Correctness of Drawings

Approval of drawings by OE shall not relieve Seller of responsibility for correctness, or for consequences arising from error or omission. Where variations exist between approved drawings and Ordering Specification, the Ordering Specification requirements shall apply unless specific approval in writing is granted by OE for each variation.

11.5 Outline Drawing

Seller shall show the Outline in five views: A top view and four elevation views. A base detail shall be provided as described in (15) below. The Outline need not be limited to one page. However, it is desirable that the Outline not exceed five pages. When the location of an item is specified to appear on the Outline, its distance, in two views, from centerline and its height above the base shall be provided either directly or by addition/subtraction between not more than two dimensions. In addition to the title block, the following information shall appear on the Outline:

- 1) Total mass of assembled transformer
- 2) Untanking mass
- 3) Core and coil mass
- 4) Mass and volume (at 25 °C) of oil (total)
- 5) Mass and volume (at 25 °C) of oil in coolers, radiators, LTC compartments, and expansion tanks
- 6) Mass of removable major components such as coolers/radiators
- 7) Mass of all paper and pressboard insulation
- 8) Total number of coolers or radiators on the transformer and the mass of each individual cooler/radiator
- 9) Location/size of all items for Owner connections or accessory mounting, e.g.: SA, BPD brackets; bushing terminals, bus duct flanges, ground pads and cable clamps, cabinet entry plate (7.7.1)
- 10) Control cabinet size, door swings, door lock mechanism type, location, height, detail of removable bottom plate, location of Seller's entry points
- 11) Center of gravity, fully assembled
- 12) Table of minimum strike distances, as specified in 6.8 and 6.9
- 13) Approximate location of all gages (± 3 in.)
- 14) Height or distance to remove all bushings
- 15) Complete structural layout of transformer base including detail of bearing area of internal structural supports or recommended supporting beam/pier placement
- 16) Detail sketch and/or description of ground pads, cable clamps, arrester and BPD brackets, untanking sketch, and bus duct flanges
- 17) Color of paint and bushing porcelain. Items galvanized or treated by means other than paint will be identified
- 18) Bushing draw lead size and material, if applicable
- 19) All items shall be identified with an part number for reference to the Parts List (11.6)
- 20) An asterisk (*) shall appear adjacent to the item number of all items removed for transport or requiring field assembly
- 21) Location and means of access of core ground bushing
- 22) Bushing cantilever strength and all other bushing data required by 11.8, when not provided on the bushing Outline, or Parts list
- 23) Location and size of manholes
- 24) Flood level (assumed at control box bottom if not otherwise shown)
- 25) Description of area and type of non-magnetic portions of tank
- 26) Designated valve for pressure/vacuum measure if gauge not provided
- 27) Place(s) of manufacture and final assembly of the transformer and major components.

11.6 Parts List

A Parts List shall be provided either separately or as part of the Outline. If the Parts List appears on the Outline then all required information below shall instead appear on the Outline.

Parts shall be numbered to correspond with part numbers shown on the Outline. The quantity of each part shall appear on the list. Parts removed for transport to be indicated by an asterisk (*). For purposes of future maintenance and spare parts inventory, each part shall be described by its vendor name and complete catalog, style, model or type designation, including any special suffix or code that identifies specific features. Owner

shall accept neither the drawing nor the part until this complete description is provided. This information must appear on the drawing beginning from initial submittal for approval. The following additional items and information shall appear on the list:

- 1) All valves and fittings, including types and sizes
- 2) All devices, gauges, indicators and accessories mounted on the transformer (devices in control cabinet are covered in 11.13)
- 3) Fans and pumps with NEMA frame size and ratings, including: number of phases, kW, kVA, rated current and voltage, starting current and torque, speed, Service Factor, and insulation class. Fan CFM, and pump GPM and static head shall also be provided
- 4) Control cabinet and terminal box description, e.g. dustproof, shock mounted, etc.
- 5) Tap changer model no., rated current, BIL contact-contact and contact-ground
- 6) Bushings including: conductor type (draw lead, bottom connected, etc.), draw lead size and material, BIL, current rating, top terminal description, and cantilever strength. If not shown on Outline, this data may be provided on the Bushing Outline
- 7) Conservator air cell, if applicable
- 8) Gasket material, if other than Nitrile rubber.

11.7 Transport Outline

The following information shall appear on a separate Transport Outline Drawing:

- 1) Transport mass
- 2) Transport dimensions, including clearance dimensions to bushing flanges
- 3) Transport center of gravity
- 4) Transport profile
- 5) Transport condition (insulating fluid or dry air filled)
- 6) Location, detail sketch of jacking, lifting and pulling facilities
- 7) Impact recorder location(s) and impact limits
- 8) Height over highest non-removable part
- 9) Other pertinent data as specified below.

The shipping profile shall show x-y (width-height) coordinates of transformer at all pertinent discontinuities in order to establish clearance through tunnels, bridges and other transport profiles. The shipping profile need not be drawn to scale and may be presented as a table of coordinates. For transformers shipped on Schnabel cars, composite car unit weight, axle loading and minimum turning ratios of loaded car shall appear on Transport Outline.

11.8 Bushing Outline

The following bushing information shall appear either on the Bushing Outline drawing or on the assembled transformer Outline:

- 1) Nominal System Voltage
- 2) BIL
- 3) Lead size and material, and inside diameter for draw rod or lead
- 4) Top terminal dimensions, material and thread description
- 5) Current ratings (dual rating where applicable)
- 6) Minimum creep distance
- 7) Wet switching surge voltage for bushings rated 345 kV and above

- 8) The cantilever strengths (lbs and N) available at top end of each bushing for Owner's cable leads, etc.

11.9 Nameplate

The following information shall appear on the nameplate and Nameplate drawing in addition to information specified by ANSI C57.12.00:

- 1) All internal electrical components and their connections including current limiting reactors, series transformers, tap changers, non-linear resistors or protective devices, current transformers, fuses, etc.
- 2) BCT ratios and accuracy classifications, including hot spot CTs
- 3) Tap position designations shall be numerals, arranged from maximum to minimum turns ratio, e.g., {1=max, 2, 3=nominal, 4, 5=min} for five-tap designs, or {1=max, 2=nominal, 3=min} for three-tap designs
- 4) Winding form (cylindrical or shell) and conductor material.

11.10 Hydraulic Schematic

A piping schematic shall be provided which shows the location, size, connection, valving, and other fittings for all pipes external to the tank. The cooling circuit piping and gas collection and/or sampling piping shall be included. The valves and fittings description may appear on this drawing in lieu of the Outline or Parts list.

11.11 Conservator Air Cell

Seller shall provide a drawing of the air cell for the conservator including a complete specification of material required.

11.12 Installation Details

Complete installation drawings shall be provided with the IB giving complete detailed sketches and instructions for any internal and external field assembly required. Any special transport bracing which must be removed shall appear with its details on the drawings. If this bracing is required for future transport, this shall also be stated on the Installation Details. The drawings shall provide specific instructions on the color and labeling of parts for removal.

11.13 Control Schematic

The following information shall appear on the Control Schematic drawing:

- 1) Power circuit and control scheme for fans and pumps (or for future cooling equipment)
- 2) Description of all temperature, pressure or other settings of each device using contacts.
- 3) Alarm and trip development scheme
- 4) Make, type, description and rating of all control and protective components
- 5) Voltages of all systems
- 6) Cooling equipment full load power requirements, including motor starting inrush current
- 7) Owner's power supply method: voltage and connection (Delta, Wye, etc.).

11.14 Wiring Connection Diagram

The Wiring Connection Diagram shall be issued for approval after the Control Schematic is approved. The following information shall appear on the Wiring Connection Diagram:

- 1) Terminal block arrangement (7.6) with Owner's connection side clearly shown for each block
- 2) A unique number or alphanumeric designation shall identify each block and terminal.
- 3) Each BCT terminal block shall be clearly referenced to its associated bushing and BCT
- 4) BCT ratio and accuracy classifications
- 5) Point to point connections of all devices by means of a wiring diagram is preferred. However, a table of point-to-point connections is acceptable. When a table is used, the table shall include a description of the path taken by the wire
- 6) Terminal block description (7.6.3) for all blocks
- 7) Wire description for all wires including conductor and insulation information.

11.15 Cabling Diagram

The Cabling Diagram shall be issued for approval after the Control Schematic is approved. The following information shall appear on the Cabling Diagram: The connection of all motors, including a description of junction boxes, power cable description and description of all electrical connectors and terminals.

11.16 Control Panel Layout

The Control Panel Layout shall be issued for approval after the Control Schematic is approved. An internal layout of the control panel including all devices and terminal blocks shall appear on this drawing. The drawing should be to scale or generally dimensioned, especially indicating the location of terminals for Owner's power supply connection and the minimum clearance available at the bottom of the control box and between terminal blocks.

11.17 BCT Curves

A complete set of measured BCT excitation and ratio correction curves shall be provided for each BCT at every BCT tap position. Certified test results shall be provided.

11.18 Instruction Books (IB)

11.18.1 General

IBs are required for each transformer as specified below.

11.18.2 Approval

Two advance copies of IB shall be submitted by Seller to OE, a minimum of twelve (12) weeks before scheduled shipment. If drawings are not finalized at that time, the latest revision of all drawings shall be included in the advance IBs. The remaining contents shall be as complete as possible and omissions shall be clearly identified.

OE will review advance IB for completeness, clarity and compliance with required contents as described below. OE will then return comments to Seller within four (4) weeks of receipt. Seller shall revise IB to incorporate these comments. Review by OE is not for purposes of approving Seller's installation and maintenance procedures, although clarifications may be required.

11.18.3 Number of Copies

One (1) copy of the final IB shall be shipped with each individual transformer. These should be placed inside the control cabinet. In addition, the quantity of copies specified in the table below shall be submitted to the OE a minimum of one (1) month prior to shipment of the transformer.

Quantity of Transformers Ordered	Number of Instruction Books
1	6
2	9
3	12

For greater quantities of transformers, three (3) additional IBs shall be provided for each additional transformer ordered.

Two electronic copy shall be submitted to the OE.

11.18.4 Contents

Instruction manuals shall be contained in hard cover, ring binders and contain at least the following:

- 1) Cover page
- 2) Table of Contents/Index Tabs
- 3) Drawings, Diagrams and Schematics, Winding configuration
- 4) Transport and Handling Information
- 5) Accessories, Control and Protection Equipment Information
- 6) Installation, Maintenance and Storage Instructions
- 7) Renewal Parts List
- 8) Photographs (photocopies of originals are acceptable)
- 9) Performance Characteristics Information per **Section 9**
- 10) Seller's Insulating Oil Specification
- 11) Other Information supplied by Seller or required by Owner

The following items further specify documentation required to appear in IB:

11.18.4.1 Binding Edge Label

The binder shall have a flat binding edge that bears a permanent label. The label shall identify, as a minimum, the following: type of transformer

(e.g. GSU transformer or unit aux transformer), Seller's name, serial number(s), and power and voltage ratings. Additional information can be provided if possible, such as IB number, Contract and purchase order numbers, Ordering Specification number and Owner's name.

11.18.4.2 Cover Page

The cover page shall include at least the following: type of transformer, serial number(s), Owner Contract and Order numbers, Ordering Specification identification and date, Seller's shop order number, location of manufacture, and other pertinent Seller references.

11.18.4.3 Table of Contents

The Table of Contents can be provided in either of the following methods. One method is to provide a general table of contents following the cover page at the front of the manual referring to major sections. Each major section shall have an index tab, and immediately following the index tab, a complete listing of contents in that section of the manual. Another method is to provide a complete table of contents at the front of the manual, following the cover page. In either method, the listing of contents shall identify the contents completely, including the revision number and/or date of instruction/information bulletins.

11.18.4.4 Drawings, Diagrams and Schematics

All drawings, diagrams and schematics specified in **11.2.2** shall be included.

11.18.4.5 Winding Configuration

Information concerning the winding configuration as specified in **Section 8** shall be included.

11.18.4.6 Transportation and Handling

At least the following shall be included: transport drawings, and instructions for handling, rigging and receiving.

11.18.4.7 Performance Characteristics

Performance characteristics information shall include general information required by **Section 8** and the Ordering Specification, such as overload and over-voltage capability data, a general winding schematic and a 60 Hz impedance model. More detailed design review data, such as impulse distribution, detailed design review data, short circuit capability, etc., is considered as confidential engineering information and shall not be published in the instruction book in order to maintain confidentiality.

11.18.4.8 Assembly Information

Complete assembly instructions shall be provided. Gasket details per 6.14 shall be included. Lead taping instructions must be supplied in detail. A description of match marking methods and shipping brace markings and removal instructions are required. If a desiccant material is used within the transformer during transport, the location and instructions for removal shall be provided.

Insulation processing instructions shall be provided in detail, including: criteria for dryness used by Seller both in factory and in the field; vacuum and filling procedures that are consistent with the dryness criteria provided.

11.19 Photographs

Two sets of photographs sufficient in number and perspective to reveal the complete core and coil assembly details shall be made prior to tanking each transformer. In no case shall less than three photographic angles be made. In addition, each purchase order shall have two sets of photographs made of: the assembled core before landing the coils, each coil section (inner, middle and outer windings) before assembly, view showing all of the inside walls of the tank and views showing all sides and ends of the assembled transformer. These photographs shall be made of each phase of the transformer. Photographs shall be sent to OE as soon as they become available but not later than two weeks prior to delivery. Photocopies of these prints shall be included in the IB (11.18).

As required in 11.21, if a factory failure should occur, photographs shall be taken of the areas of failure and one full set of such photos shall be supplied with the failure report to OE.

11.20 Certified Test Reports

The required test reports include Seller's certified transformer test report, bushing design test report and bushing routine test values as described below. All test reports are required to be received by OE no later than two weeks following completion of transformer tests. "Certified," indicates that Seller's appropriate engineering or QA representative signed the test report. Actual measurements and associated guarantees or standards to which they are to be compared shall be reported. This includes actual and standard waveshapes.

11.20.1 Seller's Test Report

Six (6) paper copies and one (1) electronic copy of Seller's certified transformer test report are required. Test results of individual units shall be submitted as individual test reports.

The transformer test report shall contain all data on each test required in Section 9. Transformer test reports shall also include a general circuit schematic including representation and description of:

- 1) Impulse generators (capacitance, resistance, initial voltage, number of stages installed)
- 2) Circuit resistors and capacitors (for example, lumped elements used in impulsive tests)
- 3) Measuring impedances (divider descriptions, shunts, etc.)
- 4) Measuring instrumentation (connections & descriptions)
- 5) Test object (tap position, connections/terminations, impedances of all terminations)
- 6) Alternating current generators (MVA, kV, no. phases, frequency)
- 7) Calibration measurements (for dielectric tests)
- 8) Actual waveshapes achieved
- 9) All other data required by 9.10.

Seller's test report shall state the name of the inspector who represented Owner at the dielectric tests and/or power tests. If no one attended the test to represent Owner, this shall also be noted.

11.20.2 Bushing Test Reports.

Six (6) paper copies and one (1) electronic copy of bushing certified test values shall be provided including bushing serial numbers, capacitance, and power factor measurements on condenser bushings rated 23 kV class (150 kV BIL) and above. This data shall be provided on a single sheet unless the amount of data exceeds that which can be legibly presented on a single sheet.

One (1) certified test report of bushing design tests required by ANSI/IEEE C57.19.00 shall be provided for each bushing, or set of identically designed bushings, to be applied at or above 138 kV, (line-line) system voltage. Only one copy of this report is required per order, regardless of quantity of transformers ordered. This requirement will be waived for each bushing design for which a certified test report has been previously submitted to OE. Seller must receive confirmation from OE that this requirement has been waived.

11.21 Trouble Reports

Test failures, questionable test results, failure to meet any guaranteed or specified requirements, and important quality defects shall be brought immediately to the attention of OE for resolution by Seller prior to proceeding with fabrication, repair, testing or shipment. Seller shall advise OE and provide OE the opportunity to witness teardown. Seller shall provide a detailed failure report to OE including photographs of the damaged or defective items. Seller shall provide electromagnetic field plots and other supporting data upon request, where appropriate to the mode of failure.

Seller shall not initiate repair of failed or defective components as specified above until OE has agreed to the proposed repair, procedure or modification.

11.22 Special Engineering Reports

A special engineering report shall be submitted with all performance and design review data specified in **Section 8** and in the Ordering Specification. Detailed Design Review data shall be held as confidential and proprietary. This report shall be issued in one complete book, e.g., a binder similar to that provided with the IB.

11.23 Schedules

A production schedule shall automatically be provided to the OE beginning six weeks after Seller's receipt of an order with updates submitted at six-week intervals thereafter. Additional updates shall be provided as requested by the OE.

11.24 Notification of Manufacturing and Testing Stages

OE shall be notified as early as possible (minimum of three weeks) prior to the following events so that travel arrangements can be approved for witnessing each of these steps:

- 1) Placing coils on core, before assembling top yoke
- 2) Tanking of core and coils
- 3) Dielectric tests (impulse and induced tests)
- 4) Temperature rise tests

Until notified otherwise by OE, Seller shall assume that OE shall attend each of the above events. Failure to provide proper notification of these events may result in the need for Seller to delay proceeding with production or testing until OE is able to arrange to witness these events at the factory.



SPECIFICATION COVER SHEET

TITLE: Fleet Control Data Communications Design Criteria

SPECIFICATION NUMBER: DC-ICE-005

PROJECT:	Fossil & Hydro Generation Projects
REVISION:	0, SUPERCEDES DC-FGD-SCR-011
DATE:	3/26/2012

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INTERNAL APPROVAL SIGNATURES

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AUTHOR: Brian E. Newell	<i>Brian Newell</i> 3/26/2012
REVIEWED BY: Randy L. Calhoun	<i>Randy L. Calhoun</i> 3/26/2012
APPROVED BY: James R. Fletcher	<i>JR Fletcher</i> 3/26/2012
Timothy V. Riordan	<i>T.V. Riordan</i> 3/26/12

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REVISION HISTORY

REV.	SCOPE OF REVISION	REV. DATE	PREPARER/ REVIEWER	APPROVAL
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1.0 PURPOSE

This document provides criteria for the application of data communication network technology within an AEP electric generating facility. Included is a description of architecture, hardware, and media. It is not the intention of this document to dictate the design of every possible network implementation at the hardware level but to define a consistent approach to developing the high level configuration and the interconnectivity of these systems. Adherence to this document shall provide a consistent interface and design approach for the networks at each AEP electric generating facility. The networks discussed include the following types: Distributed Control System (DCS) Networks, Programmable Logic Controller (PLC) Networks, Monitoring Equipment Networks, Plant Business Local Area Networks (LAN) and Corporate Wide Area Networks (WAN).

Examples of network topology have been included in section 6.0 of this guide.

2.0 APPLICABILITY

- 2.1** This document is applicable to any organizations performing work at an American Electric Power electric generating facility.
- 2.2** This document shall be used for all AEP projects where microprocessor-based networks (e.g. DCS, PLC) are added or modified.
- 2.3** This document shall be used as the basis for interfacing the DCS Networks, PLC Networks, Plant Business LAN, and Corporate WAN as defined and discussed below. Specific guidelines for the Plant Business LAN and Corporate WAN are by AEP IT and are not addressed in this guide.
- 2.4** Any request for deviation from this guide requires written approval from the AEP Engineering Services Instrumentation and Controls Engineering Section Manager.

3.0 DEFINITIONS

- 3.1** Communication Protocol – Method of addressing data so it can be transferred to and/or from the appropriate network devices. Typical Ethernet protocol utilizes the TCP/IP (Transmission Control Protocol/Internet Protocol) standards. Modbus or proprietary communications can be used as well.
- 3.2** Standard Ethernet (10BASE-T) - 10Mbps using the IEEE 802.3 data communication standard, TCP/IP protocol, and twisted-pair copper cable.
- 3.3** Fast Ethernet – 100BASE – X Ethernet Systems using the IEEE 802.3u data communication standard, TCP/IP protocol, and either copper or fiber-optic cable.
- 3.4** Gigabit Ethernet – 1000BASE – X Ethernet Systems using the IEEE 802.3ab data communication standard, TCP/IP protocol, and either copper or fiber-optic cable.

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- 3.5** Corporate Wide Area Network (WAN) – This is the AEP Corporate Network to which each of the AEP Plant Business Local Area Networks are connected
- 3.6** Plant Business Local Area Network (LAN) – This is the network on which the plant management, plant business support, and plant engineering staff’s business computers reside.
- 3.7** DCS Operations Network – This is the network of HMIs (operator consoles) that communicate with DCS Control Networks.
- 3.8** DCS Control Network – This is the network on which the process controllers reside and communicate the various control commands and functions for operation of the units.
- 3.9** PLC Operations Network – This is the network of HMIs (operator consoles) that communicate with PLC Control Networks.
- 3.10** PLC Control Network – This is a network to which multiple PLCs are linked. In addition, it can provide a means for the plant personnel to access PLC programming and diagnostics using configuration software.
- 3.11** Monitoring Equipment Network – This is a network of additional monitoring equipment that does not perform control or protection functions.
- 3.12** DMZ (demilitarized zone) Network - A middle ground between a protected internal network (DCS Operations Network, DCS Control Network, PLC Operations Network, or PLC Control Network) and an external network (Plant Business LAN or AEP Corporate WAN). The DMZ is a sub-network (subnet) that resides behind firewalls or Data Diode communications equipment. This network is designed to provide Plant Business LAN access to unit operational data. There are two types of DMZ’s: (1) Essential DMZ – A grouping of controls, monitoring, or protection equipment that is considered essential to the reliable operation of the generating unit(s). (2) Non-essential DMZ – A grouping of control, monitoring, or protection equipment that is not considered essential to the reliable operation of the generating unit(s).
- 3.13** Switch – Provides interconnectivity between nodes on a network, making it possible for multiple communications between nodes.
- 3.14** Router – Similar to a switch, however, a router has additional intelligence features that enable it to filter and direct (i.e. manage) data between the various networks.
- 3.15** Firewall – Network access control device(s) programmed to limit access to data, applications, or devices across multiple networks.
- 3.16** Node – Control processors, monitoring processors, operator stations, and servers on a network.

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3.17 Data Link – Provides digital communication between the DCS and various third-party devices (e.g. PLC, protective relays, analyzers).

4.0 CRITERIA

4.1 ARCHITECTURE

- 4.1.1** The DCS Control Network, DCS Operations Network, and PLC Control Network shall be segmented from the Plant Business LAN as shown in figure 6.3. DMZ segmentation must be reviewed and approved by the AEP Engineering Services Instrumentation and Controls Engineering Section Manager.
- 4.1.2** If establishing a Plant Business LAN connection to the DMZ, DCS Operations Network, or DCS Control Network a Firewall or Data Diode shall be used. All connections between the Plant Business LAN and these networks shall be reviewed and approved by the AEP Engineering Services Instrumentation and Controls Engineering Section Manager. Firewall and Data Diode equipment will be supplied and configured by AEP.
- 4.1.3** No connectivity shall be permitted between the Essential DMZ and the Internet. All connections between the Non-essential DMZ and 3rd party or vendor networks shall be reviewed and approved by the AEP Engineering Services Instrumentation and Controls Engineering Section Manager.
- 4.1.4** The DCS Control Network and DCS Operations Network shall be fault-tolerant, utilizing redundant hardware including communications equipment, communications media, and power supplies/sources where applicable. Figure 6.1 and 6.2 represent typical architectures. The specific requirements of the DCS shall dictate which network shall be used.
- 4.1.5** Connections between the DCS Operations Network and the DCS Control Network shall be through Ethernet or a proprietary communications connection. (i.e. ABB Computer Interface Unit or APACS Network Interface Module)
- 4.1.6** HMIs, historians, data servers, and engineering stations shall be connected to the DCS Operations Network. They shall be able to maintain a line of communications to the DCS Control Network as well.
- 4.1.7** Process information from the DCS Control Network and PLC Control Network shall be capable of interfacing with an OSI PI Historian.
- 4.1.8** The proposed use of data links between a PLC Network or Monitoring Equipment Network and a DCS Network shall be reviewed and approved by the AEP Engineering Services Instrumentation and Controls Engineering Section Manager.

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- 4.1.9 Data links shall not be used for control. Hard wired I/O shall be used for high-level commands, for example: start, stop, interlocks, trips, and set point changes.
- 4.1.10 Data links shall be limited to providing monitoring capabilities to the DCS operator workstation.

4.2 COMMUNICATIONS MEDIA

4.2.1 COPPER/FIBER

- 4.2.1.1 The DCS Control Network shall operate at a minimum of 100Mbps.
- 4.2.1.2 The DCS Operations Network shall operate at a minimum of 100Mbps.
- 4.2.1.3 Fiber-optic network cable shall be multimode 12-pair (minimum). Maximum length for multimode fiber optic communication cables is 2 kilometers (approx. 6500 feet). AEP approved fiber optic patch panels, break-out or fan-out kits should be used to terminate fiber prior to connection to equipment.
- 4.2.1.4 Copper network cable shall be twisted-pair. Maximum length for copper communication cables is 100 meters (328 feet).
- 4.2.1.5 Network cable shall be installed in dedicated conduit. Redundant network cables shall be routed in separate conduits or raceways.
- 4.2.1.6 Interconnection between switches, routers, and nodes shall be via copper cable when these devices are less than 100 meters apart. Fiber-optic cable shall be used for all other installations and where electrical noise or grounding concerns prohibit the use of copper.

4.2.2 DIGITAL BUS TECHNOLOGY

- 4.2.2.1 Digital bus technology is not approved by default. Any proposed use of digital bus technology for control and monitoring shall be reviewed and approved by the AEP Engineering Services Instrumentation and Controls Engineering Section Manager. This includes the use of control buses (e.g. Foundation Fieldbus, PROFIBUS), device buses (e.g. DeviceNet, PNet, and SDS) or bit-level sensor buses (e.g. Seriplex, AS-i).

4.2.3 WIRELESS

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- 4.2.3.1 Wireless and radio technology are not approved by default. Any proposed use of wireless and/or radio technology for control and monitoring shall be reviewed and approved by the AEP Engineering Services Instrumentation and Controls Engineering Section Manager. This includes the use of wireless transmitters and wireless network communications equipment.
- 4.2.3.2 When approved, wireless technology shall meet IEEE 802-11a, 11b, 11g, or 11n.
- 4.2.3.3 When approved, wireless or radio communications are encrypted at the hardware or application layer with sufficient security to prevent unauthorized snooping. AEP has accepted AES 256 bit encryption at the application layer as adequate. Security by Obscurity (i.e. a proprietary vendor protocol) is not a substitute for packet encryption. Wireless access points shall use WPA2 encryption. WPA, WEP and Open networks are not permitted.
- 4.2.3.4 When approved, all data packets shall include a sequence number or timestamp before encryption so no two transmitted packets are the same. This is to prevent packet spoofing. The receiving end shall recognize and reject an out-of-date or out-of-sequence packet.
- 4.2.3.5 Any battery operated wireless element shall have a low battery indicator and alarm to help prevent loss of data in mid-operation. The alarm shall operate for a minimum of 8 hours before battery exhaustion. Battery life shall be greater than one year.

4.3 COMMUNICATIONS EQUIPMENT

- 4.3.1 Firewalls, Switches, and Routers shall be an approved model from an AEP Engineering Services Instrumentation and Controls Engineering approved vendor.
- 4.3.2 Modems shall not be installed as part of or in devices connected to control, monitoring, or protection system network.
- 4.3.3 Media and protocol converters shall be an approved model from an AEP Engineering Services Instrumentation and Controls Engineering approved vendor.

5.0 EXCEPTIONS

Network technology is a continuously advancing art. Communication protocols and equipment features from both a hardware and software viewpoint are changing and evolving. With this background, it is understood that implementation procedures play a major role in the actual deployment of new control networks as well as the upgrade and maintenance of existing systems.

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Any exceptions to this Design Criteria shall be presented and reviewed prior to purchasing the control system equipment. Final approval of these exceptions shall be by the AEP Engineering Services Instrumentation and Controls Engineering Section Manager.

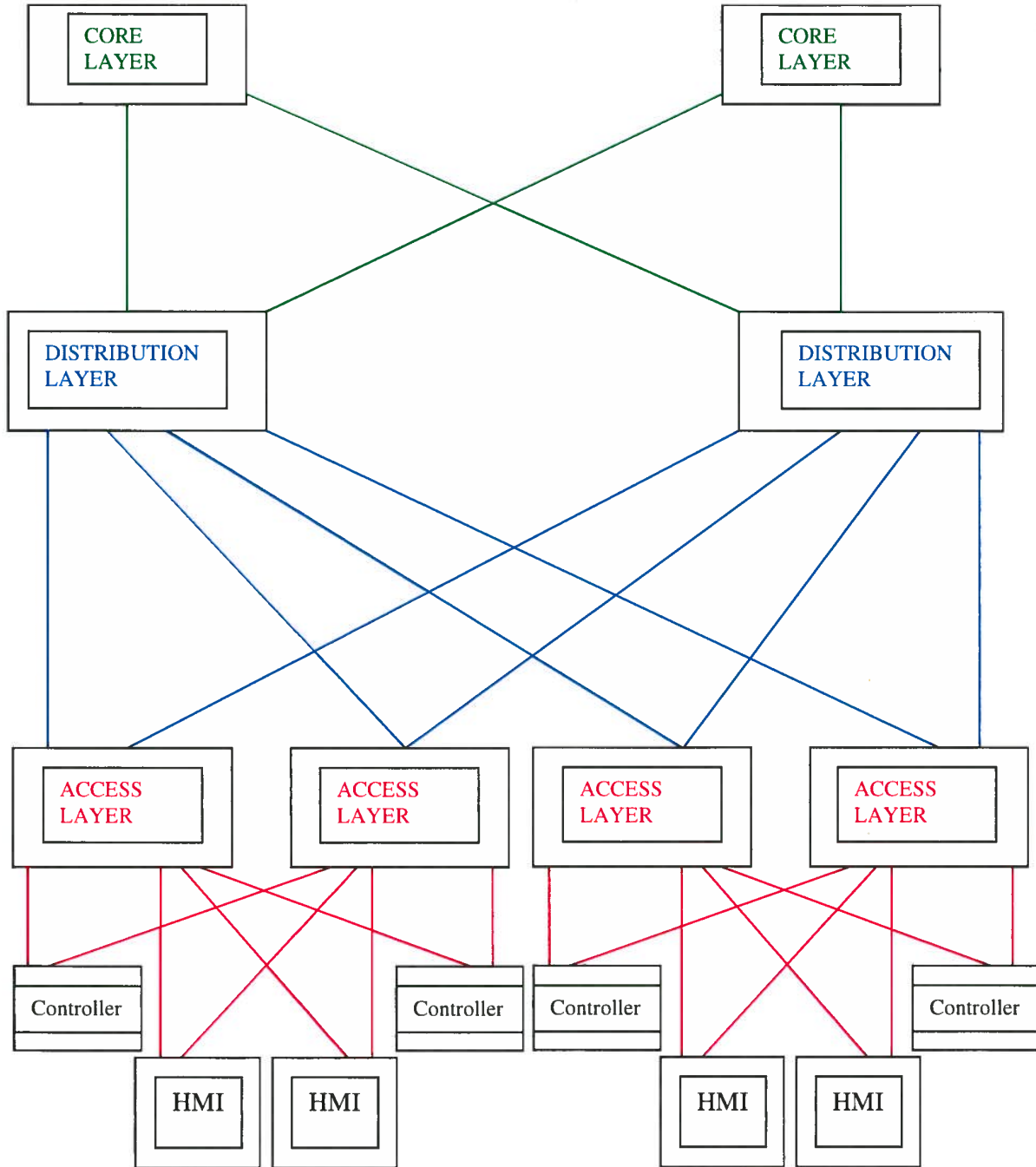
Use the following procedure for requesting an exception to Design Criteria:

1. Develop a functional description of the intended network operation. This shall be at a high level, listing items such as the ultimate intent of the system, the major networks or sub networks, and the major pieces of equipment to be served. The functional description shall also detail the network parameters that impact succeeding decisions such as protocols, data rate, interconnection media, and security measures.
2. Develop a preliminary network architecture sketch. This shall be developed in sufficient detail to promote discussion but not in such high detail that it masks the basic structure of the network and the dataflow. It shall have a well-defined border for each of the sub-systems and show any intended hardware gateways or firewalls between the networks.
3. When the functional description and the preliminary architecture have been completed a configuration meeting shall be held with representatives from each of the interfacing system owners. Information to be reviewed in the meeting shall be sent to all participants for review at least 14 days prior to the meeting date. The following representatives are recommended for attendance to the configuration meeting:
 - a. Plant operations and maintenance personnel
 - b. Plant engineering
 - c. AEP Engineering Services Instrumentation and Control (I&C) Engineering
 - d. Major equipment vendor personnel such as the DCS vendor, turbine vendor, plant historian vendor (if not provided as part of the DCS).
 - e. Architect Engineer (if engaged)
 - f. AEP Corporate IT (as required)
 - g. Network Integrator specialists (as required)

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6.0 EXAMPLES

FIGURE 6.1
HUB & SPOKE NETWORK TOPOLOGY



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**FIGURE 6.2
RING NETWORK TOPOLOGY**

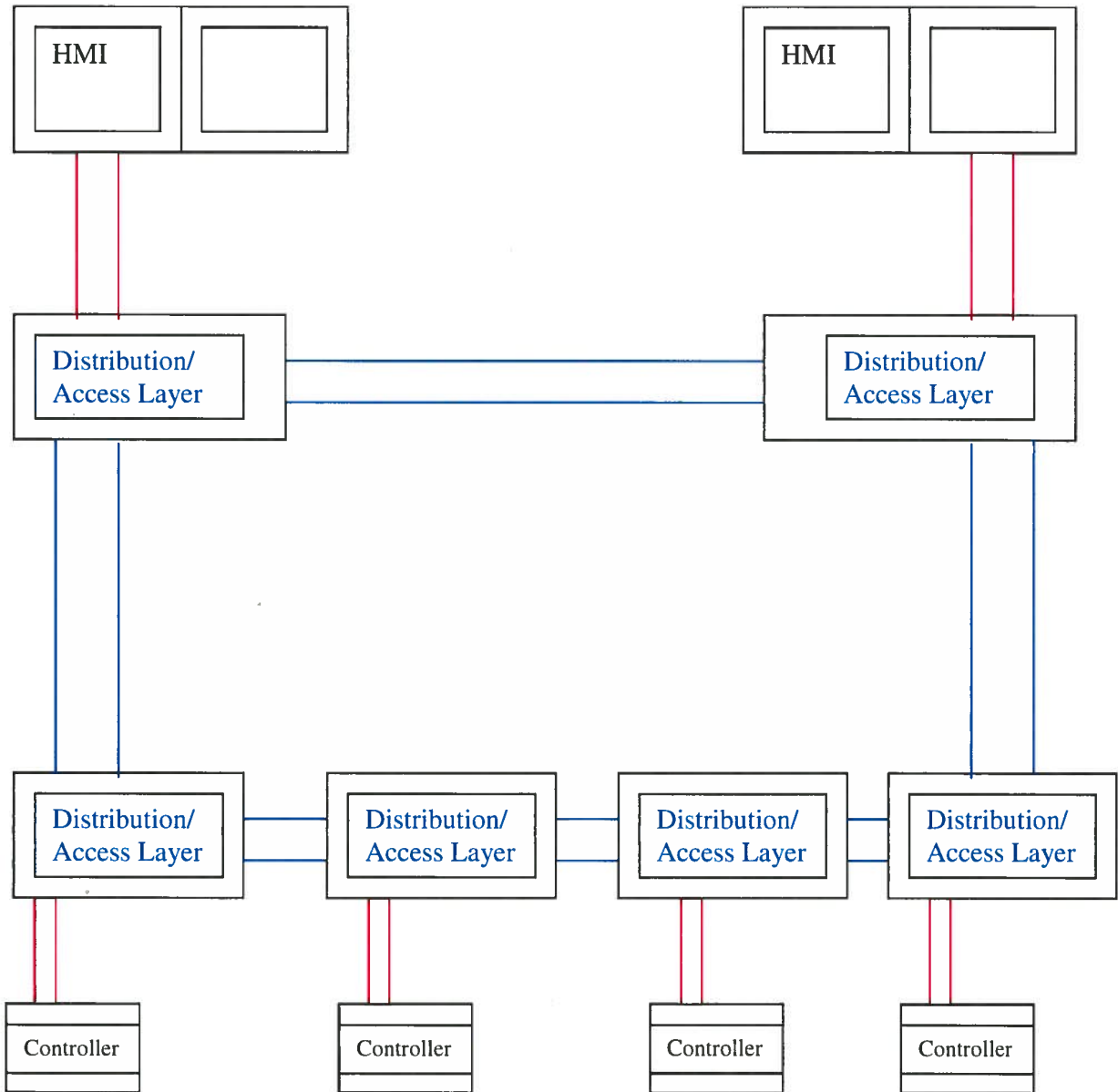
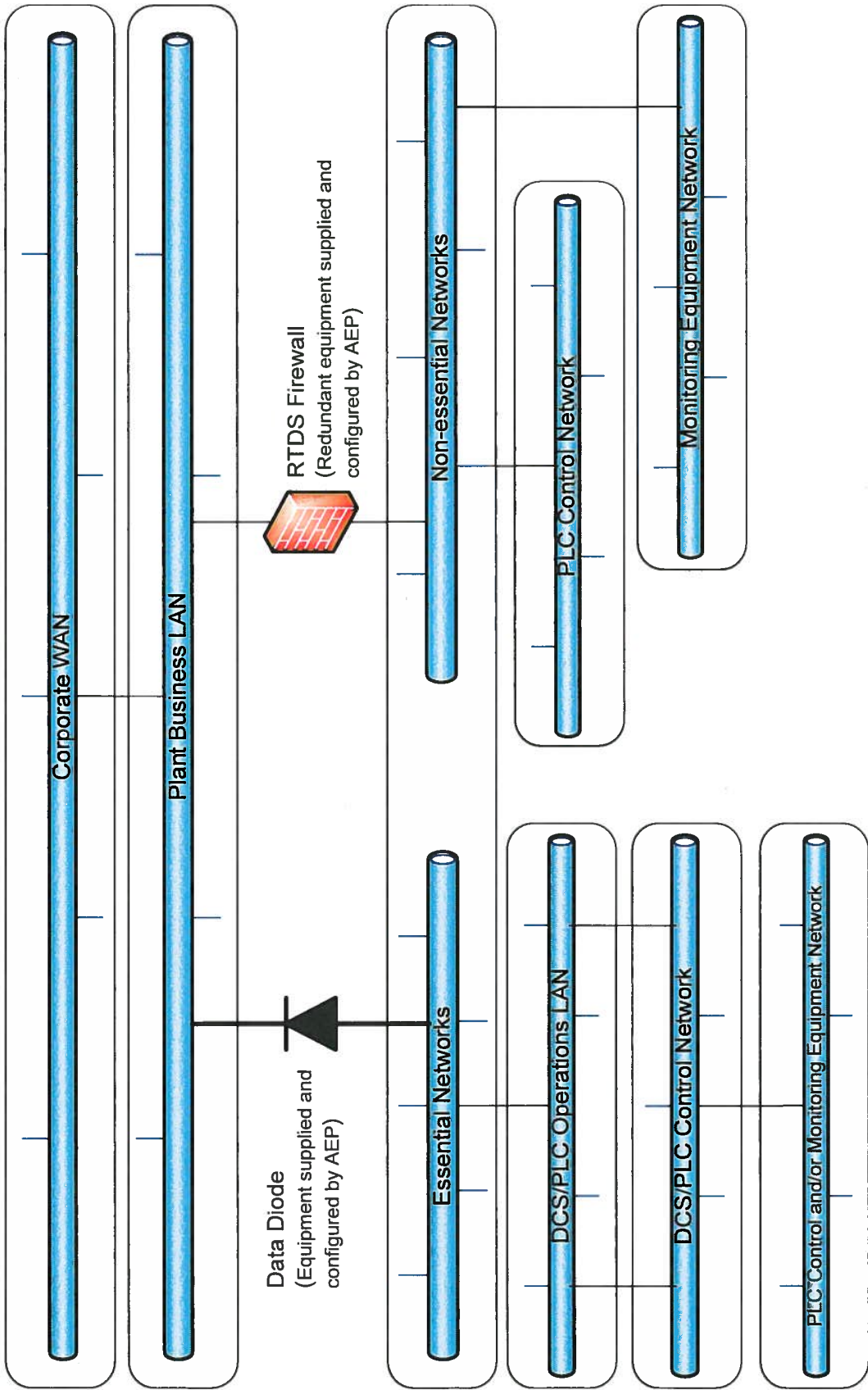


FIGURE 6.3 TYPICAL NETWORK HIERARCHY



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BOUNDLESS ENERGY

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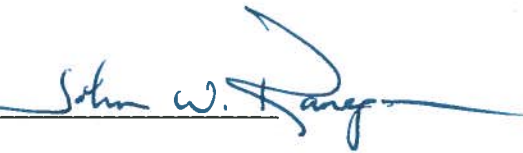
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AEP Generation Scheduling Requirements

Revision 9

Date: 07/30/15

Approved: _____



John W. Ranegar

Approved: _____



Brian D. Sherrick

For Contract: _____

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1.0 INTRODUCTION

- 1.1** The following AEP Generation (hereafter AEP) schedule development and schedule maintenance requirements are included as part of the contract. The purpose is to describe the responsibilities and interface requirements to prepare for, monitor performance and implement a planned project and/or unit outage. If you are unsure of the specific requirements please contact AEP's contract administrator or project manager.

2.0 SCHEDULE REQUIREMENTS

- 2.1** Unless otherwise designated, AEP Project Controls and AEP Outage shall act as the "Integration Scheduler" and they are responsible for establishing the schedule standards for the Integrated Project Schedules (IPS). The Integration Scheduler is responsible to coordinate and maintain the overall Integrated Project Schedule. AEP, in conjunction with the Integration Scheduler (if applicable), will establish the schedule using the Primavera P6 platform for the execution of the work as described in paragraph 2.6.

- 2.2** AEP and each contractor or designee involved in the project are responsible for providing their portion of the Integrated Project Schedule and updates to the Integration Scheduler in accordance with the scheduling deliverables outlined in paragraph 2.6.1.

2.3 Scheduler Requirements/Qualifications

- 2.3.1** Upon schedule submittal, the Contractor shall designate in writing a competent scheduler or scheduling representative in the Contractor's organization who shall be responsible for coordinating with AEP during the preparation and maintenance of the Project Schedule.

- 2.3.2** The Contractor's scheduling representative is considered key personnel by AEP. As such, AEP shall have the right to review the qualifications of the individual assigned as the scheduling representative. The Contractor's scheduling representative shall have complete authority to act on behalf of the Contractor in fulfilling the Project Schedule requirements of the Contract. The Contractor shall notify AEP in writing of any proposed changes in this position.

- 2.3.3** The Contractor's key personnel, the scheduling representative, and to the extent applicable the personnel responsible for developing and inputting information into the Project Schedule shall attend schedule related meetings. For onsite construction labor contracts, Contractors shall provide a qualified onsite scheduler.

- 2.4** The Integrated Project Schedule shall be a logic driven, resource loaded schedule utilizing the Critical Path Method (CPM). The schedule detail will be sufficiently delineated and defined to isolate individual activities within a subsystem as defined in the project Work Breakdown Structure (WBS). The end product will consist of a time scaled network that can be printed in a bar chart format (GANTT). A resource loaded and leveled schedule

(to resource availabilities and reconciled with budgets/staffing plans) will be provided for baseline review within expected timeframe. Updates to the Integrated Project Schedule shall be based on physical percent complete and accurate remaining durations.

- 2.5 The requirements for input to the Integrated Project Schedule shall include, but not be limited to, the following:
- 2.5.1 Assure realistic schedule showing the sequence of activities required to complete all of the work as set forth in the Scope of Work and Compensation sections of the RFP.
 - 2.5.2 For Outage related Projects, the schedules shall represent the period from unit shutdown to release for 100% load dispatching, and must include major pre-outage work, if critical to achieve the outage duration.
 - 2.5.3 Assure adequate planning and execution of the Work by the Contractor and its subcontractors.
 - 2.5.4 Incorporate and assure coordination of the Work of the Contractor with the activities of the Owner and its other Project contractors.
 - 2.5.5 Assist both the Contractor and Owner's designated Project Manager or designee in:
 - Evaluating contract performance relative to the Integrated Project Schedule
 - Progress reporting (as defined in Section 3.0)
 - Proposed Schedule/Scope modifications
 - Daily interaction, including change control

- 2.6 Primavera P6 Project Management Version 7.0 or newer (hereby referred to as P6) will be utilized on the project through the **AEP LAN or by VPN connection to the Primavera Enterprise database** to allow for integration of all schedules. The common schedule will contain the necessary Activity Code structure, see attached appendix "A". Critical decisions required by Owner shall be key milestones in the Integrated Project Schedule. Each contractor will develop a detailed schedule under an EPS Node designated by AEP for that contractor in the master project. This node will provide specific access restrictions and security as to prevent competitors from obtaining confidential information.

For project related activities, the contractor's schedule shall be developed in accordance with the guidance and principles set forth in the AEP Project Scheduling Handbook (available on request). For outage related activities, the contractor's schedule shall be developed in accordance with the guidance and principles set forth in the AEP Outage Scheduling Desktop Guide. These documents provide guidance for:

- Activity ID structure

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- Minimum required activity codes
- Autocost Rules
- Required P6 settings
- Baseline Process
- Activity Fragnets
- Integration Methods
- Quality Assurance Program

Questions concerning the AEP Project Scheduling Handbook and its requirements should be directed to the AEP Project Controls Department prior to acceptance of these terms.

Questions concerning the AEP Outage Scheduling Desktop Guide and its requirements should be directed to the AEP Outage Scheduling Department prior to acceptance of these terms. Latest versions of these guides are available upon request through the Integration Scheduler.

2.6.1 The following information will be furnished by the contractor to the AEP integration scheduler as a minimum for each non-Level of Effort activity:

- Preceding and succeeding Activity ID, Relationship Type, and (if applicable) Lag. Use of Lag must be identified by contractor and approved by the Project Manager and the Integration Scheduler.
- Meaningful activity description
- Estimated duration of activities
- Early start date (unless the activity dates are to be calculated by AEP)
- Early finish date (unless the activity dates are to be calculated by AEP)
- Actual start date (once the activity has begun)
- Actual finish date (once the activity has completed)
- Late start date (unless the activity dates are to be calculated by AEP)
- Late finish date (unless the activity dates are to be calculated by AEP)
- Total float in hours according to the activity's calendar (unless the activity dates are to be calculated by AEP)
- Activity percent complete (usually specified as the physical percent complete type)
- Budgeted units and specific resources required to accomplish the activity.
- Appropriate Roles for activities with resources assigned

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- Budgeted Non-Labor Units and specific commodity resources required for commodity related activities
- Unit rates/rules of credit for commodity driven activities.
- Activity Calendar by which the work is to be performed
- Activity Codes (Required by guidelines and as applicable) refer to Appendix A.
- AEP WBS Structure
- Key Milestones as directed, including Contract Payment/ Completion.

2.6.2 Level of Efforts without budgeted units will be allowed for summarizing groups of activities. LOEs with budgeted units will be allowed for indirect work that are not commodity driven or do not have a measurable deliverable. The following information will be furnished by the contractor to the AEP integration scheduler as a minimum for each Level of Effort activity:

- Preceding and succeeding activity ID number
- Activity description
- Activity percent complete
- Activity Codes (as applicable to tasks)
- WBS number
- Responsible Group
- Calendar on which work is to be performed

2.6.3 The Primavera P6 detailed schedule will be developed to include meaningful logic in a Level 4 detail, with the ability to roll up to Level 1 or Level 2. Schedule development is performed in a series of evolutions outlined below starting at a summary level and ending with a detailed and executable implementation plan for all organizations. Schedule Levels are defined in the Glossary in Appendix B.

2.7 Schedule Submittals

All schedule submittals, including the proposed Authorized Baseline schedule, will be forwarded to the AEP scheduler and be subject to acceptance by AEP. The following tables will describe the required timeline for schedule submittals.

Major Projects	
Schedule Type	Project Work
Level 2 Submittal	With Contract Bid Proposal
Level 3 Pre-Submittal	NLT 21 Days After Contract Award

Level 3 Submittal (For Project Baseline Review)	NLT 30 Days After Contract Award
Integrated Authorized Baseline Approval	NLT 45 Days After Contract Award

*Level 1 schedule will be developed and maintained by Integration Scheduler.

Outage Related Projects	
Schedule Type	Outage Work
Level 3 Initial Submittal (For Project Baseline Review) (PC-6)	Outage Start (- 5) Months
Level 3 Rev B Schedule Review and Approve (PC-10)	Outage Start (-4) Months
Level 4 Rev C Review and Incorporate comments (PD-3)	Outage Start (-2) Months
Level 4 Rev O Schedule Review and Issue (PD-8)	Outage Start (T-1) Months
Integrated Authorized Baseline Approval	Outage Start (-48) Hours

2.8 Outage Schedule Reviews

2.8.1 Rev B - Level III (Schedule confidence – Low/Medium)

Content - Work Order activity level schedule issued at approximately T-4 months. Preliminary Critical path for the outage is identified and schedule contains all identified work scope and available planning information. System windows are established and inter-window logic ties are made. Activity durations are based on best information from planning templates or past experience, implementing departments are assigned and resources are estimated. All scoped activities are included based on best information available; at a minimum work orders are scheduled as a single activity (includes all contractor/vendor work). Template activities for operations shutdown, commissioning and performance testing and startup activities are included.

Review – Organization assignments are validated and crew assignments are made, durations are validated or revised and resource assignments established. Shift work calendars are assigned and additional activity subtask logic is established as required. Work to be performed by contractors or vendors is integrated. Outstanding items are documented and assigned for resolution prior to issuance of the Rev B schedule.

2.8.2 Rev C – Level IV (Schedule confidence- Medium)

Content - Issued at approximately T-2 months. Resource assignments are completed and resource leveling is performed, Critical path and near Critical Paths is defined with detailed schedules developed for all critical sequences. Operations

clearance activities and system logic is included. Detailed schedule input has been received from outside vendors and contractors and integrated within system windows. Detailed, hourly-based activities for Environmental, Retrofit and PPB projects work and testing activities are integrated into the outage schedule. Support activities for scaffold, insulation, power, system draining/filling etc. are included and logic tied. Usage of equipment such as cranes and rigging, lay-down/staging areas, floor loading etc have been incorporated into the schedule logic.

Review - Final reviews are performed by all organizations for crew and resource assignments, activity predecessor and successor relationships etc. Craft resource loading is reviewed for schedule requirements vs. planned availability. System restoration and testing is fully integrated into the schedule and reviewed by Operations. Schedules provided by contractors are validated and include all required logistics for equipment usage, area proximity and manpower loading. Vertical slice reviews are performed to identify conflicts with system integration and equipment usage or work area logistics.

2.8.3 Rev 0 – Level IV (Schedule confidence- High)

Content – Schedule issued at approximately T-1 month. All comments have been incorporated and any emergent items are included in the schedule. Pre-outage work is in-progress and validated that work will be achieved prior to start of the outage. Outstanding Material deliveries are reviewed for impact and activities are scheduled as required. Work package walk down information is finalized and incorporated. The schedule is considered static and available to perform final vertical slice reviews along with critical path and resource analyses.

Review- Final reviews are performed and confirmations are provided by implementing organizations that the schedule is achievable and executable as written. All groups have performed integrated reviews by day and any logistic concerns have been identified and resolved.

2.8.4 Baseline (Schedule confidence- High)

Schedule created from a copy of the current integrated outage schedule at or near the start of the outage, which establishes a formal reference for comparison and verification of subsequent efforts, progress, analysis and control.

- 2.9** Contractor shall submit for approval a Level 2 Budget Loaded CPM network schedule with their bid response documents. Initial submittal for review purposes will be submitted in legible-sized file to the Integration Scheduler.

- 2.9.1** As requested, the Contractor will participate in a review and evaluation of the proposed CPM network schedule and analysis for the Level 2 and all subsequent

(Level 3 and 4) submittals with the Integration Scheduler. Revisions will be resubmitted within (10) ten days of the schedule review meeting(s).

- 2.9.2** The quantities and hours expressed in Contractor's CPM network schedule activities will represent the breakdown of values defined by the contract Form 1.
 - 2.9.3** The Integration Scheduler will create a backup copy of the approved schedule for each level that will become the authorized baseline. Once a baseline has been established no modifications between corresponding activity IDs in the current schedule and baseline will be made. Budget shifts and reductions, significant logic revisions i.e.: work flow changes due to material issues, construction related engineering issues etc, will need to be reviewed and approved by the Integration Scheduler prior to implementation into the current schedule via the Schedule Change Notice (SCN), refer to Section 2.10.2. Revisions or re-baselining of a schedule will require the approval of AEP and be required to meet specific guideline criteria.
 - 2.9.4** Contractor schedule updates shall be conducted on regular intervals as determined by the Project and Outage Management Team (Outage Work). Typically frequency for projects will be weekly and Monday, Wednesday, and Friday for outage work.
 - 2.9.5** Contractors may be required, at the request of AEP to further refine Level III schedule activities, which are to be executed during a 'tie-in' outage, to a Level IV detail, as described in Appendix B of this document.
- 2.10** Performance/adherence to the project schedule shall be monitored based on the Schedule Performance Index (SPI) and the Cost Performance Index (CPI).
- 2.10.1** All schedules shall provide schedule performance metrics, including schedule variance and Schedule Performance Index (SPI), with supporting details. For project work that involves time and material and/or cost reimbursable methods of payment, Cost Performance metrics, including Cost Variance and Cost Performance Index (CPI) shall be provided with supporting details.
 - 2.10.2** The following method of CPI and SPI calculations shall be followed.

The method of calculation for CPI is Earned Value Hours (EV) divided by Actual Hours (AC). Example: Weekly Earned Hours = 400, Weekly Actual Hours = 410, $400/410 = .975$ Weekly CPI.

The method of calculation for SPI is Earned Value Hours (EV) divided by Planned Value Hours (PV). Example: Weekly Earned Hours = 400, Weekly Planned Hours = 390, $400/390 = 1.02$ Weekly SPI. Calculation of Earned Hours shall be measured against 100% of the Early Start / Finish Dates and be measured against the "Mutually' agreed baseline planned hours as indicated in P6.

For Project Related Contracts: It is expected and required that the contractor will perform proper and consistent baseline maintenance, in accordance with PMI (Project Management Institute) scheduling principles, as a means of ensuring alignment between the planned budgets in the baseline and the correlating activities against which those budgets are earned in the current schedule. It is the contractor's responsibility to notify the AEP scheduler when baseline maintenance must be performed, a Schedule Change Notice (SCN, detailed) must be processed for all changes to the Authorized Baseline. The SCN must detail all changes and be approved by project management team. All adjustments to the baseline will be made by the Project Integration Scheduler. Changes to the baseline and adjustments to the baseline that do not need a formal SCN must be made by the Project Integration Scheduler. Note for clarity purposes that baseline maintenance is not synonymous with re-baseline. Please direct any questions concerning this process to the AEP Project Scheduling department.

Change control will be supported by contractor through Schedule Change Notice (SCN) documentation or Extra Work Order (EWO). Contractor will not make changes to authorized baseline or current schedule's budgeted units without approval of Integration Scheduler. Once a SCN/EWO is approved, contractor will work with the Integration Scheduler to implement changes (refer to the handbook).

- 2.10.3** The SPI and CPI shall be based on resource loaded logic driven schedule with budgeted labor-hours associated with the project. The Construction phase shall be based on all direct craft associated with the project below the General Foreman designation, examples being Foreman, Journeymen, Apprentice, etc.

Indirect craft and overhead associated with the project shall be contained separately in the schedule, progressed and reported as an operating cost associated with the contract. A written labor report submitted weekly to AEP or as coinciding with designated schedule progress cycle, describing by craft, the average headcount for the week and total hours worked. This requirement is for all contractor work at AEP sites and is for fixed price work as well as T&M contracts.

For commodity based schedule activities, unit rates and the resulting rules of credit for each designated commodity shall be submitted to the AEP scheduler. For example; Activity A – Install small bore pipe for coolant pump (80 lf), should have a resource (ex. Pipe Fitter), a budget (ex. 120 mhrs), a rate (ex. 0.66 lf/hr) and the resulting rule of credit would be for every (1) linear foot of pipe installed then (1.5) hours of budget are earned; therefore, after earning (1.5) hours, or installing (1) linear foot, the physical percent complete would be 1.25%. The rules of credit are independent of the activity duration.

- 2.10.4** Critical paths will be established and their respective total float will be reported on a cycle coinciding to the schedule progressing periods, weekly for project work and up to daily during an outage if work performance requires. The critical paths will be agreed upon by both AEP and the contractor. Various paths, i.e., primary, secondary, tertiary, etc. will be developed as necessary to track scheduled work and execution efforts. Float will be calculated from a point agreed to by project team.

For Projects, CPM schedule calculations shall be performed using the following settings: retained logic; contiguous activity durations for individual activities; total float based on activity finish dates; fixed duration and units; physical percent complete.

- 2.10.5** Each particular contractor will be responsible for their specific section of the schedule including progress updates; reports and schedule maintenance (refer to section 3). During Outage related projects; following the acceptance of the Level IV Rev. 0 Schedule, all updates and schedule maintenance will be performed by the Integration Scheduler.

The entire Integrated Project Schedule will be limited to having only (2) open ended activities. These activities will consist of an initial start milestone and a completion milestone.

Constraints may be used; however, their use should be kept to a minimum and will be subject to review and approval by the Integration Scheduler. It is the full intent and expectation of AEP that schedules are developed with sound logic. Mandatory Start and Mandatory Finish constraints are prohibited for all Projects unless appropriate approval and documentation from Project Controls Supervision. For Outage related projects the Start On, Start On or After, Finish On, and Finish on or After constraints are also prohibited.

During schedule progress, the following schedule errors and warnings will be corrected prior to submitting the schedule to the Integration Scheduler.

- Open Ends – Activities without Predecessors or Successors
- Activities with Actuals > Data Date
- Out of Sequence Activities
- Milestone Activities with Invalid Relationships
- Activities with unsatisfied constraints
- Activities with unsatisfied relationships
- Other checks to support Projects QA/QC process (as needed)

2.11 Commodity curves will be required for tracking both outage and construction related work and will be developed by the contractor. The intention will be to validate and provide a higher level of confidence in the physical progress of activities and quantities relating to the schedule.

2.11.1 The curve data may reside within the schedule and be produced from the software or may be developed within an offline system; however, the installation curve must coincide with the timescale logic of the associated schedule activity.

2.11.2 The reporting cycle for the updating and distribution of the commodity curves will coincide with the required schedule progress updates.

2.11.3 Curves for tracking each specific commodity will be tied to awarded contract quantities. Adjustments, including refined engineering quantities, should be approved through AEP Project Team. Commodity curves shall be developed and submitted prior to commodity work (install or remove) being initiated.

2.11.4 Required minimum data for commodity curves shall include:

- Early and Late Planned, installed, and forecasted commodities by reporting period.
- Accumulative 'S' curves for planned (total contract duration), installed (actual), and forecasted (remaining) commodities.

Establishment of the curves relating to specific installation commodities to be tracked will be determined by AEP site construction and outage management. These curves will generally be held to major items associated on or near the primary, secondary or tertiary critical path of the schedule. Typical items include but are not limited to tons of steel, cubic yards of concrete, number of instruments, total number of completed tube welds, number of platens removed, number of platens installed, linear feet of small and large bore pipe, linear feet of cable, linear feet of electrical conduit, number of terminations, etc.

3.0 PROGRESS SUBMITTALS FOR PROJECT RELATED WORK

3.1 Project Submittals

3.1.1 Weekly Progress Submittals

The comprehensive Weekly Progress Submittal is prepared by the Contractor and is typically due to the Integration Scheduler no later than 11:00 AM Monday after the close of the prior week, unless otherwise negotiated or authorized. The reporting period will be from 07:00 Monday morning through the end of backshift Sunday night. The schedule data date will be set at 07:00 Monday. The Weekly Progress Submittal will be utilized for the weekly conference/meeting. Please Note: Any project related work which requires completion or integration with a

'tie in' outage shall have an indicated period of time in which the update reporting cycle will re-align with the update cycles required for the integrated project and outage schedule. The contractor will be notified in advance of this occurring and will be advised as to the new update cycle. Typical outage update cycles are on Mondays, Wednesdays, and Fridays, but can be as frequent as daily. The contractor shall be cognizant of this requirement in order to support overall schedule integration and shall make provisions to support this effort.

- Weekly Progress Submittal will include the following information:
- Level 3 – Three week look-ahead schedule, including:
 - Progress bars for Project Baseline, Last week, and Current Week.
 - Percentage Complete and Remaining Duration on all in Progress Activities
 - Actual Completion Date and Time on all Completed Activities
 - Expected Start for Activities scheduled to start in the next reporting period.
- A progress curve with bar chart detailing information to date (cumulative), and this period (current update period) with the following parameters: planned hours/dollars, earned hours/dollars. The progress curve will indicate the plan including cumulative remaining early, the cumulative remaining late and the cumulative earned and actual.
- Schedule status of labor-hour resource loaded activity based schedule including progressed schedule computations and SPI
- Updated Commodity Curves
- Resource (Staffing) Histogram with weekly actual hours (by trade or discipline) and weekly Estimate to Complete (by trade or discipline).
- Variance (Slip) Report, as required by the AEP scheduler.
- Approved Logic change report, identifying and detailing changes for the Integration Scheduler.
- Schedule Action Item List of Issues/Restraints that includes description of activities, responsible person, due dates, and the actions being taken to meet target dates.

3.1.2 Monthly Progress Submittals

The Comprehensive Monthly Progress Submittal is prepared by contractor, submitted to the Integration Scheduler and is required by AEP no later than the tenth business day of the calendar month to support internal AEP reporting requirements to upper management. The submittal will be prepared for the close of the prior business calendar month.

Monthly Progress Submittal will include the following information:

- Executive Summary
- Milestone Schedule Summary detailing Milestones completed to date and in the last month and a recovery plan for Milestones not completed as scheduled.
- A written assessment including, if required, a recovery action plan of critical path and near critical path activities
- Cost/Schedule Status of labor-hour resource loaded activity based schedule including progressed cost and schedule performance computations and CPI and SPI as required by contract payment method
- Contract Financial Status including estimate to complete (ETC) and estimated at completion (EAC)
- Action Item List of Issues/Restraints will include description of activities, responsible person, due dates, and the actions being taken to meet target dates
- Identify changes to the project critical path and any changes to dates that are recognized as hand-off points to other contractors, AE's, etc., and an additional narrative describing the changes, their related causes, as well as recovery actions if required.

A schedule layout of the top (3) critical and near critical paths along with a descriptive narrative including explanation for any negative migration of the paths from the baseline.

3.2 Outage Project Submittals

The Outage Schedule update cycle shall be determined by the Outage Management Team based on the overall outage status and need. The schedule will be updated through the update report markup process and will be provided to the Integration Scheduler. All schedule updates will be provided no later than 0900 on date of the cycle. The update will consist of / but is not limited to the following information:

- Percentage Complete and Remaining Duration on all in Progress Activities
- Actual Completion Date and Time on all Completed Activities
- Expected Start for Activities scheduled to Start in the next reporting period.
- Updated Commodity Curves
- Approved Logic changes will need to be identified and detailed for the Integration Scheduler
- Schedule Update must be approved by the Assigned Coordinator prior to submittal to the Integration Scheduler.

APPENDIX-A – REQUIRED CODES

Required Activity Codes for all Projects		
Activity Codes	Name	Activity Code Description
RC-01	RC-01 Direct/Indirect Labor	Used in support of EV calculations. Direct work is for activities associated and driving specific work product. Indirect work is for activities not directly aligned.
RC-02*	RC-02 Outage Code	Used for enterprise alignment of outage related work. Outage dates defined by MSC tables.
RC-03	RC-03 Unit	Supports multiple unit planning in common schedules.
RC-04	RC-04 Owner	Used to support accountable organization/owner of activity and associated metrics.
RC-05	RC-05 Discipline	Identifies Craft or Functional area performing the work (e.g. IC = Instruments & Controls, ME = Mechanical).
RC-06	RC-06 Schedule Segment	Identifies the project phase of work being accomplished. Supports Level 1 summarization. (Milestone Schedule code not to be used by EWC).
RC-07	RC-07 Schedule Level	Defines the detail of the scheduled activity. Supports summarization of scheduled activities to various levels for reporting purposes.
RC-08	RC-08 Funding Phase	Identifies the Funding Phase of the Project (1, 2, 2A, 2B, 3).
RC-09*	RC-09 Team Critical Milestone	Used for summarization of identified critical milestones integrated into schedule(s). To be defined by Project Leadership team, applied by project scheduler(s).
RC-10	RC-10 WBS1 Project Type	1st level grouping identifies technology and unit being implemented (ie. FGD, SCR, ESP, Boiler, etc)
RC-11	RC-11 WBS2 System Area	2nd level grouping identifies systems or areas work is being applied to. (ie. Superheater, Aux Xfmr, Coal Conveyor, etc)
RC-12	RC-12 WBS3 Category	3rd level group, identifies a particular component work is associated with (ie. Pipe Hangars, ductwork, electrical equipment, etc)

*Not required; use as applicable

APPENDIX-A – REQUIRED CODES (cont'd)

Required Activity Codes for Outage Related Projects	
Activity Codes	Activity Code Description
'Direct/Indirect Labor	Used in support of EV calculations. Direct work is for activities associated and driving specific work product. Indirect work is for activities not directly aligned.
'Outage Code	Used for enterprise alignment of outage related work. Outage dates defined by MSC tables.
'Unit	Supports multiple unit planning in common schedules.
'Responsible Group	Used to support accountable organizational owner of activity and associated metrics.
*Discipline	Identifies Craft or Functional area performing the work (e.g. IC = Instruments & Controls, ME = Mechanical).
*Schedule Segment	Identifies the outage phase of work being accomplished. Supports Level 1 summarization. (Pre-Outage, Shutdown, Outage, etc...).
*Organization	Identifies groups performing the work, used to support schedule reporting and auditing. (ie. ARA Contractor, Startup, RSO, Construction, etc...)
*Scope	Identifies whether the activity was part of the original work scope or added / emergent scope.
'Area-Primary	Identifies systems or general areas work is being applied to. (ie. Steam Generator, Turbine, FGD, etc...)

* Note – The ' and * in the activity code name were used for sorting in Primavera and is part of the code name.

** Note – Typically, these codes required for outage related activities in Project Schedules.

APPENDIX-B - DEFINITIONS

Term	Description
Activity Constraint	Constraint Dates specify a point in time, which may be used to control or override the logical calculation of dates in a schedule network. The addition of constraint dates may artificially create negative float in the network; therefore, their use should be minimized.
Activity ID	Each activity should be labeled with a unique identifier (alpha/numeric). Activity ID formulation varies depending on the type of task being described and may be comprised of identifiers such as: contract numbers, contract code numbers, contract line numbers, plant site designations, unit numbers, and/or work category designators. The activity ID should contain a methodical intelligence relative to the project and work being performed and should not contain any spaces, commas, periods, etc within the string.
Activity Relationships	<p>The dependency between two schedule activities and or milestones, the four possible types of logical relationships as described below are: (FS) – finish to start, (FF) – finish to finish, (SS) – start to start, and (SF) – start to finish. The terms precedence relationship, logical relationship, and dependency are interchangeable.</p> <ul style="list-style-type: none"> • Finish to Start – The relationship where start of the successor activity depends upon the completion of work of the predecessor activity. • Finish to Finish – The relationship where completion of the work of the successor activity cannot finish until the completion of the predecessor. • Start to Start – The relationship where start of the work of the successor schedule activity depends on the start of work of the predecessor. <p>Start to Finish – The relationship where the completion of the successor schedule activity is dependant upon the start of the predecessor activity.</p>
Activity Status	The state of completion of an activity. A planned activity has not yet started. A started activity is in progress. A finished activity is complete.

Term	Description
Actual Cost Of Work Performed (AC)	The sum of costs actually incurred in accomplishing the work performed.
Baseline	An approved plan for a project, plus or minus approved changes. It is compared to actual progress performance to determine if performance is within acceptable variance thresholds. Generally refers to the current or authorized baseline.
Budget At Completion (BAC)	Budget At Completion is the budgeted total cost through activity completion. Computed as Budget At Completion = Budgeted Labor Cost + Budgeted Non-labor Cost + Material Cost + Budgeted Expense Cost
Cost Breakdown Structure (CBS)	A system for dividing a project into Cost Accounts and Cost categories. This provides management with a basis for analyzing accumulated cost and data for continued estimating of future activities.
Cost Performance Index (CPI)	The ratio of earned value (EV) costs to actual (AC) costs. CPI is often used to predict the magnitude of a possible cost overrun. A positive value (i.e., greater than 1) indicates that costs are running under budget. A negative value (i.e. less than 1) indicates that costs are running over budget.
Cost Variance (CV)	The difference between EV and AC showing how actual expenditure compares with the budget. This can be shown as a numeric difference, where positive values indicate costs running under budget and negative values indicate cost overruns.
Critical Path	The sequence of activities that determine the duration of the project. It is the longest path through the project. The critical path is usually defined as those activities with the least amount of total float.
Critical Path Method (CPM)	A schedule network analysis technique used to determine the amount of schedule flexibility (the amount of float) on various logical network paths in the project schedule network, and to determine the minimum total project duration. Early start and finish dates are calculated by means of a forward pass using a specified start date. Late start and finish dates are calculated by means of a backward pass starting from a specified completion date, which is generally referred to as the project early finish date determined during the forward pass calculation.
Direct Costs	Those costs (labor, material, and other direct costs) that can be consistently related to work performed on a particular project. Direct costs are best contrasted with indirect costs that cannot be identified to a specific project.

Term	Description
Earned Value (EV)	A measure of the value of work performed so far. Earned Value uses original estimates and progress-to-date to show whether the tasks are ahead or behind the baseline plan for planned value (PV) or Cash Flow.
Earned Value Analysis	A method for comparing cost and productivity to schedule productivity on a given activity. Earned value analysis translates both schedule and budget measures into dollar values and tracks them against the original planned expenditure of effort translated into its dollar value. By analyzing variances, a PM can spot developing problems in time to take appropriate action before they become serious. The two variables used to make the schedule variance measurements are PV and EV.
Estimate at Completion (EAC)	The expected total cost of an activity, a group of activities, or of the project as a whole, when the defined scope of work is completed. Most techniques for forecasting EAC include some adjustment of the original cost estimate based on project performance to date. Also shown as "estimated at completion." Computed as the actual total cost plus the estimate-to-complete cost; Estimate at Completion = Actual Cost (ACWP) + Estimate to Complete (ETC).
Estimate to Complete (ETC)	The expected additional cost of an activity, a group of activities, or of the project as a whole, when the defined scope of work is completed. Most techniques for forecasting ETC includes some adjustment of the original cost estimate based on project performance to date. The Estimate to Completion may be determined by: (BAC-EV) / CPI to obtain an optimistic value, and (BAC-EV) / (CPI*SPI) to obtain a pessimistic value.
Float	Total Float - The amount of time in work periods based upon the assigned calendar that an activity could be delayed from its early finish without delaying the project finish date or violating a schedule constraint. It is calculated using the CPM technique and determining the difference between the early and late finish dates. Free Float - The amount of time in work periods that a schedule activity can be delayed without delaying the early start of the immediate following schedule activities.
Gantt Chart	A graphic display of schedule related information. In the typical Gantt Chart, activities are listed down the left side of the chart, dates are shown across the top, and planned activity durations are shown as date-placed horizontal bars. Also called a "bar chart."
Indirect Cost	Resources expended which are not directly identified to any specific contract, project, product or service, such as overhead.

Term	Description
Integrated Project Schedule (IPS)	A single, computerized network of all activities required to execute the project through the outage from pre-outage to unit shut down thru release for 100% load dispatching. Usually a CPM Schedule that is compiled from other related project schedules and constitutes the combined level 3 / 4 detailed work plans for a single project/outage.
Integration Scheduler	<p>The Integration Scheduler is directly responsible for the overall scheduling effort including the total scheduling product. Integration Scheduler shall be responsible for many scheduling functions, including but not limited to the following:</p> <ul style="list-style-type: none"> • Support and enforce good scheduling practices. • Manage schedule logic, including inter-project ties • Analyze scheduling information in support of the project/outage and AEP Corporate needs. • Provide guidance and advice to Project and/or Outage Management Team on scheduling issues. <p>Maintain a master schedule with subordinate schedules as necessary.</p>
Key Performance Indicators (KPI)	Those project management indicators that are determined at the beginning of the project. KPI's reflect directly on the key objectives (goals) of the project and provide the basis for project management trade-off decisions during the course of the project.
Level of Effort (LOE)	Support type activity (e.g. vendor or customer liaison) of indirect cost that does not readily lend itself to measurement of discrete accomplishment. It is generally characterized by a uniform rate of activity over a specific period of time.
Level 1 Schedule	<p>Milestone and Team Critical Activities: The Level 1 project schedule provides a bar chart format of major milestone events and Team Critical activities, which must occur in a timely sequence to achieve the successful completion of the project. The items are so defined as to represent the status of major work efforts for groups of activities. For Outage related schedules, Level 1 contains summary line items for each major scope and required outage evolutions for shutdown, testing and plant startup. Durations are based on current information available or past experience for similar activities. This schedule validates the duration assigned within the long-range fleet business plan and identifies any potential impacts.</p>

Term	Description
Level 2 Schedule	Subproject Group / System / Responsible Group: The Level 2 project schedule summarizes the Level 3 Project Schedule and divides the project into the major project phases: Engineering, Procurement, Construction, and Startup as well as by major system and area. In Outage Schedules, refined activities will reflect component/equipment or area interfaces, removal/installation windows and plant system windows. Activities are included for all scoped Capital, O&M and PPB projects. Major system and equipment work windows are defined and logic tied as applicable.
Level 3 Schedule	Work Package: The Level 3 project schedule will contain a further breakdown of the systems and subsystems divided into manageable components to provide better definition and control. For the engineering effort, activities shall be single discipline responsibility with assigned resource requirements, including vendor interface activities. For the construction effort, the schedule may be further broken down by the individual work packages within contract packages or based on schedule details provided by the successful contractor including craft resource requirements. Typical schedule activities at this level would be no greater than 96 calendar hours in duration and less than the equivalent of 500 man-hours in budget. For Outage related work, activities are to be broken down into logical steps or sequences to perform work or accomplish a task. Handoffs and interfaces between work groups are defined along with work area logistics and plant equipment and system interfaces. All "task dependent" activities will have resources and budgeted units assigned to them.

Term	Description
Level 4 Schedule	For Outage related and select Project construction work, a more detailed breakdown of the daily work schedule which includes fully resource loaded and budgeted activities. Level IV schedules are required to better define critical or near-critical path sequences. Separate activities are required for each "Handoff" between groups/subcontractors and/or discipline/resource and include a more detailed breakdown of logic sequences between work groups or planned evolutions. Activity duration shall be kept to a length to allow progress to be determined during the course of the work (no longer than 96 clock hours). Some activities may be longer in duration but must have a quantifiable measure to track progress. These activities shall have a distinct definition of quantifiable measure to clearly identify when the activity starts/finishes and the rate of progress. Project related work that requires this amount of detail will be decided by the AEP Project Management Team through the Project Integration Scheduler.
Milestone Schedule	A list of important activities with expected completion dates to ensure completion of the project from initiation to closeout. The completion of these activities is important to interfacing groups to ensure that they start and complete their required activities.
Outage Management Team	<p>The Outage Management Team shall include, but is not limited to, the following members:</p> <ul style="list-style-type: none"> • Plant Manager • Site Outage Manager • Site Construction Manager • Regional Outage Manager <p>P&FS Project Manager (if applicable)</p>

Term	Description	
Outage Preparation Milestone	PC-6	Major Contractors provide a level 3 schedule to the Integration Scheduler.
	PC-10	Level 3 Rev. B schedule has been reviewed and comments incorporated into the schedule. Schedule is issued to Outage Management Team.
	PD-3	Level 4 Rev. C schedule reviews are conducted.
	PD-8	Level 4 Rev. 0 schedule is issued following incorporation of comments from the Level 3 Rev. C reviews.
Percent Complete (PCT)	A ratio comparison of the completion status to the current projection of total work.	
Planned Value	Planned Value is the portion of the budgeted total cost of the activity that is scheduled to be completed as of the project data date, according to the baseline. Calculated as $\text{Planned Value} = \text{Individual resource Budget At Completion} * (\text{Data Date of current project} - \text{Baseline Assignment Start Date}) / (\text{Baseline Assignment Finish Date} - \text{Baseline Assignment Start Date})$.	
Project Controls (PC)	The activities involved in defining, monitoring, controlling and reporting project scope, schedule, and cost. The role of project controls includes anticipating future events, facilitating project planning, and forecasting where the project is headed to provide a sound basis for management decisions.	
Resource (RES)	An item required to accomplish an activity. Resources can be people, equipment, facilities, funding or anything else needed to perform the work of a project.	
Schedule	A time sequence of activities and events that represent an operating timetable. The schedule specifies the relative beginning and ending times of activities and the occurrence times of events. A schedule may be presented on a calendar framework or on an elapsed time scale.	

Term	Description
Schedule Performance Index (SPI)	The ratio of Earned Value (EV) to work scheduled/planned (PV). The SPI describes what portion of the planned schedule work was actually accomplished. A positive value (i.e. greater than 1) indicates that work is ahead of schedule. A negative value (i.e. less than 1) indicates that work is behind schedule.
Schedule Variance (SV)	The difference between EV and PV. Schedule variance shows how the current schedule compares with the baseline schedule (in terms of time progress). This can be shown as a numeric difference, where positive values indicate that the schedule is ahead of the baseline schedule and negative values that indicate that work is behind schedule.
Scope	The work content and products of a project or component of a project (such as a contract). Scope is fully described by naming all activities performed, the resources consumed and the end products that result, including quality standards. A brief background to the project, or component, and the general objective(s) should introduce a statement of scope.
Scope of Work (SOW)	The work content of a project or any component of a project, such as a work package or a cost class, e.g., a summary description of the work involved in constructing a project. Note: Scope of Work describes the work involved in producing the product or service of the project, whereas 'Scope' or the 'Scope Statement' describes the resulting product or service.
Variance	The difference between the baseline and scheduled task or resource information. Variances occur when you set a baseline plan and begin entering actual information into your schedule or cost spreadsheet.
Variance Analysis	The analysis of the following : <ul style="list-style-type: none"> • Cost Variance = $EV - AC$ • % Over/Under = $100 \times (AC - EV) / EV$, • Unit Variance Analysis, • Labor Rate, • Labor Hours/Units of Work Accomplished, • Material Rate, • Material Usage, and • Schedule Variance = $EV - PV$.
Variance at Completion	The budget at completion less the estimate at completion. A negative result indicates that the project is over budget. = $BAC - EAC$

Term	Description
Vendor Change Order (VCO)	A document that authorizes a vendor a change in scope, schedule, cost or quality of the project.
WBS Dictionary	A document that describes each element in the WBS including a Statement of Work, describing the work content of the WBS element, and a Basis of Estimate, describing how the budget of the element was developed.
Work Breakdown Structure (WBS)	A task oriented detailed breakdown of a project, which defines the work packages and tasks at a level above that defined in the networks and schedules. The WBS initiates the development of the Organizational Breakdown Structure (OBS), and the Cost Breakdown Structure (CBS). It also provides the foundation for determining Earned Value and activity networks. The WBS is most useful in aligning performance information and cost and schedule into summary levels for hierarchical reporting of project progress.
Work Order (WO)	A generic term for a unit within a work breakdown structure (WBS) at the lowest level of its branch, not necessarily at the Lowest level of the whole WBS. It may be used to refer to a unit of work performed within the organization, while 'Commitment Package' may be used for work contracted or purchased outside The organization.



BOUNDLESS ENERGY



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PUBLIC VERSION



Projects Invoicing Requirements

Separate invoices shall be submitted for each project, contract and contract release.

General information to be included on each invoice:

- ✓ AEPSC "Project Title and Plant Unit Number".
- ✓ AEPSC eight digit Contract and four digit Release Number.
- ✓ Invoice Date: MM/DD/YYYY.
- ✓ Invoice Period: MM/DD/YYYY through MM/DD/YYYY.
- ✓ Vendor contact name and invoicing contact's telephone number.
- ✓ Remit address.
- ✓ Retention amount withheld (if applicable).
- ✓ Charges for labor, expenses, and material shall be segregated.
- ✓ Participants in ARIBA discount program must clearly mark terms & discount on invoice cover, otherwise, contract terms will apply.
- ✓ Final Invoices must be marked as such for both Contract and Field Extra Work Orders.

* Invoices not containing the detailed information above will be returned to the contractor for correction. The invoice acceptance date is the date that a properly submitted invoice is accepted by AEP Project Cost Management. Payment terms are based from that date, not the Invoice Date itself. A properly submitted invoice includes a correct CCR and all required supporting documentation

Actual quantity of work and percent completed will be verified and approved by Owner's representative prior to submission of invoices and Contractor Cost Reports (CCR). The approvals must accompany the invoice as back up documentation. All invoices for milestone based contracts must contain an approved milestone payment schedule as back up documentation.

Invoices shall identify base contract invoicing detail using the Contractor Cost Reporting Form. In addition, separate invoices will be required for each additional Field Extra Work Order(s) if applicable with an individual Contractor Cost Reporting Form for each instance.

The Contractor Cost Reporting form (CCR) form is an Excel spreadsheet preloaded with contractually dictated pricing data.

- ✓ The CCR reporting period may be daily, weekly or monthly at the discretion of AEP Project Cost Management.
- ✓ Monthly reporting is done on an exception basis and only with the advanced approval of the Principal Cost Coordinator, AEP Project Cost Management. In these cases, the reporting timeline will be addressed and at the sole discretion of Principal Cost Coordinator, AEP Project Cost Management. Weekly reporting period will be from first shift on Monday through third shift on Sunday and submitted to AEP Project Cost Management by close of business the Monday following the completion of the period.
- ✓ Daily reporting will be from start of first shift through end of third shift and submitted to AEP Project Cost Management by noon the day following the completion of the period.

For invoices that involve cost reimbursable methods of payment, time and expense details will include the following:

- ✓ Time and Equipment sheets signed by the contractor and approved by an AEP Construction Coordinator.
- ✓ Itemized Employee and Project Expense(s).
- ✓ Per Diem support documentation must be included with each invoice.
- ✓ Copies of all receipts for any reimbursable expenditure of \$25.00 or greater.
- ✓ Subtotal Expense Amount.
- ✓ This information will be reported on Contractor Cost Reporting form (CCR).

For work that involves cost reimbursable methods of payment and fixed fee, the fixed fee will require a separate invoice accompanied by a separate CCR if retention is to be withheld.

Contractor invoicing based on milestones requires submission of a copy of the milestone payment schedule with each milestone invoice.

Based on a mutually agreed method of invoice submittal, the Contractor shall submit a single (1) copy of an invoice. Owner will accept only one (1) method of submittal; either by U.S. Mail, UPS, FedEx or electronically. Invoices submitted to any AEP location other than the Cheshire Cost Center will be returned and payment date will be based on receipt of the resubmitted invoice at the Cheshire Cost Center.

Contractor shall submit all invoices within 60 days from final acceptance (excluding retention invoicing, if applicable) including each Extra Work Order as completed. Contractor need not wait until completion of Extra Work to invoice. Partial invoicing is acceptable based on owner's approvals as long as the last invoice for each Extra Work Order is marked "Final".

Submittal (hardcopy) Information: Mailing Address:

M. K. Godich
American Electric Power
Cost Control Center
PO Box 301
Cheshire, OH 45620

Electronic Invoicing: (On an exception basis, Project Cost Management will accept invoicing by email. The decision will be based on file sizes, invoicing frequencies, etc. and is at the sole discretion of AEP).

Email invoice will be sent to **Construction_Cost_Control@aep.com** with a copy to the designated Cost Coordinator/Technician.

Invoicing and payment inquiries are to be directed to the assigned Cost Technician and Mary Godich, Supervisor (mkgodich@aep.com) Phone: 740-266-3073.

Email invoice must contain the AEP Plant, Project and Contract Number in the “Subject Line”.

Prior to commencement of work, contractor shall contact Project Cost Management by email to Mary K Godich (mkgodich@aep.com) who will schedule a Project Controls kick off meeting. This meeting will require the contractor to have representation from the Cost Management, Scheduling and Invoicing department of their company. This meeting will determine the processes, contacts and requirements for the project as it relates to Project Controls.

Projects Cost Reporting Requirements

Contractors performing work on AEP Projects managed by Project Organization are required to provide owner required reports in accordance with contract terms and customary construction practices. For any work performed under a cost reimbursable method, AEP Project Cost Management expects all timesheets, equipment sheets and associated documents to be presented to AEP in a timely manner and in an acceptable format.

Prior to commencement of work the contractor is required to ensure they have submitted all Form A’s for all subcontractors and Form B’s for equipment rental rates have been submitted and approved by Contract Administration. Items not approved by Contract Administration through the Form A & Form B process will not be recognized for invoicing. For this reason, contractors need to update these form and receive approval prior to use if the intend to be reimbursed.

On projects staffed by Project Cost Management (PCM) all reports will be delivered by the contractor to Project Cost Management. No other entity is authorized to receive either daily or weekly cost reports.

The following items, though not all inclusive, are the minimal acceptable requirements.

All Documents:

- ✓ Though handwritten is acceptable, all forms must be legible.
- ✓ If multiple part documents are utilized, AEP shall be provided with “part one” of the document. Carbon sheets are unacceptable.
- ✓ All sheets must be sequentially numbered. (i.e. 1 of 20, 2 of 20, 3 of 20 and etc.)

Timesheet Requirements (Cost Reimbursable):

Labor details will include the following on a daily timesheet submitted to Project Cost Management the day following performance of the work. The reporting timeline will be as determined by Site Management but in no case later than noon.

- ✓ Employee Name.
- ✓ Employee Classification (Standard abbreviations are acceptable). Supervision will be listed by exact title approved in the contract.
- ✓ Employee ID # (Must be able to cross reference to payroll if audited). The use of Social Security Numbers on any submittal is strictly forbidden.
- ✓ Straight, Time and Half and Double Time Hours by Employee.
- ✓ Charges must be reported by PMM Cost Activity / Code and a brief description of the work performed.
- ✓ Hourly Rate(s) (Base Union Labor Rates Only)
- ✓ Cover Sheet (Attachment #2 - PCMA-21) with the Total Hours by Classification and Cost Activity

Equipment Reports

- ✓ Each piece of equipment must be listed separately.
- ✓ Each piece of equipment must be identified by a unique equipment number (This number must be clearly displayed on equipment).
- ✓ Equipment description must be that as specified in the contract equipment rate sheet (Form B).

Contractor must monitor and report equipment which is paid based on a monthly rate with a set number of hours per month. Once the monthly hour limit is reached, the contractor should either apply the reduced rate or stop charging the equipment, whichever is applicable. An audit of the monthly tracking sheet to the weekly CCRs for billing accuracy will be performed on the contracts with monthly hour limit equipment

Expense Reporting (when contractually allowable)

- ✓ AEP's Policy is to reimburse Consultant / Contractor for reasonable transportation, lodging, meals, and other services necessary to conduct official business. Since every situation encountered while traveling on business cannot be anticipated, each Consultant / Contractor shall exercise good judgment and fiscal responsibility when doing business for AEP. Any inappropriate and excessive expense will be reduced or disallowed.
- ✓ Expenses are a necessary and appropriate part of service delivery and AEP will reimburse expenses promptly. When traveling out of town, economy class air travel with maximum advance purchase and reasonable ground transportation, food, and lodging must be considered. Conference calls, transfer of information electronically, and video conferencing should be considered as alternates to travel. For each invoice, an itemization of expenses, including date and total cost should be provided.
- ✓ Use of personal vehicle will be reimbursed at the current IRS allowable mileage rate.
- ✓ Travel related expenses including ground transportation, food, lodging, mileage and airfare will be billed at actual cost with no markup. Receipts are required for charges over \$25.00.

AEP Project Cost Management will not accept nor consider for payment any cost reimbursable charges which do not meet the minimum standards above. All owner's required reports must be submitted by the time designated in the contract or by the project requirements. Late submittal of cost reports may negate AEP's responsibility for reimbursement.

Prior to the commencement of work the contractor is required to submit a Craft Rate Export request (CRA-001) to CraftRates@aep.com. AEP Craft Rate Administrator will supply the contractor an extract of craft rates and fringes. The Contractor will respond in writing (email or hard copy) that they are in agreement with the rates in the CCR. This will be required with each rate and/or markup change.

Contractors are not permitted to commence work on a Field Extra Work Order without written authorization. Doing so will negate owner's responsibility to reimburse contractor for work performed prior to issuance of the written authorization. Upon completion of the Extra Work, the contractor shall notify the AEP Construction Coordinator who will verify satisfactory completion. The Construction Coordinator will submit a EWO Closure Form to contractor for signature to verify completion of work and invoicing. Contractor will sign off on closure form and submit to Project Cost Management who will close EWO.

All Contractors are required to utilize a Contractor Cost Reporting (CCR) form (Electronic and hard copy) at the intervals specified by the project. AEP Project Cost Management is the only entity that can waive this requirement. Each CCR should be accompanied by timesheets, equipment sheets and associated documents. The Contractor is

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responsible for ensuring that the support documentation balances to the CCR. The Contractor is responsible to ensure compliance by sub contractor in both accurate and timely reporting as specified above.

On projects staffed by AEP Material Management Services, the contractor will be issued materials through the AEP Material Coordinator. The contractor is expected to provide ample notice to allow time for the Material Coordinator to stage for issue. The contractor shall designate those individuals within their organization with the authorization to receive materials. Upon receipt of the material, the contractor assumes care and custody and shall be responsible the cost of repair or replacement of lost or damaged materials. In no case is an employee of the contractor authorized to remove materials without a signed Request for Material Issue (MMS-Form 501).

Should AEP request the contractor to purchase material not contractually defined in the contract. The contractor shall submit in writing a material request to be approved by the AEP Site Construction Manager or his designee prior to purchasing the materials. This request will be made using the Contractor Material Purchase Request Form (MMS-200C). The original form will be submitted to AEP Material Management Services (Site Material Coordinator) and a copy must accompany the CCR Reporting and contractor invoicing.

All Cost Reporting and Invoicing Requirements shall flow down from the main contractor to their sub contractors. Compliance of all sub contractors is the responsibility of the main contractor.

ATTACHMENTS:

1. Contractor Cost Reporting form (CCR)
2. AEP Cost Report Cover Sheet A-21
3. Request for Material Issue MMS-501
4. Request for Material Issue MMS-200C

Contractor Cost Report



Save File	<u>Standard Rules for CCR Data Entries</u>
Enter Entry Dates	...CCR Cannot Span Months. A New CCR Must be Created if Work Occurs in Separate Months.
Clear Entry Dates	...Do Not use Microsoft Menu Bar to Save Data. Data Must be Saved Using the "Save File" Button
Print Rate & Eqpt List	<u>Files are Saved in a 32-bit Format with File Name Consisting of :</u>
Print Data	C = Cost ~ I or E = Import or Export ~ Contractor Code ~ A,B, or C = Contract Type ~ Four to Five Digit Contract Number ~ the Remaining File Name = MMddYYYYhhSS (MonthDayYearHourSeconds)
Export to PDF	...This Makes Each File Unique, so if You Need to Make a Correction to a Date, it is Done by a File that Adds or Subtracts Data for the Same Date.
Version Number: 6.30 June 2015	<u>The Standard Reporting Period is set by AEP Project Cost Management</u>
DO NOT Remove Protection From This Report	<u>Equipment Reference Number:</u>
For Assistance and Questions Call: 740-925-3099	A Serial Number or Company Inventory Number that Must be Unique for Each Piece of Equipment Rented Under the Contract Provisions Capping Equipment Hours, Typically at 176 hours.
	Prior to submittal of a new CCR the Contractor is responsible to verify all rates and calculation in the CCR. This can be done by using the "Print Rate & Eqpt List" button to extract all rates with in the CCR.



PUBLIC VERSION

Contract:	0	Contractor Code:	0
Rel-PreEAS:		Date From:	
LOA #:		Date To:	
Plant Code:	0	Outage Code:	0

Enter Rental Items and Time Periods in this section:

Eqpt List No	Eqpt List Rev	Eqpt Rel No	Eqpt Pre EAS Rel	Rental Item No	Description	Third Party	Eqpt ref No	Job Ref Type	Job Ref	Eqpt Qty	No of Periods (hrs not exceed 176 for 176 Rentals)	Hours in excess of 176	Period Rate	Period	Total Cost	Mthly Rate	Mthly Add'l Hry Rate	Rate Sch	Rate Sch Rev	Rate Rel No	Rate Pre EAS Rel	Contr Code	Operati ng Rate	Ope mati ng Hrs	Eqpt Driven Type	Eqpt Mkup %						
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Material Management Services Request for Material Issue MMS-501



Date: _____

Page: _____ of _____

Requested BY: _____

Date/Time Needed: _____

Phone Number: _____

How to be used: _____

Company: _____

MIR Number _____

	Tag #	Ident #	Req# / PO#	QTY Needed	UM	Description
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Notes:

Material Coordinator


Receiving Party

Signature _____

Signature _____

PUBLIC VERSION

American Electric Power
Contractor Material Purchase Request
MMS-200C



Plant: _____
Project: _____
Unit Number: _____ Work Order #: _____

Request # _____
Requestor's Name: _____ Date Requested: _____

How to Be Used: _____ Required on Site Date: _____

Contractor's Name: _____
Contract and Release No. _____
Contractor's Phone: _____ Contact Name: _____

Line	QTY	Description & Part No.	U/M	Price Each	Total Line
1					\$ -
2					\$ -
3					\$ -
4					\$ -
5					\$ -
TOTAL:					\$ -
Contractors Mark Up %: <input style="width: 50px;" type="text"/>					\$ -
Billable Tot					\$ -

SITE MANAGER: _____ DATE: _____

Original to: AEP Site Material Management Service

CC: AEP Construction Coordinator & AEP Project Cost Management with Invoice

Comments:



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BORING LOG NO. B-1

PROJECT: South Bend Solar Project	CLIENT: American Electric Power Columbus, Ohio
SITE: Bittersweet Road Granger, Indiana	


GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 41.7311° Longitude: -86.1083°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
	Approximate Surface Elev: 769 (Ft.) +/- ELEVATION (Ft.)							LL-PL-PI

DEPTH								
0.6	TOP SOIL (7")	768.5+/-						
	POORLY GRADED SAND WITH SILT (SP-SM) , brown to gray, wet, loose				14	2-2-3 N=5		
					14	1-1-2 N=3		
					18	2-3-3 N=6		NP
5					18	2-2-2 N=4		
6.0	POORLY GRADED SAND (SP) , brown, wet, loose	763+/-			18	2-3-3 N=6		
					18	2-2-3 N=5		NP
					18	1-2-3 N=5		
10								
12.0	POORLY GRADED SAND (SP) , brown, wet, medium dense	757+/-						
					18	2-4-6 N=10		
15.0	Boring Terminated at 15 Feet	754+/-						

Stratification lines are approximate. In-situ, the transition may be gradual.		Hammer Type: Automatic 140#/30inch	
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Advancement Method: 3.25" Hollow Stem Augers	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any).	Notes:
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Abandonment Method: Boring backfilled with cement-bentonite grout	See Appendix C for explanation of symbols and abbreviations.	
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WATER LEVEL OBSERVATIONS	 <p>800 Morrison Rd Gahanna, OH</p>	Boring Started: 11-28-2017	Boring Completed: 11-28-2017
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 Water encountered @ 5.8 feet while drilling	Drill Rig: Mobile B-57	Driller: Moore-Lansing, Matt
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	Project No.: N4175437	Exhibit: A-4
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THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. N4175437 SOUTH BEND SOLAR.GPJ TERRACON_DATATEMPLATE.GDT 12/21/17

BORING LOG NO. B-2

PROJECT: South Bend Solar Project	CLIENT: American Electric Power Columbus, Ohio
SITE: Bittersweet Road Granger, Indiana	

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 41.7307° Longitude: -86.1041°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
	Approximate Surface Elev: 770 (Ft.) +/- ELEVATION (Ft.)							LL-PL-PI

0.6	TOP SOIL (7")	769.5+/-						
1.5	SILTY CLAYEY SAND (SC-SM) , trace gravel, brown, moist, loose	768.5+/-			14	2-3-4 N=7	11	NP
	POORLY GRADED SAND (SP) , brown, wet, loose				18	2-2-4 N=6		
					18	2-2-3 N=5		NP
					18	2-2-4 N=6		
					18	1-1-3 N=4		
					18	3-3-5 N=8		
					18	2-3-4 N=7		NP
12.0	POORLY GRADED SAND (SP) , brown, wet, medium dense	758+/-						
15.0		755+/-			18	3-5-5 N=10		

Boring Terminated at 15 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic 140#/30inch

Advancement Method: 3.25" Hollow Stem Augers	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any).	Notes:
Abandonment Method: Boring backfilled with cement-bentonite grout	See Appendix C for explanation of symbols and abbreviations.	
WATER LEVEL OBSERVATIONS ▽ Water encountered @ 5.5 feet while drilling	 800 Morrison Rd Gahanna, OH	Boring Started: 11-28-2017
		Boring Completed: 11-28-2017
		Drill Rig: Mobile B-57
		Driller: Moore-Lansing, Matt
		Project No.: N4175437
		Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. N4175437 SOUTH BEND SOLAR.GPJ TERRACON DATATEMPLATE.GDT 12/21/17

BORING LOG NO. B-3

PROJECT: South Bend Solar Project	CLIENT: American Electric Power Columbus, Ohio
SITE: Bittersweet Road Granger, Indiana	

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
	Latitude: 41.7301° Longitude: -86.1°									LL-PL-PI
	Approximate Surface Elev: 768 (Ft.) +/-									

	0.6	TOP SOIL (7'')	767.5+/-								
		WELL GRADED SAND WITH SILT (SW-SM) , trace gravel trace organics, brown, wet, loose, contains organics									
		4.5		763.5+/-	5	▽					
		POORLY GRADED SAND (SP) , brown, wet, very loose to loose									
		9.0		759+/-	10						
		POORLY GRADED SAND (SP) , trace gravel, brown, wet, medium dense									
		23.5		744.5+/-	20						
		POORLY GRADED SAND WITH GRAVEL (SP) , brown, wet, medium dense									
				25							

Stratification lines are approximate. In-situ, the transition may be gradual. Started running driller mud @ 13.5'

Hammer Type: Automatic 140#/30inch

Advancement Method: 3.25" Hollow Stem Augers	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any).	Notes:
Abandonment Method: Boring backfilled with cement-bentonite grout	See Appendix C for explanation of symbols and abbreviations.	
WATER LEVEL OBSERVATIONS	<p>800 Morrison Rd Gahanna, OH</p>	Boring Started: 11-29-2017
▽ Water encountered @ 4.5 feet while drilling		Boring Completed: 11-29-2017
		Drill Rig: Mobile B-57 Driller: Moore-Lansing, Matt
		Project No.: N4175437 Exhibit: A-6


THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. N4175437 SOUTH BEND SOLAR. GPJ TERRACON DATATEMPLATE.GDT 12/21/17

BORING LOG NO. B-3

PROJECT: South Bend Solar Project

**CLIENT: American Electric Power
Columbus, Ohio**

**SITE: Bittersweet Road
Granger, Indiana**

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 41.7301° Longitude: -86.1° Approximate Surface Elev: 768 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
								LL-PL-PI
	POORLY GRADED SAND WITH GRAVEL (SP) , brown, wet, medium dense (<i>continued</i>)							
		30.0			X	18	5-7-11 N=18	
Boring Terminated at 30 Feet		30						

Stratification lines are approximate. In-situ, the transition may be gradual.
Started running driller mud @ 13.5'

Hammer Type: Automatic 140#/30inch


Advancement Method:
3.25" Hollow Stem Augers

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

Abandonment Method:
Boring backfilled with cement-bentonite grout

WATER LEVEL OBSERVATIONS

 Water encountered @ 4.5 feet while drilling



Boring Started: 11-29-2017

Boring Completed: 11-29-2017

Drill Rig: Mobile B-57

Driller: Moore-Lansing, Matt

Project No.: N4175437

Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_ N4175437 SOUTH BEND SOLAR.GPJ TERRACON_DATATEMPLATE.GDT 12/21/17

BORING LOG NO. B-4

PROJECT: South Bend Solar Project

**CLIENT: American Electric Power
Columbus, Ohio**

**SITE: Bittersweet Road
Granger, Indiana**

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. N4175437 SOUTH BEND SOLAR. GPJ TERRACON DATATEMPLATE.GDT 12/21/17

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 41.7297° Longitude: -86.0964° Approximate Surface Elev: 769 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTEMBERG LIMITS
								LL-PL-PI
		0.6						
	TOP SOIL (7")	768.5+/-				2-3-4 N=7	15	
	SILTY CLAYEY SAND (SC-SM) , brown to black, moist, loose					18		
		3.0				18	15	NP
	POORLY GRADED SAND (SP) , brown, wet, very loose to loose	766+/-				14		
						18		
		9.0				18		NP
	POORLY GRADED SAND (SP) , trace gravel, brown, wet, medium dense	760+/-				10		
						18		
		15.0				18		
	Boring Terminated at 15 Feet	754+/-				2-4-6 N=10		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic 140#/30inch

Advancement Method:
3.25" Hollow Stem Augers

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

Abandonment Method:
Boring backfilled with cement-bentonite grout

WATER LEVEL OBSERVATIONS
▽ Water encountered @ 4.5 feet while drilling



Boring Started: 11-28-2017

Boring Completed: 11-28-2017

Drill Rig: Mobile B-57

Driller: Moore-Lansing, Matt

Project No.: N4175437

Exhibit: A-7

BORING LOG NO. B-5

PROJECT: South Bend Solar Project	CLIENT: American Electric Power Columbus, Ohio
SITE: Bittersweet Road Granger, Indiana	

GRAPHIC LOG	LOCATION See Exhibit A-2	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
	Latitude: 41.7296° Longitude: -86.0931°							LL-PL-PI
	Approximate Surface Elev: 769 (Ft.) +/-	ELEVATION (Ft.)						

0.6	TOP SOIL (7")	768.5+/-						
	POORLY GRADED SAND WITH SILT (SP-SM) , brown, wet, very loose to loose				18	1-2-3 N=5		
					14	3-2-1 N=3		
					18	1-2-1 N=3		
					18	1-2-2 N=4		NP
					18	1-1-1 N=2		
7.5	POORLY GRADED SAND (SP) , brown, wet, loose	761.5+/-			18	2-2-5 N=7		
					18	3-4-5 N=9		
12.0	POORLY GRADED SAND (SP) , brown, wet, medium dense	757+/-						
15.0	Boring Terminated at 15 Feet	754+/-			18	3-5-6 N=11		

Stratification lines are approximate. In-situ, the transition may be gradual.		Hammer Type: Automatic 140#/30inch	
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Advancement Method: 3.25" Hollow Stem Augers	See Exhibit A-3 for description of field procedures. See Appendix B for description of laboratory procedures and additional data (if any).	Notes:
Abandonment Method: Boring backfilled with cement-bentonite grout	See Appendix C for explanation of symbols and abbreviations.	

WATER LEVEL OBSERVATIONS	 <p>800 Morrison Rd Gahanna, OH</p>	Boring Started: 11-29-2017	Boring Completed: 11-29-2017
▽ Water encountered @ 4.0 feet while drilling		Drill Rig: Mobile B-57	Driller: Moore-Lansing, Matt
		Project No.: N4175437	Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. N4175437 SOUTH BEND SOLAR.GPJ TERRACON DATATEMPLATE.GDT 12/21/17

BORING LOG NO. B-6

PROJECT: South Bend Solar Project

**CLIENT: American Electric Power
Columbus, Ohio**

**SITE: Bittersweet Road
Granger, Indiana**

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 41.7268° Longitude: -86.099° Approximate Surface Elev: 767 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS
								LL-PL-PI
		0.6						
	TOP SOIL (7")	766.5+/-						
	LEAN CLAY (CL) , trace gravel, black to brown, moist, medium stiff				18	2-2-3 N=5	18	24-14-10
					18	1-2-4 N=6	16	
		3.5						
	SILTY SAND (SM) , trace gravel, brown, wet, loose to medium dense	763.5+/-			18	3-5-8 N=13		
					18	3-2-3 N=5		
		6.0						
	POORLY GRADED SAND (SP) , brown, wet, very loose to loose	761+/-			18	1-1-1 N=2		
					18	1-2-1 N=3		
		9.0						
	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM) , brown, wet, loose	758+/-			18	1-2-3 N=5		
					18	2-3-4 N=7		
		15.0						
	Boring Terminated at 15 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic 140#/30inch

Advancement Method:
3.25" Hollow Stem Augers

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

Abandonment Method:
Boring backfilled with cement-bentonite grout

WATER LEVEL OBSERVATIONS

Water encountered @ 3.8 feet while drilling



Boring Started: 11-29-2017

Boring Completed: 11-29-2017

Drill Rig: Mobile B-57

Driller: Moore-Lansing, Matt

Project No.: N4175437

Exhibit: A-9

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. N4175437 SOUTH BEND SOLAR.GPJ TERRACON_DATATEMPLATE.GDT 12/21/17

PUBLIC VERSION

D

R **R**

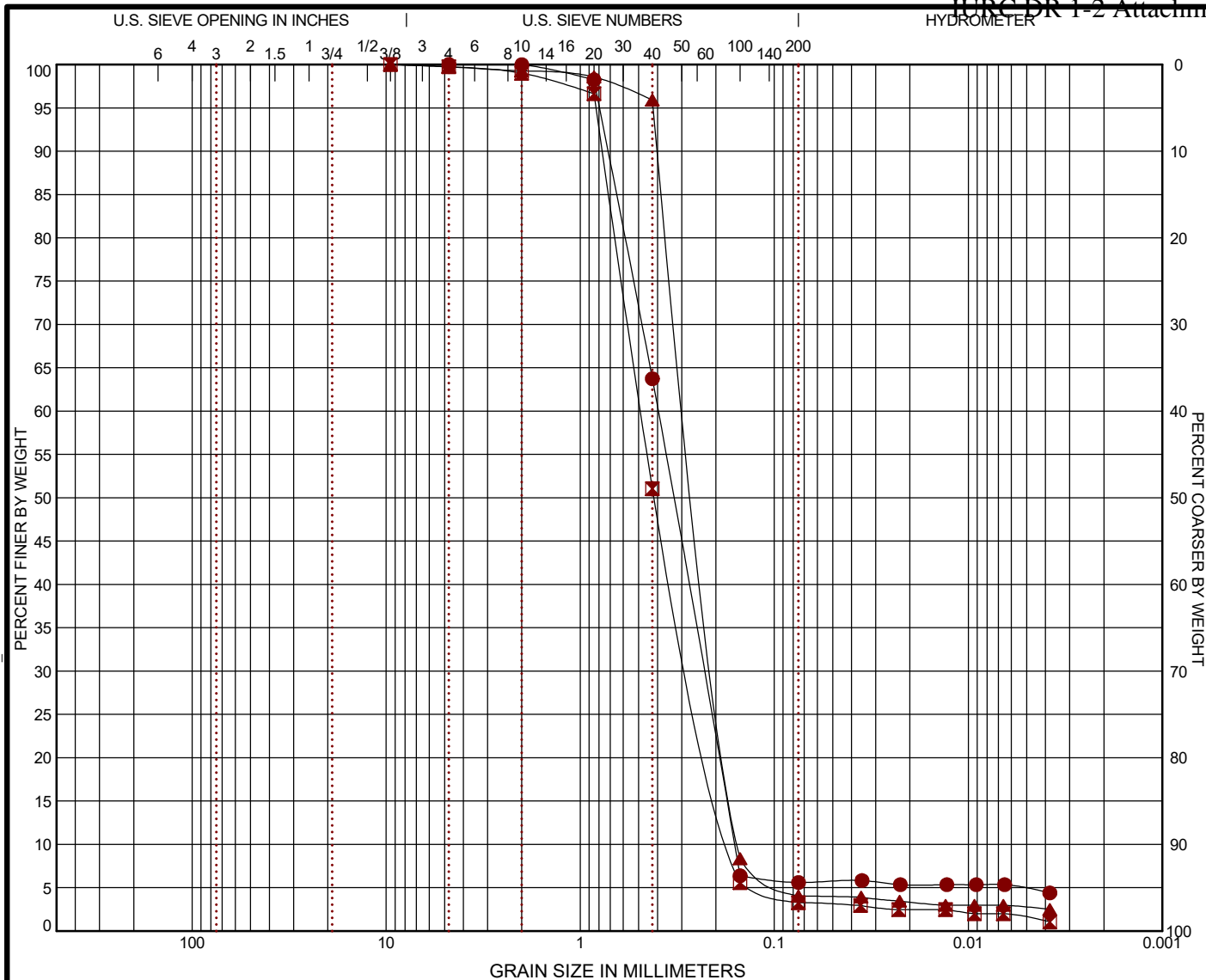
GRAIN SIZE DISTRIBUTION

PUBLIC VERSION
ASTM D422 / ASTM C136

Indiana Michigan Power Company
Cause No. 45245

IURC DR 1-2 Attachment 2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 N4175437 SOUTH BEND SOLAR.GPJ TERRACON DATATEMPLATE.GDT 12/21/17



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	B-1	3 - 4.5	0.0	0.0	94.4	0.7		4.9	SP-SM
⊠	B-1	7.5 - 9	0.0	0.3	96.5	1.7		1.5	SP
▲	B-2	3 - 4.5	0.0	0.3	95.7	1.3		2.7	SP

	GRAIN SIZE		
	●	⊠	▲
D ₆₀	0.397	0.487	0.277
D ₃₀	0.23	0.262	0.194
D ₁₀	0.16	0.166	0.153
COEFFICIENTS			
C _c	0.83	0.85	0.89
C _u	2.48	2.93	1.81

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
#4	100.0	3/8"	100.0	3/8"	100.0
#10	99.98	#4	99.73	#4	99.74
#20	98.24	#10	99.0	#10	99.27
#40	63.74	#20	96.63	#20	98.56
#100	6.38	#40	51.04	#40	95.9
#200	5.6	#100	5.59	#100	8.35
		#200	3.28	#200	4.04

SOIL DESCRIPTION

- POORLY GRADED SAND with SILT (SP-SM)
- ⊠ POORLY GRADED SAND (SP)
- ▲ POORLY GRADED SAND (SP)

REMARKS

●

⊠

▲

PROJECT: South Bend Solar Project	<p>800 Morrison Rd Gahanna, OH</p>	PROJECT NUMBER: N4175437
SITE: Bittersweet Road Granger, Indiana		CLIENT: American Electric Power Columbus, Ohio
		EXHIBIT: B-3

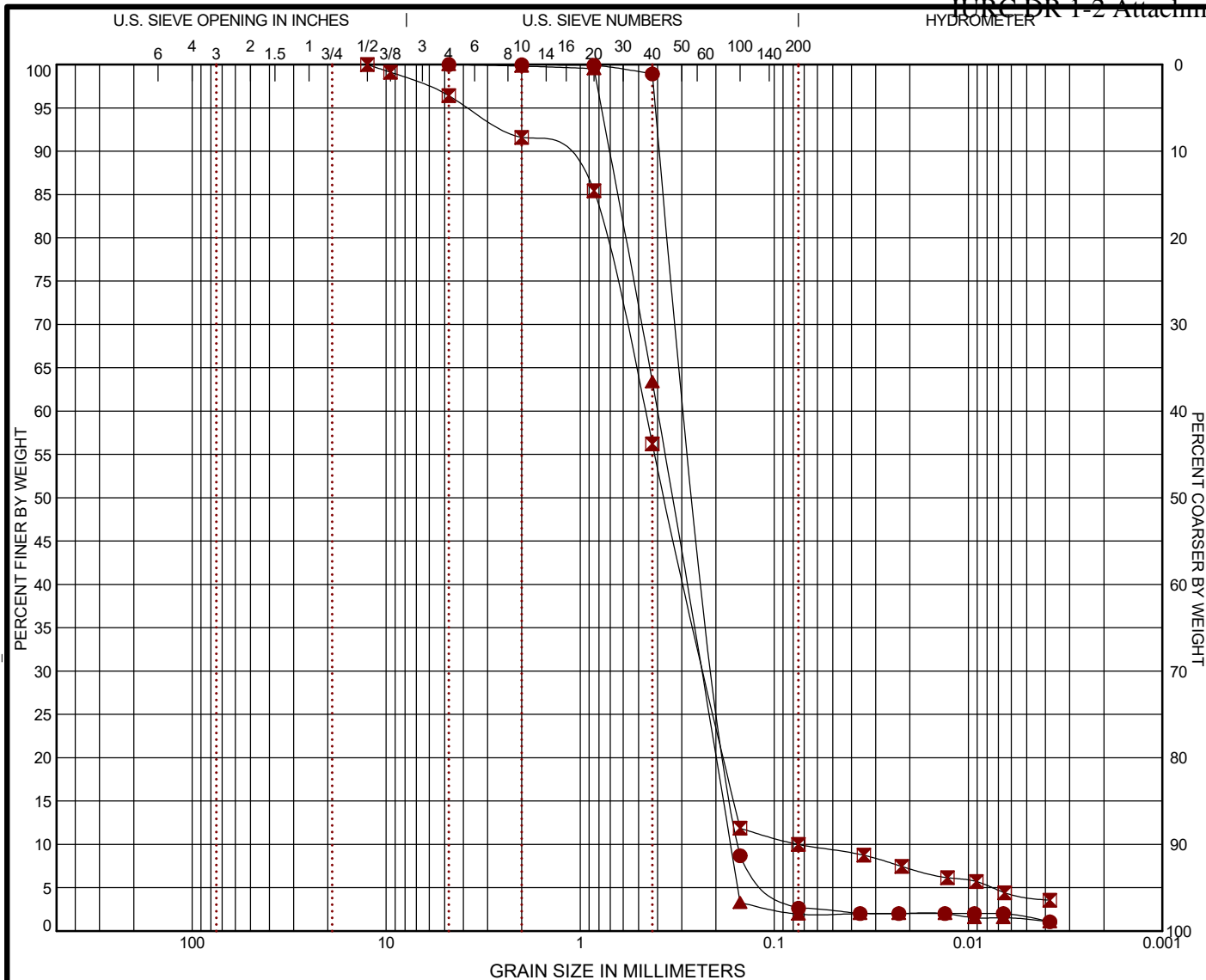
GRAIN SIZE DISTRIBUTION

PUBLIC VERSION
ASTM D422 / ASTM C136

Indiana Michigan Power Company
Cause No. 45245

IURC DR 1-2 Attachment 2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 N4175437 SOUTH BEND SOLAR.GPJ TERRACON DATATEMPLATE.GDT 12/21/17



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	B-2	9 - 10.5	0.0	0.0	97.4	1.1		1.5	SP
☒	B-3	3 - 4.5	0.0	3.6	86.4	6.0		4.0	SW-SM
▲	B-3	7.5 - 9	0.0	0.0	98.1	0.6		1.3	SP

GRAIN SIZE				SOIL DESCRIPTION					
	●	☒	▲	Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
				#4	100.0	1/2"	100.0	#4	100.0
				#10	99.96	3/8"	99.1	#10	99.82
				#20	99.91	#4	96.41	#20	99.52
				#40	98.91	#10	91.6	#40	63.4
				#100	8.69	#20	85.44	#100	3.31
				#200	2.63	#40	56.21	#200	1.95
						#100	11.86		
						#200	9.99		

● POORLY GRADED SAND (SP)
 ☒ WELL-GRADED SAND with SILT (SW-SM)
 ▲ POORLY GRADED SAND (SP)

REMARKS
●
☒
▲

PROJECT: South Bend Solar Project	 800 Morrison Rd Gahanna, OH	PROJECT NUMBER: N4175437
SITE: Bittersweet Road Granger, Indiana		CLIENT: American Electric Power Columbus, Ohio
		EXHIBIT: B-4

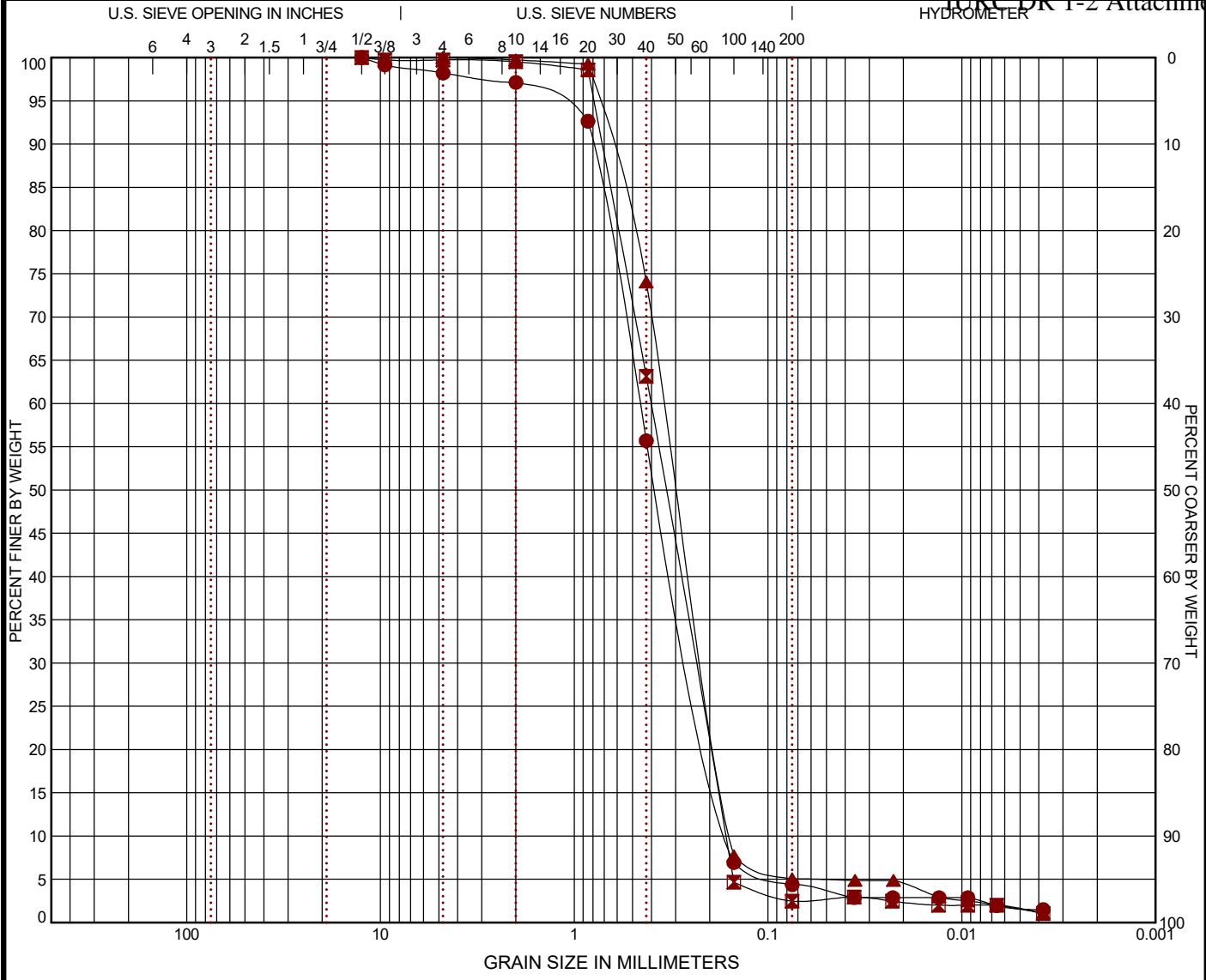
GRAIN SIZE DISTRIBUTION

PUBLIC VERSION
ASTM D422 / ASTM C136

Indiana Michigan Power Company
Cause No. 45245

IURC DR 1-2 Attachment 2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 N4175437 SOUTH BEND SOLAR.GPJ TERRACON DATATEMPLATE.GDT 12/21/17



Project Number: N4175437
Service Date: 12/13/17
Report Date: 12/18/17
Task:

American Electric Power
 Columbus, Ohio

South Bend Solar Project

Sample Submitted By: Terracon (N4)

Date Received: 12/8/2017

Lab No: 17-1256

Results of Corrosion Analysis

	Sample Number	B-1	B-5	B-6
	Sample Location	B-1	B-5	B-6
	Sample Depth (ft.)	1.0-3.5	1.0-3.5	1.0-3.5
	pH Analysis, AWWA 4500 H	8.70	8.51	8.33
	Water Soluble Sulfate (SO4), ASTM D 516 (mg/kg)	94	52	91
	Chlorides, ASTM D 512 (mg/kg)	80	35	73
	Red-Ox, AWWA 2580 (mV)	+656	+653	+666
	Resistivity, ASTM G 57 (ohm-cm)	3686	3977	2862













Analyzed By:



Trisha Campo
 Chemist

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING				WATER LEVEL		Water Initially Encountered	FIELD TESTS	(HP) Hand Penetrometer
						Water Level After a Specified Period of Time		(T) Torvane
						Water Level After a Specified Period of Time		(b/f) Standard Penetration Test (blows per foot)
	Auger	Shelby Tube	Split Spoon					N N value
	Rock Core	Macro Core	Modified California Ring Sampler					(PID) Photo-Ionization Detector
	Grab Sample	No Recovery	Modified Dames & Moore Ring Sampler					(OVA) Organic Vapor Analyzer
					Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.			

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS	RELATIVE DENSITY OF COARSE-GRAINED SOILS <small>(More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.</small>			CONSISTENCY OF FINE-GRAINED SOILS <small>(50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance</small>			
	Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, tsf	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.
	Very Loose	0 - 3	0 - 6	Very Soft	less than 0.25	0 - 1	< 3
	Loose	4 - 9	7 - 18	Soft	0.25 to 0.50	2 - 4	3 - 4
	Medium Dense	10 - 29	19 - 58	Medium-Stiff	0.50 to 1.00	4 - 8	5 - 9
	Dense	30 - 50	59 - 98	Stiff	1.00 to 2.00	8 - 15	10 - 18
	Very Dense	> 50	≥ 99	Very Stiff	2.00 to 4.00	15 - 30	19 - 42
				Hard	> 4.00	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM IURC DR 1-2 Attachment 2

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification			
				Group Symbol	Group Name ^B		
Coarse Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F		
		Gravels with Fines: More than 12% fines ^C	$Cu < 4$ and/or $1 > Cc > 3$ ^E	GP	Poorly graded gravel ^F		
		Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			Sands with Fines: More than 12% fines ^D	$Cu < 6$ and/or $1 > Cc > 3$ ^E	SP	Poorly graded sand ^I	
	Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above "A" line ^J	CL	Lean clay ^{K,L,M}	
				$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K,L,M}	
			Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K,L,M,N}
				Liquid limit - not dried			Organic silt ^{K,L,M,O}
Silts and Clays: Liquid limit 50 or more		Inorganic:	PI plots on or above "A" line	CH	Fat clay ^{K,L,M}		
			PI plots below "A" line	MH	Elastic Silt ^{K,L,M}		
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K,L,M,P}	
			Liquid limit - not dried			Organic silt ^{K,L,M,Q}	
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat		

^A Based on the material passing the 3-inch (75-mm) sieve

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

^E $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

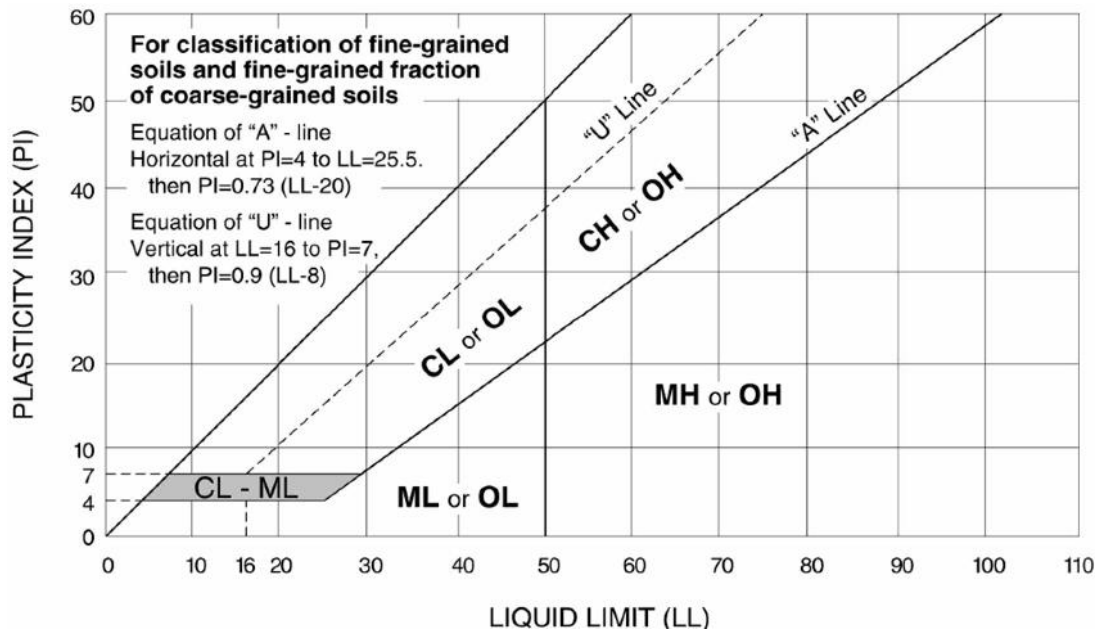
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

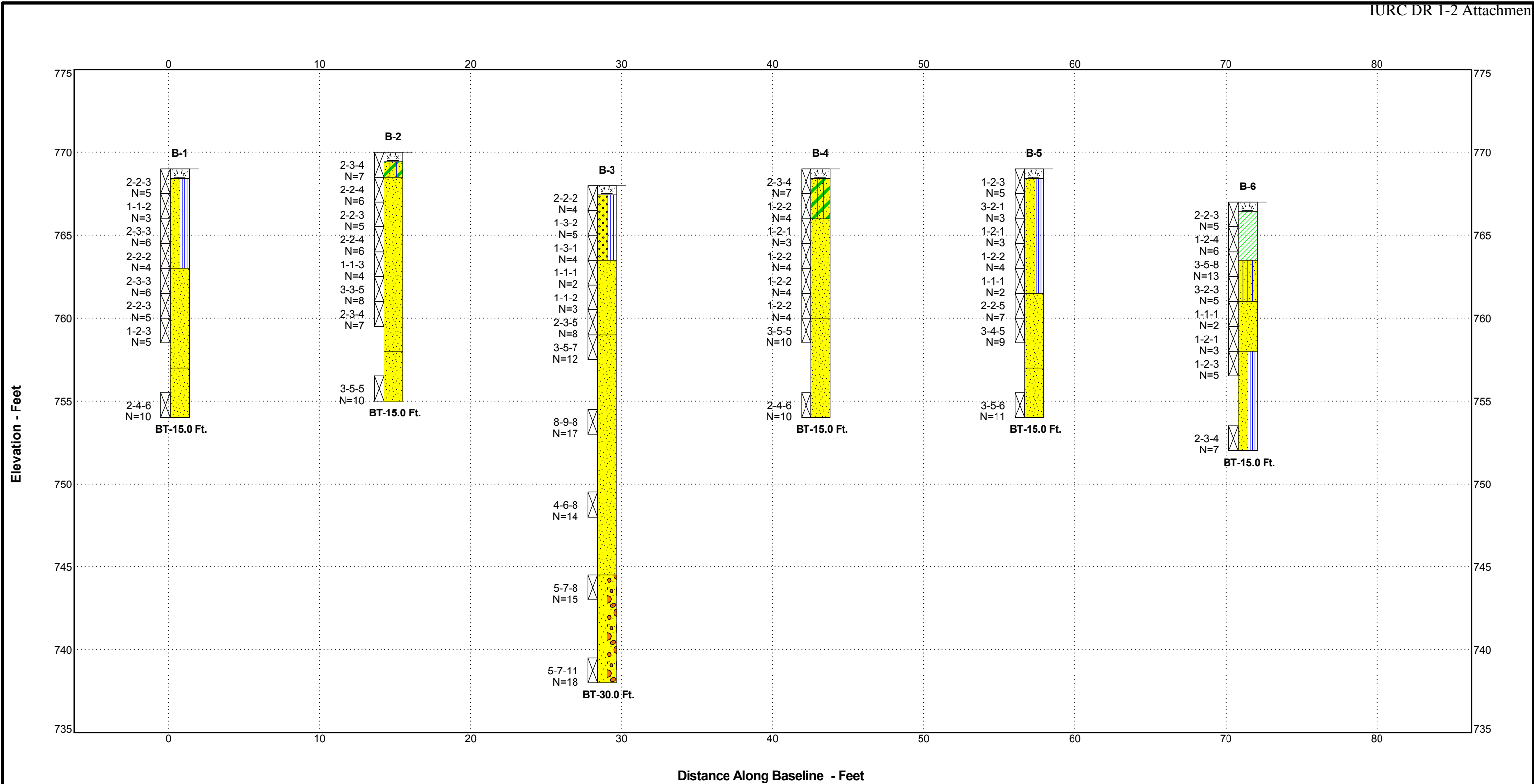
^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. SMART FENCE N4175437 SOUTH BEND SOLAR.GPJ TERRACON_DATATEMPLATE.GDT 12/20/17



Explanation

Moisture Content — %w	☒	Borehole Number	☐	Topsoil	☐	Poorly-graded Sand with Silt	☐	Poorly-graded Sand	☐	Silty Clayey Sand	☐	Well-graded Sand with Silt
Sampling (See General Notes)	☐	LL PL — Liquid and Plastic Limits	—	Poorly-graded Sand with Gravel	☐	Lean Clay	☐	Silty Sand				
	☐	Borehole Lithology										
	☐	AR — Auger Refusal										
	☐	BT — Boring Termination Type										

NOTES:
 See Exhibit A-2 for orientation of soil profile.
 See General Notes in Appendix C for symbols and soil classifications.
 Soils profile provided for illustration purposes only.
 Soils between borings may differ.
 AR - Auger Refusal
 BT - Boring Termination

Project Manager: Nachi P.
 Drawn by: SB
 Approved by:
 Date: 12/20/2017

Project No.: N4175437
 Scale: Vertical or horizontal scale, su
 File Name: N4175437

Terracon
 800 Morrison Rd
 Gahanna, OH
 PH. 614-863-3113 FAX. 614-863-0475

SUBSURFACE PROFILE
 Section A-A
 SOUTH BEND SOLAR PROJECT
 BITTERSWEET ROAD
 GRANGER, INDIANA

EXHIBIT
 C-3



d **M** **M** **r**
d **r**

-
-

D
D **R** **RM** **R**

-
-
-
-
-
-
-

d **r** **R**
R

-

R **M** **R** **1**

ALTA/NSPS LAND TITLE SURVEY
IN THE EAST HALF OF SECTION 19 AND THE WEST HALF OF
SECTION 20, TOWNSHIP 38 NORTH, RANGE 4 EAST,
HARRIS TOWNSHIP, SAINT JOSEPH COUNTY, INDIANA

SOUTHEAST CORNER,
SOUTHWEST 1/4,
SECTION 20-38-4
FOUND HARRISON MONUMENT

LEGACY LAND OPERATIONS, LLC
71-05-20-400-001.000-011

EAST LINE,
SOUTHWEST 1/4,
SECTION 20-38-4

1361.79'

1318.85'

N 89°23'20" W 1352.40'

274.16'

NORTHEAST CORNER,
SOUTHWEST 1/4,
SECTION 20-38-4
FOUND HARRISON MONUMENT

S 00°39'36" E 1044.69'



LEGEND

- = FOUND IRON
- = SET REBAR W/
CAP #LS21700004
- △ = SET MAG NAIL
- ⊙ = FIBER OPTIC MARKER
- ⊘ = TELEPHONE MANHOLE
- ⊙ = POWER POLE
- ⊙ = GUY ANCHOR
- ⊙ = GUARD POST
- ⊙ = ELECTRIC METER
- ⊙ = GUARDRAIL
- x—x— = OVERHEAD UTILITY LINE
- x—x— = FENCE LINE

LEDGER A & CHRISTY L KRUPP
71-05-20-300-002.000-011

BUCKEYE ROAD

S 00°15'05" E 1320.02'

SOUTH LINE,
SOUTHWEST 1/4,
SECTION 20-38-4

ELECTRICAL
PANEL

±208.06 ACRES
NO BUILDINGS OBSERVED
NO ADDRESS PROVIDED
OR OBSERVED

SEE DETAIL 'B'

SEE DETAIL 'D'

SEE DETAIL 'C'

SEE DETAIL 'A'

SEE DETAIL 'C'

SEE DETAIL 'A'

SEE DETAIL 'A'

SEE DETAIL 'C'

SEE DETAIL 'A'

NORTHWEST CORNER,
NORTHWEST 1/4,
SECTION 20-38-4
FOUND HARRISON MONUMENT

N 00°33'53" W
2456.38'

NORTHEAST CORNER,
NORTHWEST 1/4,
SECTION 19-38-4
FOUND HARRISON MONUMENT

S 77°45'30" E 2093.52'(m) 2092.44'(d)

I-80 TOLL ROAD
(R/W VARIES)

(44' WIDE ASPHALT EAST BOUND LANE)

R/W LINE

TOP OF BANK

CONCRETE PADS FOR IRRIGATION SYSTEM (TYPICAL)

REGULATED DRAIN EASEMENT

JUDAY CREEK

SEE DETAIL 'C'

FOUND 4" CONCRETE MONUMENT (FLUSH) ORIGIN UNKNOWN, HELD

4" WIRE FENCE ON LINE

FOUND 1-1/4" IRON PIPE (-0.3') ORIGIN UNKNOWN, HELD

SEE DETAIL 'A'

FOUND 5/8" REBAR W/ CAP NO. LS20800148 (-0.21) HELD

NORTHWEST CORNER,
SOUTHWEST 1/4,
SECTION 19-38-4
FOUND HARRISON MONUMENT

N 00°33'52" W
574.57'

2068.78'

2670.56'

N 89°26'43" W 1327.46'(m) 1327.50'(d)

(ASPHALT ROADWAY, WIDTH VARIES)

CLEVELAND ROAD

(R/W VARIES)

WEST LINE,
SOUTHWEST 1/4,
SECTION 19-38-4

SEE DETAIL 'A'

SEE DETAIL 'A'

SEE DETAIL 'A'

1570.89'

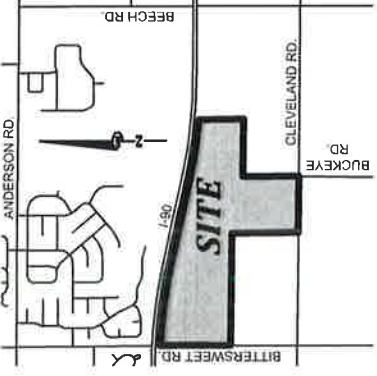
BITTERSWEET ROAD

(RW VARIES) (ASPHALT ROADWAY, WIDTH VARIES)

N 00°07'08" E
1072.80'

1072.80'

1570.89'



VICINITY MAP
(NOT TO SCALE)

SEE DETAIL 'A'

SEE DETAIL 'A'

SEE DETAIL 'A'

SEE DETAIL 'A'

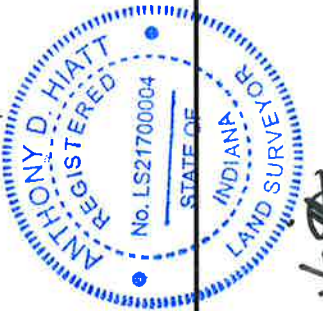
SEE DETAIL 'A'

SEE DETAIL 'A'

SEE DETAIL 'A'

SEE DETAIL 'A'

SEE DETAIL 'A'



Anthony D. Hiatt
ANTHONY D. HIATT

LS - 21700004

CLIENT: INDIANA MICHIGAN POWER COMPANY

JOB NO: 170655

DATE: 10/2/2017

SCALE: 1" = 600'

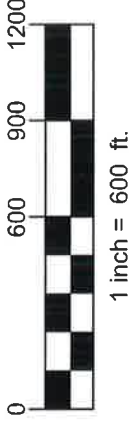
DRAWN BY: SSH

CHECKED BY:

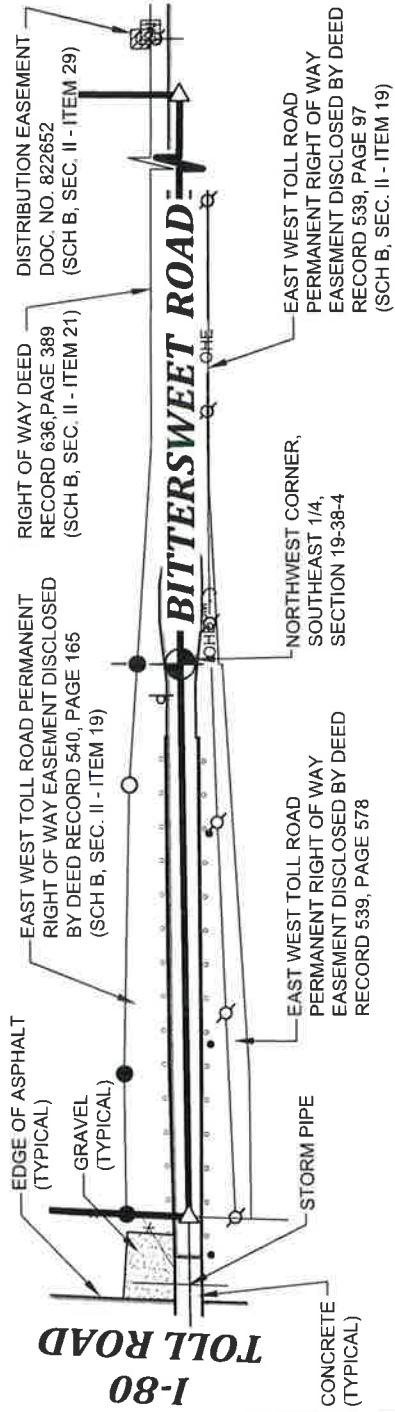
WMA
WIGHTMAN & ASSOCIATES, INC.
ENGINEERING SURVEYING ARCHITECTURE

2303 Pistone Road
Benton Harbor, MI 49022
Phone: (269) 927-0100
www.wightman-assoc.com

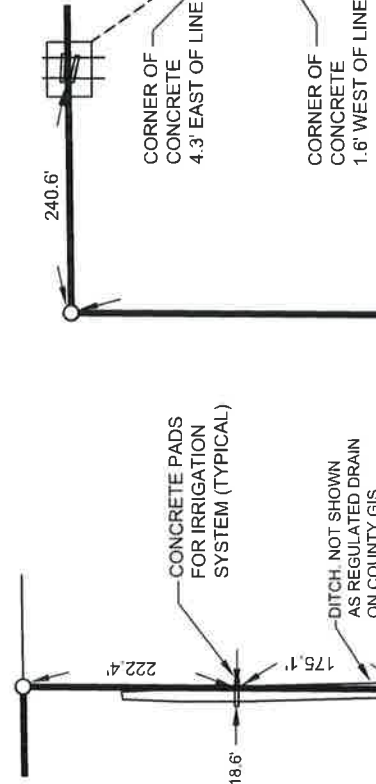
264 Western Avenue
Allegan, MI 49010
Phone: (269) 673-8465



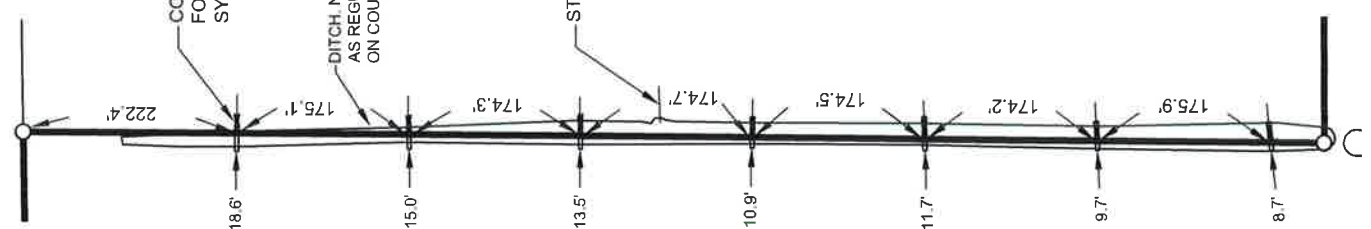
(RW VARIES) (ASPHALT ROADWAY, WIDTH VARIES)



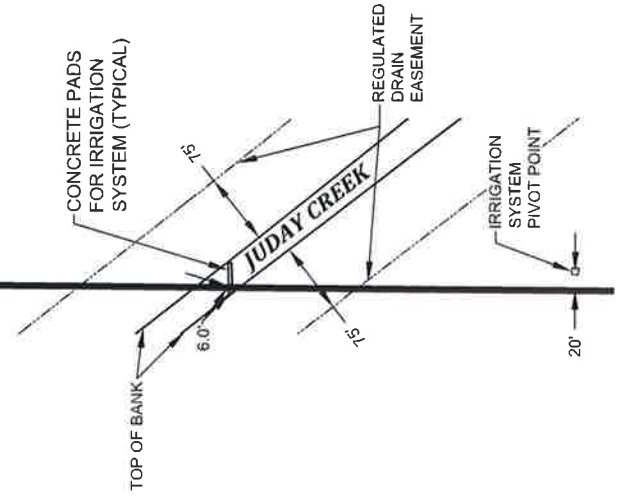
DETAIL 'A'
SCALE: 1" = 200'



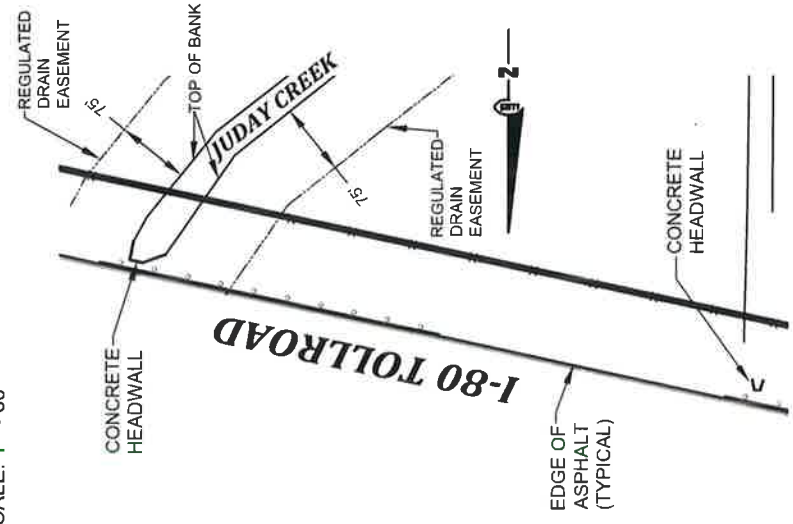
DETAIL 'B'
SCALE: 1" = 200'



DETAIL 'C'
SCALE: 1" = 200'



DETAIL 'D'
SCALE: 1" = 200'



CLIENT: INDIANA MICHIGAN POWER COMPANY

JOB No: 1706655

DATE: 10/2/2017

SCALE: AS NOTED

DRAWN BY: SSH

CHECKED BY:

WIGHTMAN & ASSOCIATES, INC.
ENGINEERING ♦ SURVEYING ♦ ARCHITECTURE

2303 Pipestone Road
Benton Harbor, MI 49022
Phone: (269) 927-0100
www.wightman-assoc.com

264 Western Avenue
Allegan, MI 49010
Phone: (269) 673-8465

Anthony D. Hiatt
ANTHONY D. HIATT

LS - 21700004

PARCEL DETAIL

NOT TO SCALE



LEGAL DESCRIPTION PER COMMITMENT FOR TITLE INSURANCE ISSUED BY FIDELITY NATIONAL TITLE INSURANCE COMPANY, COMMITMENT NO. 17-009940, EFFECTIVE DATE: SEPTEMBER 14, 2017.

PARCEL I:

A PARCEL OF LAND BEING A PART OF THE EAST HALF OF SECTION 24, TOWNSHIP 38 NORTH, RANGE 3 EAST, AND A PART OF SECTION 19 AND SECTION 20, BOTH IN TOWNSHIP 38 NORTH, RANGE 4 EAST, ALL IN HARRIS TOWNSHIP, ST. JOSEPH COUNTY, INDIANA, AND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT THE SOUTH QUARTER CORNER OF SAID SECTION 24; THENCE NORTH 00°14'26" WEST ALONG THE NORTH-SOUTH CENTERLINE OF SAID SECTION 24, A DISTANCE OF 2641.06 FEET TO THE CENTER OF SAID SECTION 24; THENCE NORTH 00°14'12" WEST ALONG SAID NORTH-SOUTH CENTERLINE, A DISTANCE OF 576.70 FEET TO SAID LINE'S INTERSECTION WITH THE SOUTH RIGHT-OF-WAY LINE OF THE INDIANA EAST-WEST TOLL ROAD; THENCE FOR THE NEXT FIVE COURSES ALONG SAID SOUTH RIGHT-OF-WAY LINE, THE FIRST COURSE BEING NORTH 89°32'10" EAST, A DISTANCE OF 4567.86 FEET; THENCE ALONG A CURVE TO THE RIGHT HAVING A RADIUS OF 11309.16 FEET, A CENTRAL ANGLE OF 03°08'46", AND LIMITED IN LENGTH BY A CHORD WHICH BEARS SOUTH 88°53'24" EAST, A DISTANCE OF 620.92 FEET TO SAID SOUTH RIGHT-OF-WAY LINE'S INTERSECTION WITH THE NORTH-SOUTH CENTERLINE OF SAID SECTION 19; THENCE CONTINUING ALONG SAID CURVE TO THE RIGHT HAVING A RADIUS OF 11309.16 FEET, A CENTRAL ANGLE OF 09°33'29", AND LIMITED IN LENGTH BY A CHORD WHICH BEARS SOUTH 82°32'16" EAST, A DISTANCE OF 1884.41 FEET; THENCE SOUTH 77°45'30" EAST, A DISTANCE OF 2092.44 FEET; THENCE ALONG A CURVE TO THE LEFT HAVING A RADIUS OF 11609.16 FEET, A CENTRAL ANGLE OF 07°05'27", AND LIMITED IN LENGTH BY A CHORD WHICH BEARS SOUTH 81°18'16" EAST, A DISTANCE OF 1435.79 FEET TO SAID RIGHT-OF-WAY LINE'S INTERSECTION WITH THE NORTH-SOUTH LINE OF SAID SECTION 20; THENCE SOUTH 00°39'36" EAST ALONG SAID LINE, A DISTANCE OF 1044.69 FEET; THENCE NORTH 89°23'20" WEST, A DISTANCE OF 1352.40 FEET; THENCE SOUTH 00°15'05" EAST, A DISTANCE OF 1320.02 FEET TO A POINT ON THE SOUTH LINE OF SAID SECTION 20; THENCE NORTH 89°26'43" WEST ALONG SAID LINE, A DISTANCE OF 1327.50 FEET TO THE SOUTHEAST CORNER OF SAID SECTION 19; THENCE NORTH 89°28'23" WEST ALONG THE SOUTH LINE OF SAID SECTION 19, A DISTANCE OF 2670.76 FEET TO THE SOUTH QUARTER CORNER OF SAID SECTION 19; THENCE SOUTH 89°52'29" WEST ALONG SAID SOUTH LINE, A DISTANCE OF 2540.96 FEET TO THE SOUTHEAST CORNER OF SAID SECTION 24; THENCE SOUTH 89°35'22" WEST ALONG THE SOUTH LINE OF SAID SECTION 24, A DISTANCE OF 2635.43 FEET TO THE POINT OF BEGINNING, CONTAINING 687.64 ACRES, MORE OR LESS.

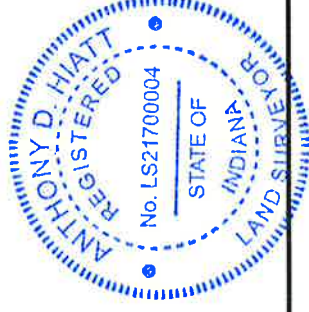
EXCEPT THEREFROM ANY PART THEREOF LYING WITHIN SECTION 24, TOWNSHIP 38 NORTH, RANGE 3 EAST.

LEGAL DESCRIPTION AS SURVEYED

THAT PART OF THE EAST HALF OF SECTION 19 AND THE WEST HALF OF SECTION 20, TOWNSHIP 38 NORTH, RANGE 4 EAST, HARRIS TOWNSHIP, SAINT JOSEPH COUNTY, INDIANA, DESCRIBED AS: BEGINNING AT A HARRISON MONUMENT AT THE SOUTHEAST CORNER OF THE SOUTHEAST QUARTER OF SAID SECTION 19, SAID POINT ALSO BEING THE SOUTHWEST CORNER OF THE SOUTHWEST QUARTER OF SAID SECTION 20; THENCE NORTH 00° 35' 24" WEST ON THE EAST LINE OF THE SOUTHWEST QUARTER OF SAID SECTION 19 A DISTANCE OF 1569.86 FEET TO A SET 5/8" REBAR WITH CAP #LS21700004; THENCE NORTH 89° 26' 39" WEST PARALLEL WITH THE NORTH LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 19 A DISTANCE OF 2651.26 FEET TO A SET PK NAIL ON THE WEST LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 19; THENCE NORTH 00° 07' 08" EAST ON SAID WEST LINE 1072.80 FEET TO A HARRISON MONUMENT AT THE NORTHWEST CORNER OF THE SOUTHEAST QUARTER OF SAID SECTION 19; THENCE NORTH 00° 33' 52" WEST ON THE WEST LINE OF THE NORTHWEST QUARTER OF SAID SECTION 19 A DISTANCE OF 574.57 FEET TO A SET PK NAIL ON THE SOUTHERLY RIGHT OF WAY LINE OF THE INTERSTATE 80 TOLL ROAD; THENCE EASTERLY 1885.59 FEET ON SAID SOUTHERLY RIGHT OF WAY LINE AND ON A 11309.16 FOOT RADIUS CURVE TO THE RIGHT WHOSE CHORD BEARS SOUTH 82° 32' 27" EAST 1883.41 FEET (DEEDED SOUTH 82° 32' 16" EAST 1884.41 FEET) TO A FOUND CONCRETE MONUMENT; THENCE SOUTH 77° 45' 30" EAST ON SAID SOUTHERLY RIGHT OF WAY LINE 2093.52 FEET (DEEDED 2092.44 FEET) TO A FOUND REBAR WITH CAP NO. S0523; THENCE EASTERLY 1436.67 FEET ON SAID SOUTHERLY RIGHT OF WAY LINE AND ON A 11609.16 FOOT RADIUS CURVE TO THE LEFT WHOSE CHORD BEARS SOUTH 81° 18' 16" EAST 1435.75 FEET (DEEDED 1435.79 FEET) TO A FOUND REBAR WITH CAP NO. S0523 ON THE EAST LINE OF THE SOUTHWEST QUARTER OF SAID SECTION 20; THENCE SOUTH 00° 39' 36" EAST ON SAID EAST LINE 1044.69 FEET TO A SET 5/8" REBAR WITH CAP NO. LS21700004; THENCE NORTH 89° 23' 20" WEST 1352.40 FEET TO A SET 5/8" REBAR WITH CAP NO. LS21700004; THENCE SOUTH 00° 15' 05" EAST 1320.02 FEET TO A SET PK NAIL ON THE SOUTH LINE OF THE SOUTHWEST QUARTER OF SAID SECTION 20; THENCE NORTH 89° 26' 43" WEST ON SAID SOUTH LINE 1327.46 FEET (DEEDED 1327.50 FEET) TO THE POINT OF BEGINNING, CONTAINING 208.06 ACRES MORE OR LESS.

SUBJECT TO THE RIGHTS OF THE PUBLIC AND OF ANY GOVERNMENTAL UNIT IN ANY PART THEREOF TAKEN, USED, OR DEEDED FOR STREET, ROAD, OR HIGHWAY PURPOSES.

BEARINGS ARE RELATED TO THE INDIANA STATE PLANE COORDINATE SYSTEM, EAST ZONE (U.S. SURVEY FEET).



W&A
 264 Western Avenue
 Allegan, MI 49010
 Phone: (269) 673-8465

ENGINEERING ♦ SURVEYING ♦ ARCHITECTURE
 2303 Pinestone Road
 Benton Harbor, MI 49022
 Phone: (269) 927-0100

CLIENT: INDIANA MICHIGAN POWER COMPANY
 JOB NO.: 170655
 DATE: 10/2/2017
 SCALE:
 DRAWN BY: SSH
 CHECKED BY:

INDIANA MICHIGAN POWER COMPANY

Anthony D. Hiatt
 ANTHONY D. HIATT

LS - 21700004

ITEMS PER SCHEDULE B, SECTION 2, SPECIAL EXCEPTIONS

TERMS AND PROVISIONS OF THE EAST-WEST TOLL ROAD PERMANENT RIGHT OF WAY EASEMENT GRANTED TO THE STATE OF INDIANA BY INSTRUMENTS DATED JULY 14, 1954 AND RECORDED MARCH 18, 1955 IN BOOK 539, PAGE 97 AND DATED JULY 12, 1954 AND RECORDED APRIL 20, 1955 IN BOOK 540 PAGE 165. (SECTION 19) AFFECTS PARCEL AS SHOWN (ITEM 19).

EASEMENT FOR LINES, POLES AND WIRES FOR TRANSMITTING ELECTRIC, POWER, TELEPHONE OR TELEGRAPH GRANTED TO INDIANA & MICHIGAN ELECTRIC COMPANY DATED OCTOBER 24, 1958 AND RECORDED DECEMBER 12, 1958 IN BOOK 584 PAGE 514. (SECTIONS 30 & 19) DOES NOT AFFECT PARCEL (ITEM 20).

RIGHT OF WAY GRANTED TO ST. JOSEPH COUNTY BY INSTRUMENT DATED MAY 11, 1961, AND RECORDED MARCH 26, 1963, IN BOOK 636, PAGE 389. (SE QUARTER SECTION 19) AFFECTS PARCEL AS SHOWN (ITEM 21).

RIGHT OF WAY GRANTED TO ST. JOSEPH COUNTY BY INSTRUMENT DATED MAY 11, 1961, AND RECORDED MARCH 26, 1963, IN BOOK 636, PAGE 390. (NW QUARTER SECTION 30) DOES NOT AFFECT PARCEL (ITEM 22).

RIGHT OF WAY GRANTED TO ST. JOSEPH COUNTY BY INSTRUMENT DATED MAY 11, 1961, AND RECORDED MARCH 26, 1963, IN BOOK 636, PAGE 391. (SE OF SW QUARTER SECTION 19) DOES NOT AFFECT PARCEL (ITEM 23).

RIGHT OF WAY GRANTED TO ST. JOSEPH COUNTY BY INSTRUMENT DATED MAY 11, 1961, AND RECORDED MARCH 26, 1963, IN BOOK 636, PAGE 392. (NE OF SW QUARTER SECTION 19) DOES NOT AFFECT PARCEL (ITEM 24).

RIGHT OF WAY GRANTED TO ST. JOSEPH COUNTY BY INSTRUMENT DATED MAY 11, 1961, AND RECORDED MARCH 26, 1963, IN BOOK 636, PAGE 393. (SW OF NE QUARTER SECTION 19) DOES NOT AFFECT PARCEL (ITEM 25).

RIGHT OF WAY GRANTED TO ST. JOSEPH COUNTY BY INSTRUMENT DATED MAY 11, 1961, AND RECORDED MARCH 26, 1963, IN BOOK 636, PAGE 394. (NE QUARTER SECTION 30) DOES NOT AFFECT PARCEL (ITEM 26).

EASEMENT FOR GAS MAIN GRANTED TO NORTHERN INDIANA PUBLIC SERVICE COMPANY, AN INDIANA CORPORATION DATED AUGUST 31, 2006 AND RECORDED SEPTEMBER 22, 2006 AS INSTRUMENT NO. 0641298. (SECTION 30) DOES NOT AFFECT PARCEL (ITEM 27).

DISTRIBUTION EASEMENT BY HEARTLAND FARMS, LLC TO INDIANA MICHIGAN POWER COMPANY DATED MAY 13, 2008 AND RECORDED JULY 8, 2008 AS INSTRUMENT NO. 0822651. (SECTION 19) DOES NOT AFFECT PARCEL (ITEM 28).

DISTRIBUTION EASEMENT BY HEARTLAND FARMS, LLC TO INDIANA MICHIGAN POWER COMPANY DATED MAY 13, 2008 AND RECORDED JULY 8, 2008 AS INSTRUMENT NO. 0822652. (SECTION 19) AFFECTS PARCEL AS SHOWN (ITEM 29).

TEMPORARY HIGHWAY EASEMENT GRANT TO THE BOARD OF COUNTY COMMISSIONERS OF ST. JOSEPH COUNTY, STATE OF INDIANA DATED DECEMBER 3, 2008 AND RECORDED JANUARY 16, 2009 AS INSTRUMENT NO. 0901398. (SW QUARTER SECTION 19) DOES NOT AFFECT PARCEL (ITEM 30).

SURVEY NOTES

A NEW LEGAL DESCRIPTION WAS DRAFTED TO DESCRIBE ONLY THAT PORTION OF PARCEL I AS DESCRIBED IN COMMITMENT FOR TITLE INSURANCE ISSUED BY FIDELITY NATIONAL TITLE INSURANCE COMPANY, COMMITMENT NO. 17-009940, EFFECTIVE DATE SEPTEMBER 14, 2017, SURVEYED AS SHOWN.

THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION. THE SURVEYOR MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN-SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES ARE IN THE EXACT LOCATION INDICATED ALTHOUGH THE SURVEYOR DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM THE INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.

AREAS OF THE SURVEYED PARCEL ARE LOCATED WITHIN ZONE X. (AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN), ZONE X, (AREAS SUBJECT TO THE 0.2% ANNUAL CHANCE FLOODPLAIN) AND ZONE AE (AREA SUBJECT TO 1% ANNUAL CHANCE 100 YEAR FLOOD) PER FEMA FLOOD INSURANCE RATE MAPS NUMBER 18141C0226D EFFECTIVE DATE JANUARY 6, 2011 AND 18141C0227D EFFECTIVE DATE JANUARY 6, 2011.

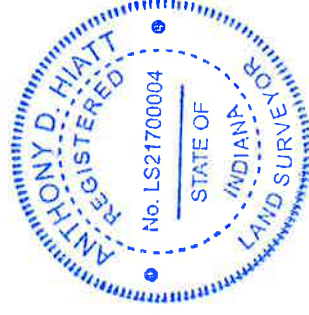
THERE ARE NO PROPOSED CHANGES IN STREET RIGHT OF WAY LINES PER INFORMATION OBTAINED FROM THE INDIANA DEPARTMENT OF TRANSPORTATION ON 10/11/2017. NO EVIDENCE OF RECENT STREET OR SIDEWALK CONSTRUCTION OR REPAIRS WAS OBSERVED IN THE PROCESS OF CONDUCTING THE FIELDWORK. (TABLE A, ITEM 17)

SURVEYOR'S REPORT

IN ACCORDANCE WITH TITLE 865, ARTICLE 1, CHAPTER 12, SECTION 1 THROUGH 29 OF THE INDIANA ADMINISTRATIVE CODE, THIS RETRACEMENT SURVEY WAS PERFORMED BY OR UNDER THE DIRECTION OF THE REGISTERED LAND SURVEYOR STATED HEREON AND TO THE BEST OF SURVEYOR'S BELIEF WAS EXECUTED ACCORDING TO THE SURVEY REQUIREMENTS OF THIS RULE. FURTHERMORE, THE FOLLOWING OBSERVATIONS AND OPINIONS ARE SUBMITTED REGARDING THE VARIOUS UNCERTAINTIES IN THE LOCATIONS OF THE LINES AND CORNERS ESTABLISHED ON THIS SURVEY AS A RESULT OF:

- A) AVAILABILITY AND CONDITION OF REFERENCE MONUMENTS;
- B) OCCUPATION OR POSSESSION LINES
- C) CLARITY OR AMBIGUITY OF THE RECORD DESCRIPTION USED AND OF ADJOINERS' DESCRIPTIONS AND THE RELATIONSHIP WITH ADJOINER'S LINES.
- D) THE RELATIVE POSITIONAL ACCURACY OF THE MEASUREMENTS

THIS SURVEY HAS BEEN PERFORMED UNDER CLASSIFICATION OF A RURAL SURVEY. THE RELATIVE POSITIONAL ACCURACY OF THE MEASUREMENTS AND CORNERS OF THE SUBJECT TRACT ESTABLISHED IN THIS SURVEY ARE WITHIN SPECIFICATIONS FOR A RURAL SURVEY (0.26 FEET PLUS 200 PARTS PER MILLION).



264 Western Avenue
Allagan, MI 49010
Phone: (269) 673-9465

ENGINEERING ♦ SURVEYING ♦ ARCHITECTURE
9835 Portage Road
Portage, MI 49002
Phone: (269) 927-0100

CLIENT: INDIANA MICHIGAN POWER COMPANY
JOB No: 170655
DATE: 10/2/2017
SCALE:
Phone: (269) 327-3532
DRAWN BY: SSH
CHECKED BY:

Anthony D. Hiatt
ANTHONY D. HIATT

LS - 21700004

THEORY OF LOCATION:

THE PURPOSE OF THIS SURVEY IS TO PREPARE AN ALTA/NSPS LAND TITLE SURVEY OF A PORTION OF PARCEL 1 AS DESCRIBED IN THE COMMITMENT FOR TITLE INSURANCE PREPARED BY FIDELITY NATIONAL TITLE INSURANCE COMPANY COMMITMENT NUMBER 17-009940 EFFECTIVE DATE SEPTEMBER 14, 2017. SAID PARCEL ALSO DESCRIBED IN WARRANTY DEED RECORDED AS DOCUMENT NO. 1128527 IN THE OFFICE OF THE RECORDER OF ST. JOSEPH COUNTY, INDIANA.

THE BASIS OF BEARING FOR THIS SURVEY IS BASED ON THE INDIANA STATE PLANE COORDINATE SYSTEM, EAST ZONE.

THE FOLLOWING DEEDS AND PLATS WERE REFERENCED FOR THIS SURVEY:

- COMMITMENT FOR TITLE INSURANCE ISSUED BY FIDELITY NATIONAL TITLE INSURANCE COMPANY, COMMITMENT NO. 17-009940, EFFECTIVE DATE SEPTEMBER 14, 2017.
- WARRANTY DEED RECORDED AS DOCUMENT NO. 1128527 IN THE OFFICE OF THE RECORDER OF ST. JOSEPH COUNTY, INDIANA.
- WARRANTY DEED RECORDED AS DOCUMENT NO. 9511686 IN THE OFFICE OF THE RECORDER OF ST. JOSEPH COUNTY, INDIANA.
- CORPORATE WARRANTY DEED RECORDED AS DOCUMENT NO. 0811752 IN THE OFFICE OF THE RECORDER OF ST. JOSEPH COUNTY, INDIANA.
- RIGHT OF WAY PLANS FOR INTERSTATE 80 TOLL ROAD DESIGN SECTION D6, CONTRACT NO. C-31 (1953, LAST REVISED 1959).

COMMENTS / SUMMARY:

THE EAST LINE OF THE SOUTHEAST QUARTER OF SECTION 19-38-4, SAID LINE ALSO BEING THE WEST LINE OF THE SOUTHWEST QUARTER OF SECTION 20-38-4, WAS ESTABLISHED BY HOLDING HARRISON MONUMENTS FOUND AT THE SOUTHEAST AND NORTHEAST CORNERS THEREOF. THE LINE BEARING NORTH 89° 26' 39" WEST 2651.26 FEET ACROSS THE SOUTHEAST QUARTER OF SAID SECTION 19 WAS ESTABLISHED 20 FEET NORTH OF THE PIVOT POINT OF A CENTER PIVOT IRRIGATION SYSTEM AND PARALLEL WITH THE NORTH LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 19 AS INSTRUCTED BY THE CLIENT. THE WEST LINE OF THE SOUTHEAST QUARTER OF SAID SECTION 19 WAS ESTABLISHED BY HOLDING HARRISON MONUMENTS FOUND AT THE SOUTHWEST AND NORTHWEST CORNERS THEREOF. THE WEST LINE OF THE NORTHEAST QUARTER OF SAID SECTION 19 WAS ESTABLISHED BY HOLDING A HARRISON MONUMENT FOUND AT THE SOUTHWEST CORNER AND A RAILROAD SPIKE FOUND AT THE NORTHWEST CORNER. THE SOUTHERLY RIGHT OF WAY LINE OF THE I-80 TOLL ROAD WAS ESTABLISHED BY RIGHT OF WAY PLANS AND FOUND MONUMENTATION. THE EAST LINE OF THE SOUTHWEST QUARTER OF SECTION 20-38-4 WAS ESTABLISHED BY HOLDING A HARRISON MONUMENTS FOUND AT THE SOUTHEAST AND NORTHEAST CORNER THEREOF. THE LINES RUNNING WESTERLY AND SOUTHERLY BETWEEN THE EAST LINE OF THE SOUTHWEST QUARTER OF SAID SECTION 20 AND THE SOUTH LINE OF THE SOUTHWEST QUARTER OF SAID SECTION 20 WERE ESTABLISHED BY HOLDING DEEDED BEARINGS AND DISTANCES. THE SOUTH LINE OF THE SOUTHWEST QUARTER OF SAID SECTION 20 WAS ESTABLISHED BY HOLDING HARRISON MONUMENTS FOUND AT THE SOUTHEAST AND SOUTHWEST CORNER THEREOF.

AS A RESULT OF THE ABOVE OBSERVATIONS, IT IS MY OPINION THAT THE UNCERTAINTIES IN THE LOCATIONS OF THE LINES AND CORNERS ON THIS SURVEY ARE AS FOLLOWS:

- DUE TO VARIANCES IN THE AVAILABILITY AND CONDITION OF REFERENCE MONUMENTS: NONE.
- DUE TO INCONSISTENCIES IN THE LINES OF OCCUPATION OR POSSESSION: CONCRETE PADS FOR IRRIGATION SYSTEM UP TO 18.6 FEET OVER LINE.
- DUE TO DISCREPANCIES OR AMBIGUITY IN THE RECORD OR ADJOINING DESCRIPTIONS: DIFFERENCE BETWEEN DEEDED AND MEASURED DIMENSIONS UP TO 1.08 FEET.

I AFFIRM, UNDER THE PENALTIES FOR PERJURY, THAT I HAVE TAKEN REASONABLE CARE TO REDACT EACH SOCIAL SECURITY NUMBER IN THIS DOCUMENT, UNLESS REQUIRED BY LAW.

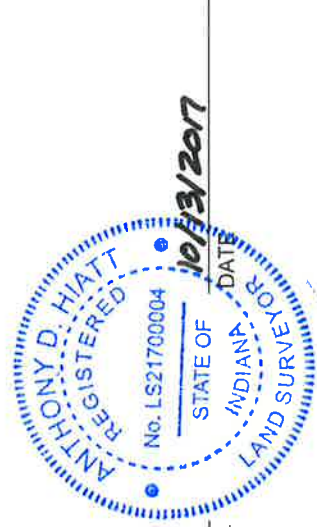
SURVEYOR'S CERTIFICATE

TO: INDIANA MICHIGAN POWER COMPANY, AN INDIANA CORPORATION AND FIDELITY NATIONAL TITLE INSURANCE COMPANY.

THIS IS TO CERTIFY THAT THIS MAP OR PLAT AND THE SURVEY ON WHICH IT IS BASED WERE MADE IN ACCORDANCE WITH THE 2016 MINIMUM STANDARD DETAIL REQUIREMENTS FOR ALTA/NSPS LAND TITLE SURVEYS, JOINTLY ESTABLISHED AND ADOPTED BY ALTA AND NSPS, AND INCLUDES ITEMS 1, 2, 3, 4, 7(A), 8, AND 17 OF TABLE A THEREOF. THE FIELDWORK WAS COMPLETED ON OCTOBER 12, 2017.



ANTHONY D. HIATT LS - 21700004
THIATT@WIGHTMAN-ASSOC.COM



264 Western Avenue
Allagan, MI 49010
Phonic: (269) 673-8465

ENGINEERING ♦ SURVEYING ♦ ARCHITECTURE

2303 Pinestone Road
Portion Harbor, MI 49022
Phonic: (269) 927-0100

9835 Portage Road
Portage, MI 49002

Phonic: (269) 327-3532

DRAWN BY: SSH

CHECKED BY:

CLIENT: INDIANA MICHIGAN POWER COMPANY

JOB No: 170655

DATE: 10/2/2017

SCALE:



d **M** **M** **r**

-
-

D
RM **MM** **R** **R** **R** **RM**

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d **r** **R**
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R **M** **R** **1**



d **M** **M** **r**

-
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D **1** **R** **D** **R** **RM**

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d **r** **R** **R**

-

R **M** **R** **1**

Project Input Data
PROJECT SPECIFICATIONS
VAISALA

Client name

Project name

Date at which project started operation (if applicable)

Latitude

Longitude

Elevation

AC Capacity [MW]

DC Capacity [MW]

Total number of modules

Total number of inverters

Modules per string

Module Manufacturer and Model **Please provide manufacturer datasheet, and PVsyst .pan file if available*

Inverter Manufacturer and Model **Please provide manufacturer datasheet, and PVsyst .and file if available*

Mounting Type Select From Drop-Down

Tilt angle

Azimuth

Pitch (m) (see picture 1)

Width of sensitive area (m) (see picture 1)

Distance from lower edge of array to ground (m)

Module orientation (landscape or portrait)

Table or Racking configuration (see picture 2)

(If trackers used) Backtracking?

(If trackers used) Tracker range (min/max rotation)

Auxiliary loads to subtract from production if any (W/kW)

Cleaning frequency

Is output curtailed? If so, please provide details.

Number of transformer stages between inverters and energy meter

For each transformer stage, please indicate the following	Transformer stage 1	Transformer stage 2 (if any)	Transformer stage 3 (if any)
Rating (MVA)	<input type="text"/>	<input type="text"/>	<input type="text"/>
Voltage (kV)	<input type="text"/>	<input type="text"/>	<input type="text"/>
No-load loss (%)	<input type="text"/>	<input type="text"/>	<input type="text"/>
Load loss at peak power (%)	<input type="text"/>	<input type="text"/>	<input type="text"/>
Is night disconnect used?	<input type="text"/>	<input type="text"/>	<input type="text"/>

If transmission line losses are significant, please specify for each line

	Line 1 (if any)	Line 2 (if any)	Line 3 (if any)
Loss (%)	<input type="text"/>	<input type="text"/>	<input type="text"/>
Line length (km)	<input type="text"/>	<input type="text"/>	<input type="text"/>
Resistance per unit length (Ω/m)	<input type="text"/>	<input type="text"/>	<input type="text"/>
Conductors per phase	<input type="text"/>	<input type="text"/>	<input type="text"/>

Please specify power factor, if not equal to 1



Picture 1



Picture 2

Please provide separately any system-specific loss calculations that have been performed (e.g. AC and DC wiring, auxiliary losses, transmission line losses, soiling)
Please provide separately any information relevant for shading analysis
Please provide separately any other relevant documentation for energy modeling (e.g. single-line diagrams)



APPENDIX 11

**POWER OUTPUT AND ENERGY
PERFORMANCE TESTING REQUIREMENTS**

EXHIBIT G-1 – POWER OUTPUT TEST

1.0 DEFINITIONS

- 1.1** “**Block**” means each AC Block (Array) at the Facility as set forth in Attachment A to Exhibit G-2.
- 1.2** “**Capacity Liquidated Damages**” has the meaning set forth in Section 2.5 below.
- 1.3** “**Facility Met Data**” means, for each hour of the day during the Energy Performance Test, the irradiance, relative humidity and ambient temperature actually recorded for the applicable time period by all meteorological stations at the Facility. When multiple meteorological stations are located on a Facility site, the data will be averaged together.
- 1.4** “**Facility Meter**” means the permanent ANSI C-12 power meter located at the Facility’s point of interconnection.
- 1.5** “**Combining Switchgear**” means the switchgear which collects generated power from the inverters.
- 1.6** “**Minimum Power Output Guarantee**” means 95.0% of the Power Output Guarantee.
- 1.7** “**Power Output Guarantee**” means the capacity of the Facility as measured by the Facility Meter that is the expected result of the Power Output Test, corrected to Standard Test Conditions.
- 1.8** “**Power Output Test**” means a test carried out in accordance with steps, procedures and conditions specified in this Exhibit G-1, to demonstrate achievement of the Power Output Guarantee and the Minimum Power Output Guarantee shown in the table below:

Power Output Test	Power Output Guarantee (in MW AC)	Minimum Power Output Guarantee (in MW AC)
South Bend	20	19

- 1.9** □ **“Primary Measurement Device”** means an instrument that provides a measurement or reading that is used in calculating power output pursuant to this Exhibit G-1.
- 1.10** □ **“Secondary Measurement Device”** means an instrument that is not used in calculating the output power or energy but is used as a check on primary measurements.
- 1.11** □ **“Standard Test Conditions (STC)”** means the following, with respect to each Block in the Facility: (i) irradiance in the plane of the array (module tilt angle and orientation) of 1,000 W/m²; (ii) 25°C module cell operating temperature as measured at the back surface or cell of the module (reference module temperatures shall not be used for temperature correction); and (iii) Air Mass (AM) of 1.5.
- 1.12** □ **“Temperature Corrected Output”** means the solution of the linear regression equation for the Power Output Test, where x is equal to 1,000 W/m².

2.0 □ **POWER OUTPUT TEST**

The objective of the Power Output Test is for Contractor to demonstrate to Owner that the Facility shall achieve (i) the Minimum Power Output Guarantee as a condition to achievement of Substantial Completion, and (ii) the Power Output Guarantee, in each case when the results are corrected from the test conditions to STC.

2.1 □ **Outline of Steps for POWER OUTPUT TEST**

2.1.1 □ **Conduct field tests:** Contractor shall measure and record AC power output (P_m) at the Facility Meter, Module temperature(s) from representative Modules in the Blocks, and irradiance levels using laboratory certified reference modules identical to those mounted in the field. Record this data over a duration and frequency to achieve a sufficient data population and minimize random error.

2.1.1.1 □ Module temperature shall be measured by use of Resistance Temperature Detectors (RTD) attached to the back side of representative Modules in the solar field, or embedded into the Module cells. If attached to the back side of the Module, the RTD shall be attached in a manner which will not allow any air gaps between sensor and surface, will not come loose, and will not create any hot spots. A minimum of 4 Modules will be instrumented for temperature readings. These RTDs shall be distributed throughout the solar field with 20% on the north-south perimeter rows and the third module in from edge of east-west rows.

2.1.1.2 □ Laboratory certified reference modules or cells shall be (to be provided by Module Supplier):

(1) Calibrated by National Renewable Energy Laboratory or

approved equal with appropriate supporting documentation.

- (2) Of the same type (identical optical and electrical properties) and rated power (reference module power rating shall be equal to the rated power of the Modules to within +/- 1%) as those in the solar field.
 - a. Mounted in the same plane (same tilt angle and orientation) and elevation as field solar arrays.
 - b. Labeled with permanent weatherproof label as certified calibrated reference module.
 - c. Provided in quantities as specified in Table 2-1.

2.1.2 Compile and reduce test data set: For each Power Output Test, raw test data shall be analyzed by Contractor and reduced to eliminate data points that clearly exhibit a high degree of random error or are not indicative of actual typical operating conditions, such as shading, clipping, or disturbances or unstable weather that were not indicative of the test. Contractor shall document all data that are eliminated and review with Owner for acceptance. Details shall be included in the agreed upon Power Output Test Procedures.

2.1.3 Apply temperature correction factors: Contractor shall correct each power measurement to 25 °C (STC temperature) using the module temperature coefficient of power to yield the corrected output power, P_{STC} . To ensure a mean representative solar module temperature is used in this correction calculation, the module temperature transmitters shall be placed as described in 2.1.1.2 and in quantities as specified in Table 2-1.

2.1.4 Ancillary Load Considerations: The test shall account for ancillary loads up to the Facility Meter which deduct energy from the net AC output. These are loads which are used for the running of the Facility but which reduce the net delivered power of the Facility. An example of this would be HVAC/lighting loads for the buildings (if used) which house the inverters, back feed power to transformers, etc. If such loads exist, they must be running during the test.

2.1.5 Plot data set using computational software: Contractor shall plot temperature-corrected power measurement versus measured solar irradiance as a scatter graph (y axis = power, x axis = plane of array irradiance).

2.1.6 Generate curve fit: Contractor shall, using computational software, generate a linear regression curve fit through the data and obtain the curve equation.

2.1.7 Solve for standard insolation, 1000 W/m²: Contractor shall solve the equation using a value of 1000 watts/m² for the irradiance to calculate what the value would be at STC.

2.1.8 **Determine pass/fail:** Contractor shall compare the Temperature Corrected Output resulting from the Power Output Test to the Power Output Guarantee per 2.5.

2.2 **Pre-Test Activities**

2.2.1 **Contractor/Owner Representatives:** Owner and Contractor shall define lead representatives for the power output testing. Lead test representative for Contractor shall be termed the Test Manager.

2.2.2 **Power Output Test Procedures:** Thirty (30) days prior to commencement of the Power Output Test, Contractor shall submit to Owner for review and approval the Power Output Test Procedures which shall detail all Power Output Test activities including:

2.2.2.1 Specification “cut-sheets” for all Primary Measurement Devices. Also provide drawing showing location of all measurements for field verification.

2.2.2.2 Field testing procedures (to meet minimum test duration and frequency requirement as specified in Table 2-2).

2.2.2.3 List of Secondary Measurement Devices and locations.

2.2.2.4 Applicable Equipment factory test certificates.

2.2.2.5 Calculations, methodologies, equations and procedures.

2.2.3 **Power Output Test Scheduling:** Contractor shall notify Owner in writing of proposed test date not less than 5 days prior to the proposed date for the Power Output Test.

2.2.4 **Pre-test Conditions:** Tests may be performed only when the following conditions are met:

- 2.2.4.1□ The Completion Tests have been Successfully Run, and system is in automatic operation.
 - 2.2.4.2□ Weather conditions are as required to complete the Power Output Test, as addressed in this exhibit and in the approved Power Output Test Procedures.
 - 2.2.4.3□ Utility grid voltage is stable and within +/- 5% of design voltage.
 - 2.2.4.4□ There is grid connectivity at each inverter such that the Power Output Test can be accomplished under load.
- 2.2.5□ **Pre-Test Meeting:** Prior to each test, a pre-test meeting shall be conducted and recorded. The meeting shall review the applicable approved Power Output Test Procedures, instrumentation locations, calibration sheets and other relevant topics including safety requirements. Minutes of this meeting shall be recorded by Contractor and approved by both Parties. Immediately after the meeting, a system walk-through shall be conducted to verify calibration certificates match field instrumentation and to verify instrumentation is correctly installed and located.
- 2.2.6□ **Pre-Test Runs:** Contractor shall perform preliminary test runs prior to the official test in order to validate instrument readings, data acquisition operation and stable system operation. Owner shall be notified one day in advance of preliminary test runs and shall be allowed to observe testing.

2.3□ Test Measurements

All test measurement devices used shall be fully documented in terms of their make/model, accuracy, calibration and location. The following tables summarize these measurements:

TABLE 2-1: POWER OUTPUT TEST Measurements (Minimum)

Measurement	Quantity	Type	Instrument Type	Range	Minimum Accuracy
Solar Irradiance	1 per Facility	Primary for Power Output Test	NREL calibrated Reference module	0 to 1600 W/m ²	+/- 5.0%
	1 per Facility	Primary for Energy Test	Pyranometer (Global Horizontal Irradiance)	0 to 1600 W/m ² 285 to 2800 nm	+/- 2.0% daily
	1 per Facility	Secondary for Power Output Test	Pyranometer (Plane of Array Irradiance)		
Ambient Air Temperature	1 per Facility	Primary for Energy Test	Temperature Probe	-52°C to +60°C	+/- 0.3°C @ 20°C
Wind Speed	1 per Facility	Primary for Energy Test	Sonic Wind Sensor	0 – 60 m/s	±3% at 10m/s
Rain Fall	1 per Facility	Primary for Energy Test	Raincap Sensor	None specified	+/- 5.0%
Relative Humidity	1 per Facility	Primary for Energy Test	Temperature/ Humidity Sensor	0% to 100%	±3%RH at 0 to 90%RH and ±5% at >90 to 100%RH
Net Power Output Power (kW), Power Factor (PF), Current (A), Voltage (V)	1 per Facility	Primary for Power Output Test	ANSI C-12 power meters installed by CONTRACTOR at the COMBINING SWITCHGEAR with calibrated CTs and PTs.	0 to PV Power Plant size +20%	+/- 0.2%
Module cell temperature	4 per Facility	Primary for Power Output Test	Platinum RTD (resistance temperature detector) transmitter (.00385 TCR DIN B), on back surface or cell of module	-50°C to 85°C	.08% drift**<0.1°C per year
AC/DC power, volts and amperage	1 per Inverter	Secondary	From inverter via SCADA	N/A	determined from inverter data sheet
Soiling ¹	1 per Facility	Primary for Adjusted Energy Performance Test	Soiling Monitoring Station	0 to 100%	+/- 0.2%

¹ When a Soiling Monitoring Station is utilized, the uncleaned portion of the system will be considered a Reference Module.

2.3.1 Instrument Calibration: All instruments shall have current NIST or equivalent calibration certificates. All calibration certificates shall be submitted to Owner for review prior to commencement of the applicable Power Output Test.

2.3.2 Test Duration and Data Frequency: Testing duration and frequency shall be as follows:

TABLE 2-2: POWER OUTPUT TEST

Test Duration	The test period shall consist of at least 5 valid days. A day is considered valid if a wide distribution of data is collected over the range of insolation values from 200 W/m ² to 1,000 W/m ² . Each day shall have an adequate quantity (minimum of 150 data point sets per day) of valid data points in the morning (sunrise to solar noon) and in the afternoon (solar noon to sunset).
Data Frequency	1 minute instantaneous
Minimum Number of Data Points	750

2.3.3 Data Collection: Data shall be recorded by the SCADA. The use of alternative means for data acquisition shall be reviewed for acceptance by Owner.

2.3.4 Adjustments: Any adjustments made during the test to any portion of the Facility or test measurement devices shall be reviewed for acceptance by Owner prior to execution. Any revisions shall be fully documented.

2.3.5 Cancellation of a Power Output Test: Either Party has the right to cancel a test with written justification if it can be shown that test conditions or other reasons are causing erroneous data. Any test cancelled by either party shall not be deemed to be successfully run.

2.3.6 Test Data and Acceptance/Rejection of Test Data: At the conclusion of each day's data collection, Contractor shall provide Owner the electronic file of the data set from the SCADA. If either party reasonably demonstrates that the data are inaccurate, the data shall be rejected and the applicable Power Output Test must be re-run.

2.4 Test Calculations

2.4.1 Temperature Correction of Power Measurements: Each power measurement will be corrected to 25 °C (STC temperature) using the Module temperature coefficient of power. This temperature coefficient shall accurately model the Module's performance in a grid connected Block at the Facility location. This

value and the basis for its validity shall be submitted during the bid process and as an attachment to the Power Output Test Procedures.

The correction is determined by the following equation:

$$P_{stc} = \frac{P_m}{1 + C_t(T_m - 25^\circ\text{C})}$$

Where,

P_{STC} = AC power corrected to STC temperature (25°C)

P_m = measured AC power output (kW) at the POI

C_t = module temperature coefficient of power per manufacturer's spec sheet.

T_m = averaged measured module cell operating temperature in degrees Celsius.

$$T_m = \Sigma T_f / \#T_f$$

Where,

T_f = measured field module temperature (distributed as described above)

$\#T_f$ = number of module temperature sensors.

2.4.2 □ **Generation of Performance Curve and Determination of Temperature**

Corrected Output: The temperature-corrected power measurement as calculated above is then plotted as a scatter graph of temperature corrected power output (y axis) versus solar irradiance (x axis). Using the graphical data in the scatter graph, a linear regression curve is generated along with its equation, in the form of,

$$\square y = mx + b$$

Where,

□ y = power (corrected)

□ m = slope

□ x = irradiance (W/m²)

□ b = y intercept

The resulting equation is solved for Irradiance of 1000 W/m² to calculate the Temperature Corrected Output (MW).

The Coefficient of Determination (R-squared) shall be 0.95 or higher (for the complete data set of the test) to validate a statistically acceptable fit.

2.4.3 **Combine Results:** Combine the Temperature Corrected Output results for each day to determine final results. The 5-day cumulative data shall be plotted together to determine the final Power Output Test result. Each day's results, however, must first be reviewed and approved by Owner. If one day, for example, is unacceptable, then an additional test day shall be required if still below the five day minimum. The minimum R² value for each day is 0.90. The minimum R² value for the overall test (5 day cumulative) is 0.95.

2.5 **Pass / Failure of a Power Output Test**

If the Temperature Corrected Output is equal to or greater than the Power Output Guarantee, then Contractor has successfully achieved the objective of the Power Output Test.

If the Temperature Corrected Output is equal to or greater than the Minimum Power Output Guarantee, then Contractor will have successfully achieved the objective of the Power Output Test, but, as described in the Agreement, Contractor may elect to remediate and retest within the Cure Period, or pay Capacity Liquidated Damages in accordance with Section 13.4.1 of the Agreement. If the Temperature Corrected Output is less than the Power Output Guarantee, "**Capacity Liquidated Damages**" shall be calculated as follows:

One minus (a) the Temperature Corrected Output divided by the Power Output Guarantee (rounded to the nearest thousandth (ex. 1.2519% rounded to 1.252%)), multiplied by (b) the Contract Price (CP).

$$\text{Capacity Liquidated Damages} = \left(1 - \frac{\text{Temperature Corrected Output}}{\text{Power Output Guarantee}}\right) * CP$$

Final acceptance of the Power Output Test will be given once the test report is submitted by Contractor and approved by Owner.

If the result of the calculation above is a negative number, then no Capacity Liquidated Damages shall be due.

2.6 **Test Reporting**

Contractor shall submit a detailed test report within 5 business days of completion of successful Power Output Test to Owner, after which Owner will have 15 business days to review and either accept or reject. The test report shall consist of the following at a minimum:

2.6.1 Power Output Test Procedures (as executed).

2.6.2 Instrument calibration sheets/certificates.

2.6.3 Test data (manual and data acquisition).

2.6.4 □ Field observations and notes.

2.6.5 □ Calculations and results.

2.6.6 □ Conclusions.

EXHIBIT G-2 – ENERGY PERFORMANCE TEST

1.0 □ DEFINITIONS

- 1.1 □ “AC Losses”** means all transformation and line losses between the point of power conversion within each inverter as measured on the AC side and the Facility Meter.
- 1.2 □ “Actual Energy Performance”** means the actual energy produced by the Facility during the Energy Performance Test as measured at the Facility Meter (measured in MWh). The result is an 8760 hour Actual Energy Performance data file.
- 1.3 □ “Adjusted Expected Energy Performance”** means the Expected Energy Performance Data File adjusted to account for Block Degradation, Effective Availability, AC Losses and power limitations imposed at the point of interconnect (expressed in MWh) for the Facility.
- 1.4 □ “Ancillary Services Losses”** means reactive power and voltage control losses, plant ramp rate restrictions or other power limiting restrictions as defined by the grid operator necessary to maintain reliable operations between interconnected transmission systems and within controlled areas.
- 1.5 □ “Auxiliary Load Adjustment”** means to correct the Expected Energy Performance for any auxiliary loads present during the data collection which were not accounted for in Attachment A to this Exhibit G-2 input assumptions, as necessary.
- 1.6 □ “Average Solar Irradiance”** means the average of plane of array (“POA”) irradiance measurements in W/m^2 from all operational weather stations in the Facility.
- 1.7 □ “Block”** means each AC Block (Array) at the Facility as set forth in Attachment A to this Exhibit G-2.
- 1.8 □ “Block Degradation”** means a degradation amount of five-tenths of a percent (0.5%) per annum applied to each of the PV modules comprising a Block, beginning 366 days following the Commencement Date.
- 1.9 □ “Facility Met Data”** means, for each hour of the day during the Energy Performance Test, the Average Solar Irradiance, relative humidity and ambient temperature actually recorded for the applicable time period by all meteorological stations at the Facility, including the irradiance measurements by all pyranometers. When multiple meteorological stations are located on the Facility site, the data will be averaged together.
- 1.10 □ “Facility Meter”** means the permanent ANSI C-12 power meter located at the Facility’s point of interconnection.

- 1.11** ☐ **“Commencement Date”** means the date which is the first Business Day following the conclusion of the Cure Period.
- 1.12** ☐ **“Effective Availability”** means the actual Effective Availability calculated pursuant to Attachment B to this Exhibit G-2.
- 1.13** ☐ **“Energy Model”** means the PVsyst version 6.22 and post-processing software, using input assumptions set forth in Attachment A to this Exhibit G-2.
- 1.14** ☐ **“Energy Performance Guarantee”** means 97% of the Adjusted Expected Energy Performance.
- 1.15** ☐ **“Expected Energy Performance”** means the Energy Model predicted energy performance using actual Facility Met Data and corrected for soiling losses experienced during the Energy Performance Test for the Facility.
- 1.16** ☐ **“Expected Energy Performance Data File”** means the 8760 hour output file produced by the Energy Model’s calculation of the Expected Energy Performance.
- 1.17** ☐ **“Interruptions”** means any Force Majeure Events, Owner’s regularly scheduled maintenance outages, or outages due to curtailment of the Facility by the grid operator, which for clarity does not include forced outages or unplanned maintenance outages unless as the result of Force Majeure Events or grid curtailments.
- 1.18** ☐ **“MWh”** means the megawatt-hours measured on an Alternating Current (“AC”) basis.
- 1.19** ☐ **“Primary Measurement Device”** means an instrument that provides a measurement or reading that is used in calculating annual energy production pursuant to this Exhibit G-2.
- 1.20** ☐ **“Reference Period”** means a 1 year (365 day) duration for the Energy Performance Test beginning on the Commencement Date. The Reference Period shall in no event be extended unless the Parties agree in writing to extend such period.
- 1.21** ☐ **“Secondary Measurement Device”** means an instrument that is not used in calculating the output power or energy but is used as a check on primary measurements.
- 1.22** ☐ **“Soiling Losses”** means actual soiling losses calculated using the methods described in Attachment C to this Exhibit G-2 and measured by a Soiling Monitoring Station (SMS) consisting of calibrated reference modules mounted in the same location and orientation. One half of the SMS reference modules will be cleaned at regular intervals.

2.0 **PRETEST ACTIVITIES**

2.1 **Procedures and Conditions:** The following procedures to be performed by Contractor and conditions are applicable to the Energy Performance Test.

2.1.1 **Contractor/Owner Representatives:** Five (5) days prior to the start of testing activities, Contractor shall provide notice to Owner of testing and Owner and Contractor shall each identify lead representatives for the Energy Performance Test.

2.1.2 **Test Procedures:** Thirty (30) days prior to the start of testing activities, Contractor shall provide the Energy Performance Test Procedure to Owner for review and mutual agreement, as further described in Section 6.3.2 of the Scope of Work. The Energy Performance Test Procedure shall include:

2.1.2.1 Purpose, inputs, methodology, calculations, results and conclusion

2.1.2.2 Approval, review and submittal requirements

2.1.2.3 List and location of all Primary Measurement Devices and Secondary Measurement Devices for field verification

2.1.2.4 Applicable equipment factory test certificates

2.1.2.5 Soiling Losses and Effective Availability calculations, as applicable.

ENERGY PERFORMANCE TEST

2.2 **Energy Performance Test:** Beginning on the Commencement Date, Contractor shall conduct the Energy Performance Test for the Reference Period separately measuring the Actual Energy Performance of the Facility compared to its Energy Performance Guarantee. Contractor shall perform the Energy Performance Test in accordance with the procedures, conditions and requirements contained in this Exhibit G-2 and the Energy Performance Test Procedures to be approved by Owner.

2.2.1 **Data Collection:** Facility test related parameters are collected on an instantaneous one (1) minute interval for the Reference Period. The data shall consist of the actual Facility Met Data and the Actual Energy Performance of the Facility during Energy Performance Test.

2.2.2 **Compile Test Data Set:** The instantaneous one (1) minute interval test data is summed into hourly values and averaged across the number of same measurement instruments to produce average per hour result.

2.2.3 **Reduce Test Data Set:** The hourly data shall be filtered so that the data set is free of nuisance data points and bad data that exhibit a high degree of error (such as errors caused by faulty instrumentation). Contractor shall document data that is eliminated.

2.2.3.1 **Data Filtering** – The following criteria shall be used to filter the data used for this test:

(i) **Snow or frost** – Any measurement intervals with snow or frost accumulation on the modules will be excluded.

(ii) **Ancillary Services Losses** – Any measurement intervals where Ancillary Services Losses beyond design conditions are reducing AC power output will be excluded (example design for inverters is for a power factor of +/-0.95 and actual power factor is -0.90).

(iii) **Interruptions** – Time periods of Interruptions that reduce the power output of the Facility shall be excluded.

(iv) **Nuisance or bad data** – Any nuisance data points or bad data that clearly exhibit a high degree of error including required meteorological measurement equipment that is identified as being out of calibration or requiring adjustment.

(v) **The Facility Meter reads “importing” power** – These data points will not be included.

2.2.4 **Determine the Expected Energy Performance:** PVsyst and post-processing software are used to calculate the Expected Energy Performance using actual Facility Met Data and corrected for soiling.

2.2.5 **Determine the Adjusted Expected Energy Performance:** The Expected Energy Performance (EEP) is adjusted to account for Auxiliary Loads (AUX), Block Degradation (BD), Effective Availability (EA), AC Losses (AC) and power limitations (PL) imposed at the point of interconnect. **AEEP = (EEP * (1-AUX) * (1-BD) * (EA) * (1-AC)) - PL**

2.2.6 **Determine the Actual Energy Performance:** Collect the metered energy output of the Facility over the testing period.

2.2.7 **Acceptable Test Results:** The Actual Energy Performance (AEP) meets or exceeds the Energy Performance Guarantee (EP_G).

$$\text{AEP} \geq \text{EP}_G \quad \text{Where: } \text{EP}_G = 97\% * \text{AEEP}$$

2.2.8 **Reporting:** Contractor shall submit to Owner a detailed report of the Energy Performance Test for the Facility within five (5) days after completion of the Energy Performance Test. Owner shall have fifteen (15) Business Days after receipt to review and comment to the report. The report shall contain the following:

2.2.8.1 Metered Facility Met Data

2.2.8.2 8760 hour Expected Energy Performance data

2.2.8.3 8760 hour Actual Energy Performance data from SCADA

2.2.8.4 Filtered or excluded data

2.2.8.5 Adjusted Expected Energy Performance

2.2.8.6 Comparison of the Actual Energy Performance to the Energy Performance Guarantee

2.2.8.7 Comments, field notes and annotations

2.2.8.8 Results and conclusions

2.2.9 **Determine the Test Factor:** “**Test Factor**” is used by the Limited Warranty Agreement, Exhibit N, and means the lesser of (i) one (1.0) and (ii) the ratio of (A) Actual Energy Performance divided by (B) Adjusted Expected Energy Performance, in each case, as determined by the Energy Performance Test.

3.0 ENERGY PERFORMANCE LIQUIDATED DAMAGES

3.1 ENERGY PERFORMANCE LIQUIDATED DAMAGES

3.1.1 Energy Performance Liquidated Damages: After the Energy Performance Test, if the Actual Energy Performance is less than the Energy Performance Guarantee, “**Energy Performance Liquidated Damages**” shall be calculated as follows:

3.1.1.1 (A) (1) (i) [REDACTED] *minus* (ii) Actual Energy Performance (AEP) *divided* by the Energy Performance Guarantee (EP_G) (and multiplied by [REDACTED] so as to be expressed as a percentage, and rounded to the nearest one hundredth of a percent (ex. [REDACTED] rounded to [REDACTED])) *multiplied* by (2) the Contract Price (CP) *minus* (B) any Capacity Liquidated Damages paid by Contractor.

Energy Performance LDs = [(([REDACTED] - ((AEP/ EP_G)* [REDACTED])) x CP) – Capacity LDs]

3.1.1.2 If the amount resulting from the calculation of the formula in Section 3.1.1.1 is greater than zero (0), then such amount shall be payable by Contractor to Owner as Energy Performance Liquidated Damages.

3.1.1.3 If the amount resulting from the calculation of the formula in Section 3.1.1.1 is less than zero (0), then the absolute value of such amount shall be payable by Owner to Contractor, in an amount not to exceed the total Capacity Liquidated Damages paid by Contractor, as a reimbursement of such Capacity Liquidated Damages paid by Contractor.

Attachment A

Energy Model Input Assumptions – TBD Based on Final Facility Design

[End of Attachment A]

Attachment B

Effective Availability Calculation

A. Purpose

The Effective Availability calculation determines the overall availability of the Facility performed on an inverter basis.

B. Definitions

1. **“Clipping”** means that an inverter limits the AC output power or current it produces to its maximum nameplate AC power or current rating. The input DC power and current would otherwise enable a greater output AC power or current to be produced.
2. **“Effective Availability”** means, for each Reference Period, the calculation resulting from the following formula:

$$\text{Effective Availability} = \frac{\text{MWh Produced}}{\text{MWh Produced} + \text{MWh Lost}}$$

3. **“Facility Off-Line Period”** means any period of time during which all Facility inverters are Off-Line Inverters.
4. **“Inverter Meter”** means a meter measuring an inverter’s AC power output.
5. **“MWh Lost”** means the total MWh lost at the Facility during the Reference Period caused by any Interruptions, calculated as the sum of lost energy due to Off-line Inverters and Facility Off-Line Periods.
6. **“MWh Produced”** means the total MWh produced by the Facility during the Reference Period as measured by the Facility Meter(s).
7. **“Off-Line Inverter”** means any inverter that is not producing power measured at the Inverter Meter when the Average Solar Irradiance is greater than 85 W/m².
8. **“On-Line Inverter”** means any inverter that is producing power measured at the Inverter Meter when the Average Solar Irradiance is greater than 85 W/m².
9. **“Reference Period”** means a period of time for which the Effective Availability is calculated.

C. Data Collection

1. Over the Reference Period, log the Interruptions.
2. Collect and Log the instantaneous samples at one minute intervals for:
 - a. Inverter kW output
 - b. Average Solar Irradiance W/m²
 - c. Facility Meter kW and MWh output.

D. Normalization of Inverter Data

The collected inverter kW output data is revised for balance of system losses between the inverter kW output and the Facility Meter (Revenue Energy Meter) kW output, then normalized on a Facility basis to account for differences in inverter DC sizes.

1. Inverter kW Contribution of the Revenue Energy Meter (REM):

$$\text{Inverter REM kW} = \frac{\text{Inverter AC kW}}{\text{SUM Inverter AC kW}} \times \text{Facility REM kW}$$

Where:

- a. **Inverter AC kW** = AC kW value produced by the inverter at that minute as measured at the inverter.
- b. **SUM Inverter AC kW** = sum of all inverters' AC kW value at that minute.
- c. **Facility REM kW** = AC kW value at the Facility Meter at that minute.

2. Normalized Inverter kW

$$\text{Normalized Inverter kW} = \text{Inverter REM kW} \times \frac{\text{Average of all Inverters' Nameplate Capacity}}{\text{Inverter's Nameplate Capacity}}$$

Where:

- a. **Inverter's Nameplate Capacity**
 - i. When the inverter is Clipping: AC nameplate capacity of the inverter.
 - ii. When the inverter is not Clipping: the DC capacity feeding the inverter.
- b. **Average of all Inverters' Nameplate Capacity**
 - i. When the inverter is Clipping: the average of the inverter AC nameplate capacity of all inverters in the Facility.
 - ii. When the inverter is not Clipping: the average of the DC capacity feeding all inverters in the Facility.

3. Calculation of the Average Inverter Normalized Value

- a. Inverters are ranked by Normalized Inverter kW values from highest to lowest excluding any off-line inverters.
- b. The highest 40% of Normalized Inverter kW values are then averaged together to achieve the **Average Inverter Normalized Value**.
- c. Off-Line Inverters are excluded from the calculation.

4. Calculation of Inverter Denormalized kW

- a. Inverter Denormalized kW for each inverter Off-Line the following formula is used:

$$\text{Inverter Denormalized kW} = \text{Avg Inverter Normalized Value} \times \frac{\text{Inverter's Nameplate Capacity}}{\text{Average of all Inverters' Nameplate Capacity}}$$

- b. For the avoidance of doubt, Inverter Denormalized kW is limited to the AC nameplate capacity of each inverter.

E. Calculation of MWh Lost

The MWh Lost is the sum of the components listed in the equation below:

$$MWh\ Lost = OffLine\ Inverter\ MWh + Facility\ OffLine\ MWh$$

1. **Off-Line Inverter MWh**

The Off-Line Inverter MWh is equal to the sum of the Inverter Denormalized kW values for the off-line period converted from kW-minutes to MWh (60 kW-minutes per kWh, 1000 kWh per MWh). The Off-Line Inverter lost MWh are calculated as follows:

$$Offline\ Inverter\ MWh = \frac{\sum (Inverter\ Denormalized\ kW)}{60 \times 1000}$$

2. **Facility Off-Line MWh**

For any Facility Off-Line Period, the total amount of energy lost, which shall be the Adjusted Adjusted Expected Energy Performance in MWh projected to have been generated by the Energy Model, in each case for the period commencing at the time all such inverters are so removed from service and ending at the time that the first inverter is considered an On-Line Inverter (such period, a “Facility Off-Line Period”).

3. **For all purposes of this Exhibit, any calculation of MWh Lost shall be made in accordance with the following:**

- a. MWh Lost shall exclude any (or any portion of any) MWh lost due to an Interruption.
- b. MWh Lost will only be calculated when the Average Solar Irradiance is greater than 85 W/m².
- c. Because the Facility controller directs On-Line Inverters to compensate for Off-Line Inverters, only Off-Line Inverters that aren’t compensated will be included in the Effective Availability calculations. In other words, Lost MWh will be limited for each minute to the difference between the Facility controller commanded MW output and measured MW output.

F. Determining MWh Produced

Record the Facility Meter MWh value over the Reference Period.

G. Effective Availability Calculation

Insert the MWh Produced and MWh Lost values over the Reference Period into the equation below and calculate the Effective Availability:

$$\text{Effective Availability} = \frac{\text{MWh Produced}}{\text{MWh Produced} + \text{MWh Lost}}$$

[End of Attachment B]

Attachment C

Soiling Losses Calculation

1 Introduction

Quantifying the long term soiling loss factor can be achieved by comparing the output of one or more pairs of reference modules. In each pair, one module is regularly cleaned as a control while the other is left to accumulate dust from weather events. This document outlines the methodology for determining the soiling level using a Soiling Monitoring System (SMS). For information on the installation, commissioning, and operation of the SMS, reference the manufacturer's documentation for further details.

2 Instrumentation

The photovoltaic array is instrumented with one pair of reference modules per weather station installed at the site. These modules shall be verified to have identical tilt and azimuth. The modules' short-circuit currents are outdoor-calibrated by an independent laboratory, or field calibrated by qualified technicians. These non-power generating modules operate in short-circuit bias with the current measured by the power plant's data acquisition system. All reference modules shall be recalibrated or replaced annually.

The control reference module(s) are cleaned at regular intervals by automatic cleaning systems, or by hand, at least once per week. The test module(s) are representative of the condition of typical power plant modules and are therefore left to accumulate dust naturally. They are also subject to natural cleaning events such as rain or snow.

In the case of automatic washing, self-cleaning systems shall be installed on the reference module(s) designated as controls. These devices periodically dispense a spray of water to remove dust. They are configured to clean the control modules at a daily frequency during non-power-generating hours.

3 Soiling Measurement Algorithm

The soiling accumulation is measured by calculating the percentage difference between the short-circuit currents of control and test module pairs. The absolute soiling level over an interval of time is determined by calculating the percentage difference between the cumulative measured current of the test module and that of the control module. Measured parameters required for this analysis include:

- Test and Control Module short circuit current, ISC (A)
- Module cleaning times (if not continuously washed by an automatic cleaning system)
- Automatic wash cycle status (Boolean, historized in SCADA)

- Daily rainfall accumulation (mm), as measured by each Met Station

To correct any Module calibration differences, the Baseline Offset shall be applied to the ratio of Test to Control Module currents for all Reference Periods. Prior to or during the soiling measurement period, the reference Modules in the SMSs (including Control and Test Modules) shall be washed uniformly and daily for a period of at least one (1) week (the “Baseline Period”). The “Baseline Offset” shall equal the coefficient which, if multiplied by the ratio of the Test Module current to the Control Module current during the Baseline Period, results in a product of 1.0. The Baseline Offset shall be calculated as follows:

- 1) Omit both Test and Control Modules’ short circuit current values, (the “BTMSC” and “BCMISC” respectively), in cases with instrumentation error (such as missing data from one SMS Module);
- 2) Aggregate the BCMISC for the Baseline Period (which shall only include values of BCMISC >0.6 Amps) (the “AGG BCMISC”);

$$AGG\ BCMISC = \sum_{i=1}^n BCMISC_i ; For\ BCMISC > 0.6\ Amps$$

- 3) Aggregate the BTMSC for the Baseline Period (which shall only include values of BTMSC when the corresponding BCMISC >0.6 Amps) (the “AGG BTMSC”);

$$AGG\ BTMSC = \sum_{i=1}^n BTMSC_i ; For\ BCMISC > 0.6\ Amps$$

- 4) Divide the AGG BTMSC by AGG BCMISC, subtract 1 and convert to a percentage (the “BLOS%”);

$$BLOS\% = \left(\frac{AGG\ BTMSC}{AGG\ BCMISC} - 1 \right) * 100$$

When deemed necessary, a new baseline scale factor may be established using data gathered during the three days immediately following rain events of at least four millimeters.

In the event that no rain occurs in the immediate weeks following commissioning, the following procedure may be used to quantify soiling losses on the array until the next rain event:

- Clean one module from each pair and measure the results for at least one clear sky day. The delta observed will correspond with the plant’s current soiling level.
- Once this has been observed, clean both modules in each pair. This will quantify the baseline offset in each pair.

- After these two points have been established, continue with the normal control cleaning procedure. The delta observed in the first measurement, corrected with the baseline offset, can be used as an adder to the measured soiling until a rain event occurs.

This procedure requires the soiling stations be installed at roughly the same time as the surrounding array so that they may be subjected to the same soil accumulation through commissioning.

3.1 □ Procedure

- 1) □ Omit both Test and Control Modules' current values, (the "TMSC" and "CMSC" respectively), in cases with instrumentation error (such as missing data from one SMS Module);

- 2) □ For each SMS, aggregate the CMSC for each month of the Reference Period (which shall only include values of CMSC > 0.6 Amps) (the "AGG CMSC");

$$AGG\ CMSC = \sum_{i=1}^n CMSC_i ; \text{ For } CMSC > 0.6\ Amps$$

- 3) □ For each SMS, aggregate the TMSC for each month of the Reference Period (which shall only include values of TMSC when the corresponding CMSC > 0.6 Amps) (the "AGG TMSC");

$$AGG\ TMSC = \sum_{i=1}^n TMSC_i ; \text{ For } CMSC > 0.6\ Amps$$

- 4) □ Divide the AGG TMSC by AGG CMSC, subtract 1 and convert to a percentage (the "RAW SOIL%");

$$RAW\ SOIL\% = \left(\frac{AGG\ TMSC}{AGG\ CMSC} - 1 \right) * 100$$

- 5) □ Subtract the BLOS% from the RAW SOIL% to determine the SOIL%;

$$SOIL\% = RAW\ SOIL\% - BLOS\%$$

- 6) □ If the SOIL% is positive, the SOIL% shall equal 0 for that month (the "ABS SOIL%"); in no instance of this daily calculation can the result be positive;

$$ABS\ SOIL\% = \max_{-100 \leq SOIL\% \leq 0} (SOIL\%)$$

3.2 Example Soiling Calculation

An example soiling calculation, for illustrative purposes only is shown in **Table 1**.

Table 1

Baseline Offset	BTMSC	BCMSC
Day 1	897.0955508	895.6993791
Day 2	925.0377031	922.6451839
AGGREGATE	1822.133254	1818.344563
BLOS%		0.21%

Soiling Adjustment	TMSC	CMSC
Day 1	923.9695411	928.2912125
Day 2	936.7651188	941.9753581
Day 3	925.5108449	927.1688807
AGGREGATE	2786.245505	2797.435451
RAW SOIL%		-0.40%
SOIL%		-0.61%
ABS SOIL%		-0.61%

In this illustration, the soiling reduction is -0.61% and represents the energy lost due to soiling for the test period, and is computed by taking the average of all soiling for the reference period.

[End of Attachment C]



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Form of Limited Notice To Proceed



LIMITED NOTICE TO PROCEED

Date: [INSERT]

Via Email and Fax To

White Construction, LLC
Attention: David Berthelsen, President
3900 E. White Avenue
P.O. Box 249
Clinton, IN 47842
Email: david.berthelsen@iea.net
Fax No.: (765) 832-2075

Infrastructure and Energy Alternatives, Inc.
Attention: Gil Melman, General Counsel
6325 Digital Way, Suite 460
Indianapolis, IN 46278
Email: gil.melman@iea.net
Fax No.: (888) 730-1216

Re: Limited Notice to Proceed in accordance with that certain Contract No. [xxx] between American Electric Power, as an agent for Indiana Michigan Power Company, and Indiana corporation (“**Owner**”) and White Construction, LLC, an Indiana corporation (“**Contractor**”), dated as of May [X], 2019 (the “**Contract**”)

In accordance with §5.1.1 of the Scope of Work pursuant to the Contract, Owner hereby gives Contractor Limited Notice to Proceed and authorizes Contractor to immediately proceed with the “**Preliminary Work**” as defined therein for the South Bend Solar Project (RFP No. AEP-LC-2672) upon receipt of this letter in accordance with the terms and conditions of the Contract. Owner does not authorize Contractor to perform any other services anticipated under the Contract, except at its sole risk.

For and on behalf of

American Electric Power, as an agent for **Indiana Michigan Power Company**

By: _____
Name: _____
Title: _____

cc: [INSERT ADDITIONAL EMAIL ADDRESSES AS APPLICABLE]

Form of Notice To Proceed



NOTICE TO PROCEED

Date: [INSERT]

Via Email and Fax

White Construction, LLC
Attention: David Berthelsen, President
3900 E. White Avenue
P.O. Box 249
Clinton, IN 47842
Email: david.berthelsen@iea.net
Fax No.: (765) 832-2075

Infrastructure and Energy Alternatives, Inc.
Attention: Gil Melman, General Counsel
6325 Digital Way, Suite 460
Indianapolis, IN 46278
Email: gil.melman@iea.net
Fax No.: (888) 730-1216

Re: Notice to Proceed in accordance with that certain Contract No. [xxx] between American Electric Power, as an agent for Indiana Michigan Power Company, and Indiana corporation (“*Owner*”) and White Construction, LLC, an Indiana corporation (“*Contractor*”), dated as of May [X], 2019 (the “*Contract*”)

In accordance with §5.1.2 of the Scope of Work pursuant to the Contract, Owner hereby gives Contractor Notice to Proceed and authorizes Contractor to immediately proceed with the “**Work**” as defined therein for the South Bend Solar Project (RFP No. AEP-LC-2672) upon receipt of this letter in accordance with the terms and conditions of the Contract.

For and on behalf of

American Electric Power, as an agent for
Indiana Michigan Power Company

By: _____
Name: _____
Title: _____

cc: [INSERT ADDITIONAL EMAIL ADDRESSES AS APPLICABLE]



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1. Introduction
The purpose of this document is to provide a detailed description of the project and its objectives. This document is intended for the use of the project team and stakeholders.

2. Objectives
The primary objectives of this project are to improve the efficiency of the process and to reduce the overall cost. The project will be completed by the end of the year.

3. Scope
The scope of this project includes the design, construction, and testing of the system. The project will be managed by the project manager.

4. Resources
The resources required for this project include personnel, equipment, and materials. The project budget is estimated to be \$1,000,000.

5. Risks
The risks associated with this project include delays, cost overruns, and quality issues. The project team will monitor these risks closely.

6. Conclusion
This project is a critical component of the overall strategy and will have a significant impact on the organization's performance.

7. Appendix
The appendix contains additional information related to the project, including a detailed schedule and a list of references.

8. Contact Information
For more information, please contact the project manager at [email address].

9. Acknowledgments
The project team would like to thank the following individuals for their support and contributions.

10. References
The following references were used in the preparation of this document.

11. Glossary
The following terms are defined in this glossary.

12. Index
The index provides a quick reference to the various sections of the document.

Mick M. Deal

Mick M. Deal, Project Manager



Infrastructure & Energy Alternatives, Inc.

6325 Digital Way
Suite 460
Indianapolis, IN 46278
Tel (800) 688 3775
Tel (317) 210 9550
www.iea.net

Detailed description of the project and its location.

Market conditions and demand projections.

Environmental impact assessment and mitigation measures.

Financial analysis, including revenue and cost estimates.

Regulatory compliance and permitting requirements.

Summary of key findings and recommendations.

Detailed description of the project and its location.

Market conditions and demand projections.

Environmental impact assessment and mitigation measures.

Item	Description	Market	Market	Revenue
1	Item 1	Market 1	Market 2	Revenue 1
2	Item 2	Market 1	Market 2	Revenue 2
3	Item 3	Market 1	Market 2	Revenue 3
4	Item 4	Market 1	Market 2	Revenue 4

Summary of key findings and recommendations.

Quality

Placeholder text for the Quality section.



Project Schedule

Placeholder text for the Project Schedule section.

Project Management & Staffing

Placeholder text for the Project Management & Staffing section.

Financial Strengths

Placeholder text for the Financial Strengths section.

Strengths in Utility Solar

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PUBLIC VERSION

LUMP SUM, TURNKEY CONTRACT PRICE – 2019 OPTIONS

Preliminary Milestones

1. Notice to Proceed: 4-1-19
2. Site Mobilization: 4-10-19
3. Substantial Completion date: 12-15-19

Price Breakdown:

Item	OPTION #1 - 2019 Fixed Tilt System Price (\$)	OPTION #2 - 2019 Single Axis Tracking System Price (\$)
<u>ITC Eligible</u>	25.1694 MWdc	24.885 MWdc
Solar Inverters		
Modules		
Site Preparations		
Racking		
Transformers		
Cabling to Transformers (<u>AC collection</u>)		
Metering		
Switchgear on or before transformer	Included in inverter	Included in inverter
System monitoring equipment		
Conduit Protection (<u>Combiner Boxes</u>)		
Foundations		
Engineering		
DC Conduit/wire/miscellaneous		
Labor		
Commissioning		
<u>ITC Ineligible</u>		
Lines from transformer to vault		
Lines from vault to pole		
Switchgear in vault		
Switchgear at load		
Line from inverter to load		
Permitting		
Fencing		
Security		
Bonding (<u>Performance & Payment Bond</u>)		
Interconnection Costs		
Regional Transmission Operator fees		
Labor		
Financing Costs		
TOTAL		
Total Price in \$/W_{DC}		

PUBLIC VERSION

LUMP SUM, TURNKEY CONTRACT PRICE – 2020 OPTIONS

Preliminary Milestones

1. Notice to Proceed: 4-1-20
2. Site Mobilization: 4-10-20
3. Substantial Completion date: 12-15-20

Price Breakdown:

Item	OPTION #3 - 2020 Fixed Tilt System Price (\$)	OPTION #4 - 2020 Single Axis Tracking System Price (\$)		
<u>ITC Eligible</u>	25.17048 MWdc	25.3564 MWdc		
Solar Inverters				
Modules				
Site Preparations				
Racking				
Transformers				
Cabling to Transformers (<u>AC Collection</u>)				
Metering				
Switchgear on or before transformer			Included in inverter	Included in inverter
System monitoring equipment				
Conduit Protection (<u>Combiner Boxes</u>)				
Foundations				
Engineering				
DC Conduit/wire/miscellaneous				
Labor				
Commissioning				
<u>ITC Ineligible</u>				
Lines from transformer to vault				
Lines from vault to pole				
Switchgear in vault				
Switchgear at load				
Line from inverter to load				
Permitting				
Fencing				
Security				
Bonding (<u>Performance & Payment Bond</u>)				
Interconnection Costs				
Regional Transmission Operator fees				
Labor				
Financing Costs				
TOTAL				
Total Price in \$/W_{DC}				

PUBLIC VERSION
FORM A
 (Electrical Work)

THIS FORM A IS APPLICABLE TO ELECTRICAL CONSTRUCTION WORK AUTHORIZED UNDER A COST PLUS CONTRACT, AN EXTRA WORK ORDER OR CONTRACT AMENDMENT FOR COST PLUS OR EXTRA WORK

Owner's Facility the Below Rates are Applicable to: *South Bend Solar*

Markup Percentages for Cost Plus Work As a Percentage of Base Wage Rates plus Taxable Fringe Benefits
 (Refer to Notes A and B on Page 5)
STATUTORY RATES

ITEM #	CLASSIFICATION	STRAIGHT TIME % (Refer to Note D)	PREMIUM TIME % (Refer to Note E)
1	Social Security Tax (FICA)	7.65%	7.65%
2	Federal Unemployment Insurance	0.60%	0.60%
3	State Unemployment Insurance	8.15%	8.15%
4	Workers' Compensation (Refer to Note F on Page 5)		
5	General Liability & Property Damage Insurance (Refer to Note P on Page 6)		
6	Overhead (Refer to Note C on Page 5)		
7	Profit		
8	Total Markup on Base Wage (Sum Items 1 - 7)		

Contractor : IEA

Specification: South Bend Solar Spec

Initial: _____

Date: 12/14/2018

Page _____ of _____

THIS FORM A IS APPLICABLE TO ELECTRICAL CONSTRUCTION WORK AUTHORIZED UNDER A COST PLUS CONTRACT, AN EXTRA WORK ORDER OR CONTRACT AMENDMENT FOR COST PLUS OR EXTRA WORK

Owner's Facility the Below Rates are Applicable to:	South Bend Solar
-----------------------------------------------------	------------------

All-inclusive Hourly Billable Rates and Per-Diem Living Allowance for Supervision and Field Office Personnel. (Refer to Notes G, H, I, J & K on page 5)								
ITEM #	CLASSIFICATION (Refer to Pages 3 & 4)	1st Shift ST	1st Shift 1.5 Time	1st Shift 2.0 Time	2nd Shift ST	2nd Shift 1.5 Time	2nd Shift 2.0 Time	Per-Diem
9	Project Manager	\$	\$	\$				
10	Superintendent	\$	\$	\$				
11	Craft Supervisor	\$	\$	\$				
12	Office Manager (field accountant)	\$	\$	\$	N/A	N/A	N/A	
13	Timekeeper	\$	\$	\$	N/A	N/A	N/A	
14	Safety & Health Coordinator	\$	\$	\$				
15	Planner/Scheduler	\$	\$	\$				
16								
17								

ITEM #	Other Rates and Mark-Up Percentages	\$ or %
18	Unit price adder per ST/OT billable craft workhour (General Foreman and below) for Small Tools, Consumables & Personal Protective Equipment for electrical work. (Refer to Notes L, M, N & O on Pages 5 & 6 and Pages 7 through 12 for additional clarifications on this item). This unit price shall as a minimum include all consumables and personal protective equipment listed on Pages 7 & 8 and all small tools listed on Pages 9 & 10 regardless if their cost currently or at some future date exceeds \$1,500 in value. In addition, items that are not currently listed as a small tool but are currently under \$1,500 in value will be considered to be covered by this small tool adder unless already identified as a rental item on Page 12. If at some future date tooling that is not currently listed on Page 12 exceeds \$1,500 in value, it will be considered to be a rental item. A listing (not all inclusive) of reimbursable rental items is listed on Page 11.	█
19	% Mark-Up of Materials, third party rentals or subcontractors at Actual Invoice Cost. Not including Consumables, tools or equipment included in Item 18 above. (Refer to Notes 1 & 2 on Page 6)	█
20	Unit price adder per manhour worked for personnel required to wear personal protective equipment due to arsenic, lead, hexavalent chromium, cutting and welding fumes. (Refer to Page 13)	█

Contractor : IEA

Specification: South Bend Solar Spec
Initial: _____
Date: 12/14/2018
Page _____ of _____

Page 2 ITEM #	Supervision and Field Office Personnel Classification Notes
9	The Project Manager has all the responsibilities of the Superintendent but has multiple Superintendents on site that report to them such as during multi-shift work or major projects with multiple work areas and crafts. The necessity of and employment of a Project Manager shall be agreed to by Owner and Contractor before bringing them on Owner's site.
10	<p>The Superintendent's responsibilities include but are not limited to the following:</p> <ol style="list-style-type: none"> 1 Functions as the primary liaison with Owner to define the work scope and objectives of the project. 2 Performing constructability reviews to support Contractor's Engineering and Estimating activities needed to support the project. 3 Assisting its Planner/Scheduler and Owner in developing work plans. 4 Determining staffing levels for both field office and craft labor for each phase of the project. 5 Recruiting and assigning of project personnel including assigning all duties and responsibilities of their subordinates. 6 Providing direction to Craft employees to meet Safety Goals, Quality Requirements, Cost, Schedule and Design requirements. 7 Ensure strict adherence to all safety procedures and manage any infractions. 8 Monitoring scope, scope changes, budgets, and schedules and directs and coordinates all activities of its site personnel including any sub contractors it hires to ensure that the project remains on schedule and within budget. 9 Supporting all its field personnel to ensure they have the proper number and pieces of equipment and materials required to perform the work. 10 Obtaining and providing technical advice and resolving problems related to the work. 11 Performing first line inspection of removal and installation activities including the successful implementation of Contractor's Project Quality Assurance/Control Program.
11	<p>Craft Supervisor directly supervises General Foreman, Foreman and Craft labor of a particular union craft such as boilermakers, ironworkers, pipe fitters, etc. and is considered to be highly knowledgeable and skilled in that particular craft. Must have prior Supervisory or General Foreman / Foreman experience. The Craft Supervisor's responsibilities include but are not limited to the following:</p> <ol style="list-style-type: none"> 1 Assist in the development of work packages, schedule and cost updating, and recovery plans if required. 2 Provide direction and mentoring to the Craft General Foreman / Foreman. 3 Develop expectations in safety culture, quality standards, budget and schedule adherence, and design requirements. 4 Manage the work in accordance with the project schedule and plan. 5 Assures the work crews have the proper tools, equipment, and materials are available to support the work activities. The necessity of and employment of a Craft Supervisor shall be agreed to by Owner before bringing them on Owner's site.
12	<p>The Office Manager may act and have all the responsibilities of a timekeeper. In addition, responsibilities of the Office Manager may include but are not limited to the following:</p> <ol style="list-style-type: none"> 1 Is proficient with computers and knowledge in Microsoft word, Excel and Contractor's accounting system. 2 Supervision of timekeeper(s). 3 Preparation of daily/weekly (manpower and cost) reports. 4 Maintaining and updating applicable union wage and fringe benefit rates. 5 Preparation of Weekly invoicing for submittal to Owner.

Page 2 ITEM #	Supervision and Field Office Personnel Classification Notes
13	<p>The Timekeeper's responsibilities include but are not limited to the following:</p> <ol style="list-style-type: none"> 1 Creating and maintain time sheets. 2 Tracking and reporting all time associated with Contractor's work daily and weekly by cost codes, work orders and releases provided by Owner to Contractor. 3 Track and report daily and weekly all material, equipment and subcontractor costs.
14	<p>The Safety and Health Coordinator's responsibilities and qualifications include but are not limited to the following:</p> <ol style="list-style-type: none"> 1 Qualification for these individuals shall include satisfactory work experience and completion of the OSHA 500 or 510 training and satisfactory work experience as determined by Owner. 2 Is responsible for assisting Contractor's supervision in carrying out its responsibilities for job site safety and health and other loss prevention programs associated with the Work. <p>Prior to bringing Safety and Health Coordinator(s) on Owner's work site, Contractor shall provide Owner with their resumes and documentation of their training which will be reviewed and must be approved by Owner.</p>
15	<p>The Planner/Scheduler's responsibilities and qualifications include but are not limited to the following:</p> <ol style="list-style-type: none"> 1 Is proficient in Primavera Enterprise Version 6.2 or newer (P3e) and capable of providing Level 4 detail. 2 Is able to provide Owner with a work schedule showing the sequence of activities required to complete all of the work assigned to Contractor and its subcontractors by Owner. 3 Will be responsible for assisting Contractor and Owner's designated Project Manager or designee in evaluating contract performance relative to Owner's integrated schedule. 4 Will provide Owner with Daily/Weekly and Monthly progress reports. 5 Will be responsible for assisting Contractor and Owner's designated Project Manager or designee in adjusting the schedules due to proposed schedule and or scope modifications.

ITEM #	Pages 1 & 2 Notes
A	Base wages are the taxable wage and taxable fringe benefit amount paid according to union agreement. Base Wages shall include craft levels up to and including General Foreman.
B	Fringe benefits are the nontaxable amount paid to trust funds in accordance with union agreements. Fringe benefits shall be billed at cost without additional markup. Owner will not reimburse any Industry Advancement Fund as a direct labor cost.
C	Unless otherwise specified, the Contractor's overhead markup shall include all home office expenses and all field office equipment costs and other field office misc. expenses, including but not limited to: office furniture, telephone & fax machines and services, computers and internet services, copying machines, paper, postage, water, ice, etc.
D	Straight Time (ST): Hours actually worked; also, paid holidays and show up time. The straight time markup shall be applied only to Base Wages.
E	Premium Time (PT): Hours for which wages are paid, but not worked, over and above ST. (The premium portion of overtime paid at time-and-one-half is the one-half hour paid, but not worked.). The total PT markup shall be applied only to Premium Time Wages.
F	Contractor's Worker's Compensation markup shall not include any costs associated with claims as set forth in Article 16.6 of Owner's "General Terms and Conditions for Labor and Services" . The percentage markup on premium time for workers' compensation shall be applicable for cost-plus work performed in Ohio only.
G	Supervision and field office personnel billing rates shall be quoted fully loaded, including insurance, taxes, overhead and profit.
H	The per diem living allowance shall be all inclusive with no additional markup. Items to be included in the per-diem cost are all hotel/motel expenses, meals, tips, laundry services, parking expenses, personal phone calls, taxes, overhead and profit. The per-diem living allowance shall be billable for days worked only for Supervision and Field Office Personnel that have a permanent legal residence 50 miles or more from the job site. For example, Contractor employees arrive on a Sunday to begin work on a Monday. No per diem would be paid for Sunday. Work is completed on a Friday, Contractor could bill the per-diem for that Friday even though its employees went home. Contractor shall provide proof of residency prior to submittal of an invoice for the per diem along with a document such as from Mapquest that provides the mileage from the employees home address to the physical work plant site.
I	Travel time for Supervision and Field Office Personnel that have a permanent legal residence 50 miles or more from the job site shall be billable for one time to the Site and one time from the Site, at the applicable straight-time rate, not to exceed eight hours total in either instance.
J	Holiday pay for the Supervision and Field Office Personnel shall be billable at the straight-time rate, not to exceed eight hours pay each, if said holiday occurs during an ongoing project. The exception is if the Contractor is working a 4-10 schedule. In that case if the holiday occurs on a day they would have worked, then they are paid ten hours at the straight-time rate. If Contractor is working a 5-10 schedule than the Contractor would only be entitled to 8 hours pay at the straight time rate for a holiday. If the Contractor works the holiday they are entitled to double time for all hours worked on the Holiday. Holidays are considered to be those that apply to the craft workers on site and will not be paid for Holidays that apply to Owner's personnel only. Owner will only pay Holiday pay if Contractor's Supervision and Field Office Personnel worked the day before and or the day after the holiday occurred.
K	Supervision and field office personnel shall be paid at the rates of time and one-half and double time on the same basis as craft labor at the Site.

PUBLIC VERSION
FORM A
(Electrical Work)

Item #	Pages 1 & 2 Notes (Continued)
L	Small tools are defined as construction equipment that have a current market value or new replacement cost, whichever is less, of \$1,500 and would normally be utilized by Contractor in the performance of electrical work. This value is based on the cost of the tool when new and includes all parts, pieces & accessories associated with the tooling such as saw blades, tool stands, dies, mandrels, drill bits, cutoff wheels etc. Owner will reimbursing Contractor for the use of this equipment based on the Owner approved rental rates submitted on Form B or actual invoice cost plus markup. The exception to the \$1,500 market value or replacement cost for small tools are listed on Page 12 .
M	Consumables are defined as those items which do not become a permanent part of a piece of equipment or structure. This includes miscellaneous parts and pieces associated with tools and equipment such as drill bits, cut off wheels, grinding wheels, saw blades, ect. Only those items listed on the "Non-Inclusive Consumables List" (Page 13) used in the performance of cost-plus work are not covered by the dollar per man-hour rate for small tools, consumables and personal protective equipment. When requested by Owner, Contractor shall supply specific items listed on the "Non-Inclusive Consumables List" . Contractor will be reimbursed for these items based on their actual invoice cost plus Contractors approved applicable markup (Item 19, Page 2).
N	Personal protective equipment is defined as all equipment Contractor needs to provide its employees in order to perform the specific assigned task, that will protect the employee from bodily injury or potential future health problems, including but not limited to hands, feet, limbs, head, eyes, torso, skin and lungs. Not included but covered under a separate dollar per hour adder are safety items required for working in areas with potential exposure to an arsenic, lead or hexavalent chromium.
O	Contractor is not required to supply small tools for use by others under the dollar per manhour small tool adder. Contractor is only required to supply small tools for Work Contractor is performing. For example, if Owner wants light stringers installed for its own use, then Contractor must install/remove the light stringers as well as provide the labor to replace broken light bulbs.
P	Contractor's General Liability & Property Damage Insurance markup shall only include costs associated with maintaining minimum insurance requirements set forth in Article 16.0 of Owner's "General Terms and Conditions for Labor and Services" . Any cost associated with additional insurance that the contractor chooses to carry shall be included in Contractor's Overhead Markup.
Other Rates and Mark-Up Percentages Notes:	
1	Contractor may invoice Owner for any of the items on the Exemption List (Refer to Page 8) not covered by the Small Tool Adder nor included in the items covered in Notes 1 above, Material, Construction Equipment Fuel (Unless specifically included in the equipment rental rate), Permits, Freight, Subcontractors and Third Party Rentals at the Invoice Cost to the Contractor Plus the stated % markup of the invoice. Contractor shall not purchase any materials unless specifically directed to do so by Owner.
2	Should Contractor utilize an affiliated company to perform any portion of the Work, Owner shall be billed for performance of this Work at invoice cost, with no additional markup.

REFER TO PAGE 2, ITEM 18: TYPICAL SMALL TOOL OVERHEADS, CONSUMABLES AND PERSONAL PROTECTIVE EQUIPMENT INCLUDED IN DOLLAR PER HOUR ADDER FOR ALL TYPES OF WORK

THE FOLLOWING ITEMS ARE CONSIDERED AS TYPICAL OVERHEADS THAT ARE TO BE INCLUDED IN THE DOLLAR PER CRAFT MANHOUR WORKED FOR SMALL TOOLS, CONSUMABLES AND PERSONAL PROTECTIVE EQUIPMENT:

ID	Description
1	Administrative cost associated with purchasing the tool.
2	Cost of space to store the tools at Contractor's facilities.
3	Cost of a storeroom attendant (at Contractor's home office).
4	Cost of labor to load and unload tools at Contractor's facility.
5	Cost of inspecting and cleaning tooling after each project.
6	Cost of labor and materials to repair tooling.
7	Cost of insurance on the tools.
8	Cost of replacing stolen or damaged tools.
9	Contractor's cost of money to own the tools.
10	Depreciation cost on the tools.
11	Depending on state law, there may be taxes on ownership of the tools (personal property tax).

THE FOLLOWING IS A PARTIAL LISTING OF ITEMS THAT WOULD NORMALLY BE CONSIDERED AS A CONSUMABLE OR PERSONAL PROTECTIVE EQUIPMENT COVERED UNDER THE SMALL TOOL, CONSUMABLES & PERSONAL PROTECTIVE EQUIPMENT ADDER ON FORM A (SEE PAGES 5 & 6 FOR NOTES REFERENCED BELOW)

A. Consumables - General (Refer to Note M on Page 6)

ID	Description	ID	Description
1	Abrasives (cloth/paper/powder)	18	Flints
2	Antifreeze	19	Fuses
3	Baricade Tape	20	Glue
4	Bottles Water	21	Grease
5	Bags (all types)	22	Grinding burrs
6	Batteries (all types)	23	Heating Fuel(Kerosene) and Gases(Propane) for office, change, shower and break areas.
7	Cable ties, nylon, all sizes	24	Hinges
8	Chalk, marking	25	Ice
9	Cloth, emery	26	Light Bulbs (florescent, halogen, Incadescent LCD, AC/DC)
10	Compounds, cleaning	27	Lubricants (thread/dope)
11	Connectors, hose/cable	28	Markers (ink/paint)
12	Cork(s)	29	Nails
13	Crayons	30	Oils - air tool, cutting, lubricating
14	Cups, drinking	31	Paint, spray cans
15	Deicing salts for walkway areas around Contractor's Office and Change Trailers.	32	Paint Remover, Thinners.
16	Filters, respirator (disposable)	33	Paper (toilet/wrapping)
17	Flux, soldering / brazing	34	Pens and Pencils

PUBLIC VERSION
FORM A
(Electrical Work)

A. Consumables - General (Cont'd. - Refer to Note M on Page 6)

ID	Description	ID	Description
35	Putty	47	Stakes (wood)
36	Rags & shop cloths	48	Steel wool
37	Reciprocating saw blades	49	Stencils (steel/paper)
38	Repair kits, air/torch hose & weld leads	50	Stones, rubbing, honing & sharpening
39	Saw blades & cutoff wheels, all types for wood &	51	Tape, electrical / masking / teflon/duct
40	Signs & Labels (Warning, Hazardous Materials, Key information, etc.)	52	Temp sticks
41	Sandpaper	53	Tips, cutting/welding & cleaners
42	Screws	54	Towels, hand/paper, antiseptic wipes
43	Soaps	55	Wheels, abrasive flapper/grinding/brush
44	Soapstone	56	Wire, No. 9 / tie or smaller
45	Solder	57	Wire rope, 3/4" diameter & smaller
46	Spill Kit/s (large enough to handle the biggest spill, but multiple kits for the Work may be required for remote equipment)		

B. Personal Protective Equipment & Supplies - General (Refer to Note N on Page 6)

ID	Description	ID	Description
1	Boots, (rubber/paper)	16	Hardhat, ears/suspensions/hatband
2	Confined Space retrieval protection system	17	Hood repair kits
3	Coveralls, disposable	18	Hoods, disposable
4	Disinfectants	19	Jackets, welding flame resistant cloth
5	Dust masks (paper type) with or without valve	20	Keys
6	Ear Plugs, ear muffs	21	Knee Pads
7	Eye wash stations	22	Lenses, welder/helmets
8	Eyewash solution	23	Life vest
9	Face Shields	24	Rainsuits
10	Fire extinguishers	25	Retractable life line, stainless steel, 30' or 50'
11	Flashlights	26	Safety belts lanyards & accessories
12	First aid kit	27	Salt tablets and dispensers
13	Glasses & goggles, safety/flash	28	Saw Guards
14	Gloves - all types (welding/rubber/jersey)	29	Visor refills
15	Hand Cleaner	30	Welding sleeves & jackets

TYPICAL LIST OF SMALL TOOLS THAT IS TO BE INCLUDED IN THE SMALL TOOL ADDER FOR ELECTRICAL CONSTRUCTION WORK (Refer to Item 18 on Page 2)

General Notes:

- | | |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | The following listing is intended as clarification of Small Tools that are addressed by the Form A dollar per manhour adder applied per ST/OT billable craft workhour (General Foreman & Below) for use of small tools, consumables and expendables. |
| 2 | Reference the Exemption List on Pages 11 & 12 of for listing of items that are considered to be Rentals & are not included in the small tool adder. |

THE FOLLOWING IS A LISTING OF TYPICAL ITEMS THAT WOULD NORMALLY BE CONSIDERED AS A SMALL TOOL UNDER THE DOLLAR PER MANHOURLY ADDER ON FORM A FOR ELECTRICAL WORK. ADDITIONAL ITEMS NOT LISTED MAY BE CONSIDERED A SMALL TOOL, IF THEY ARE UNDER \$1,500 IN VALUE. LIST CONTINUED ON PAGE 10.

ID	Description	ID	Description
1	Air mover & fan 110volt	28	Clamp Meters-voltage and amperage
2	Air hose (2" & smaller)	29	Come-A-Long ≤ 10T
3	Barrels (trash or storage)	30	Conduit Benders-hand
4	Bits, drill	31	Conduit Benders 1 1/4"- 1 1/2"-Mechanical (Greenlee 1800, 1801 & 1801 G1 or equiv).
5	Bolt Cutters	32	Confined Space retrieval protection system
6	Bottle nut wrenches	33	Crowbar
7	Brass board & brass	34	Crimping tools-manual, electric and hydraulic including dies
8	Brooms and handles	35	Dies, bolt and pipe
9	Brushes (dope/wire)	36	Distribution Panels (Power)
10	Buckets (all types)	37	Dolly 4-wheel
11	Bulbs, lighting (AC & DC)	38	Drill 1/2" electric (bench & portable) including hammer drills
12	Buried line locator (Greenlee BLL-200 or equivalent)	39	Extension cords, 110V
13	Burning torch complete	40	Fault line locator (Greenlee PE 2003 or equivalent).
14	Cable Cutters-Hand, Ratcheting and Hydraulic	41	Files, and hasp
15	Cable Benders-ratchet type	42	Fish Tape, sticks and poles
16	Cable Benders- Hydraulic with foot pump & hose (Greenlee 800 & 800F 1725 or equiv).	43	Funnels
17	Cable tie guns-heavy duty	44	Gas can-safety
18	Carbon air arc - torch	45	Gas Pump 4"
19	Chain & wire rope to < 10T	46	Generator 4,000 watt or less
20	Chisels, all types & sizes	47	Grinder, pencil, deburr (all types)
21	Chokers to ≤ 10T (wire rope slings)	48	Grinders, air/electric (all types)
22	Chop Saw	49	Hacksaw & blades
23	Circular saw 7"	50	Hammer, ramming/roto
24	Circuit Tracer	51	Hammer & handles
25	Clamp "C" - brass pin 6" & smaller	52	Hand pallet jack truck (all types)
26	Clamps, cable (7/8" & under)	53	Heliarc torch (complete)
27	Clamps, beam	54	Hydraulic punch set 1/2" through 2"

PUBLIC VERSION
FORM A
(Electrical Work)

THE FOLLOWING IS A LISTING OF TYPICAL ITEMS THAT WOULD NORMALLY BE CONSIDERED AS A SMALL TOOL UNDER THE DOLLAR PER MANHOURLY ADDER ON FORM A FOR ELECTRICAL WORK. ADDITIONAL ITEMS NOT LISTED MAY BE CONSIDERED A SMALL TOOL, IF THEY ARE UNDER \$1,500 IN VALUE. CONTINUED FROM PAGE 9.

ID	Description	ID	Description
55	Insulated nutdrivers and screwdrivers	84	PVC electric heater benders-1/2"-6" (Greenlee 849 & 851-4 or equiv).
56	Kerosene Can	85	Radios, two-way w/holster & charger
57	Knives-utility	86	Roller stands
58	Knock out punches & dies	87	Rope, safety/manila/nylon ≤ 3/4"
59	Ladder (all types)	88	Ruler, folding/straight edge/retractable
60	Level, Magnetic 6' and under	89	Screwdrivers
61	Light stringers, electric	90	Shackles from 1/2" to ≤ 1"
62	Lighters & flints (torch ignition)	91	Sidecutters
63	Line, chalk	92	Socket set with ratchets & extensions, 3/8", 1/2" & 3/4"
64	Mig welders such as Licoln Power Mig 215 or equivalent	93	Spud/pry bar
65	Megohmmeter (calibrated)-manual crank (Greenlee 5778 & 5778-c or equivalent).	94	Tap set, 1/2" to 1-1/2"
66	Mops	95	Tape measures
67	Multimeters-Digital/analog (Greenlee 5882C or equivalent)	96	Tarpaulin(s)
68	Needle scaler, weld flux chipper	97	Tig welders
69	Padlocks, all types	98	Tool boxes or cages
70	Paint brushes, rollers and pans	99	Transformers-Step down transformers
71	Pipe wrenches	100	Tube cutters
72	Pipe stand, Adjustable (all types)	101	Vacuum / blower power fishing system-1/2"-4" conduits (Greenlee 690 or equiv).
73	Pipe threader-manual with dies	102	Vise, bench
74	Plazma cutters up to 3/8" thick steel (Lincoln Procut or equiv.)	103	Visegrips
75	Pliers	104	Wedges, steel/wood/plastic
76	Plumb bob	105	Welder-stick, single use such as Lincoln Idealarc 250
77	Points, degree finders, etc.	106	Welder, chipping hammers
78	Power hacksaw-bandsaw type and blades	107	Welding lead with camlocks
79	Porta power equipment	108	Wire Tag Printer (BRADY LS 2000, TLS2200, BMXC or equivalent).
80	Portable bench grinder	109	Wire Stripper
81	Punches, all types	110	Workbench, steel/wood
82	Push Carts-2 and 4 wheel, including wire, cable and conduit storage carts.	111	Wrenches, all types adjustable/Allen
83	PVC cutters		

PUBLIC VERSION
FORM A
(Electrical Work)

THIS PAGE APPLIES TO ELECTRICAL CONSTRUCTION WORK

General Notes:

1	Small tools for electrical work are defined as those items costing \$1,500 or less in value new and includes all parts and pieces associated with the tooling such as drill bits, cutoff wheels, etc.
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THE FOLLOWING ITEMS ARE EXEMPT FROM BEING CONSIDERED AS A SMALL TOOL OR CONSUMABLE & ARE NOT COVERED BY THE DOLLAR PER CRAFT MANHOUR WORKED SMALL TOOL ADDER ON (Refer to Page 2, Item 18). IF CONTRACTOR SUPPLIES ANY OF THESE ITEMS, THEN CONTRACTOR IS ENTITLED TO REIMBURESENT AT THE ACTUAL INVOICE COST, PLUS APPLICABLE MARKUP (Refer to Page 2 Item, 19)

ID	Description
1	Auger / Bucket Truck (Digger Truck)
2	Bucket Truck
3	Cable Feeder (Greenlee 6810 or Equivalent)
4	Cable Puller with Pulling System-Electrical (Greenlee Super 6001, Ultra 6505, 6800, 6805 or Equivalent)
5	Cable Test Equipment (Wave-Tech , CAT5 & Fiber)
6	Communication / Test Certification Kit (Fluke DTX 1800-CAT5, CAT6 & Fiber)
7	Conduit Benders - Electric with Shoes (Greenlee 555R / Sidewinder or Equivalent)
8	Conduit (2" & Larger) Benders - Hydraulic with Pump, Shoes and Table (Greenlee 880, 884, 885 or Equivalent)
9	Documenting Process Calibrator - Fluke 744
10	MegOhmMeter-5KV (Greenlee 5990 or Equivalent)
11	Field Change / Break Trailer
12	Field Tool / Equipment Trailer
13	Fork Truck
14	Hydraulic Roper Whitney Punch
15	Large Simplex Reel Jacks (Set) 10 Ton (Greenlee 656 Ratchet Cable Reel Stands or Equivalent)
16	MegOhmMeter-5KV (Greenlee 5990 or Equivalent)
17	Pickup Truck
18	Plasma Arc Cutter
19	Pressure Module for Fluke 744
20	PVC Bender (Electric) 1/2"-6" Greenlee 848
21	PVC Bender (Propane) 1/2"-6" Probend 1100
22	Pipe Threader-Geared-(Rigid 141 and 161 or Equivalent)
23	Pipe Cutting & Threading Machines with Dies, Stand & Oiler (2" Conduit & Above) (Rigid #300, 535, 700 1224, 1822) (Wheeler Rex 6590, 6790 or Equivalent)
24	Scissors Lift (Telescoping Manlift)
25	Welder - 300 Amp Gas
26	Welding Machine, 4, 6 & 8 Pack with Converter, 200 Amp Each

PUBLIC VERSION
FORM A
(Electrical Work)

THIS PAGE APPLIES TO ELECTRICAL CONSTRUCTION WORK IURC DR 1-2

THE FOLLOWING ARE NOT COVERED BY THE SMALL TOOL ADDER AND ARE CONSIDERED TO BE RENTAL ITEMS THAT ARE REIMBURSEABLE PER THE RATES ON FORM B OR AT INVOICE COST PLUS MARKUP.

ID	Description	ID	Description
1	Air Compressor, 185 ≥CFM or Diesel	18	Tugger, Single Drum Wire Rope w/Air 2,000# or greater
2	Air Compressor, 715 ≥CFM Electric	19	Tugger, 2 Drum wire rope w/air 5,000# or greater
3	Boiler Basket, (Skyclimber/Spider) 1 or 2 man complete	20	Tugger, 2 or 3 Drum wire rope Diesel 150 HP (or similar)
4	Boiler Scaffold (Skyclimber), 20' - 40' pick, 4 man complete	21	Hydraulic Stub Pulling Gun
5	Blocks, 5 sheave, to 50 ton	22	Lead Abatement Equip. HEPA Vac crawler, grinder, scaler, roto pein, & vacuum
6	Blocks, 5 to 8 sheave, 50 ton to 100 ton	23	Level, Paragn Jig w/tripod all types
7	Blocks, 8 - 10 sheave, all lift(s) to 500 ton	24	Personnel & Equip Hauler, JDGator (or similar)
8	Concrete Drill, Truco w/motor (or similar)	25	Pickup Truck, 1/2 or 3/4 Ton 2WD or 4WD
9	Dollie, 5th Wheel, Tandem Axle (or similar)	26	Pipe/Tube Beveler over 5-3/8" O.D., all types
10	Drill Press, Mag Base w/Power Feed	27	Pump, test w/air drive 6,000# or larger
11	Field Office Trailer.	28	Saw Kit, Esco Track type
12	Field Change/Break Trailer.	29	Skip Pan 8,000 pound OSHA approved
13	Field Shower Trailer 4 or 8 Stall	30	Tractor (18 Wheeler) Yard Type
14	Forktrucks	31	Tractor Trailer, Flat Deck
15	Hoist Chain, with air drive over 2 ton	32	Tractor Trailer, Flat Deck Extendable
16	Hoist, Chain with Electric Drive over 3 ton	33	Tractor Trailer, Low Boy Deck 35 Ton
17	Hoist, Chain with Manual Drive over 10 ton	34	Welding Machine, 4, 6 and 8 Pack with Converter, 300 AMP each

Page _____ of _____

PUBLIC VERSION
FORM A
 (Electrical Work)

REFER TO PAGE 2, ITEM 20

Unit price per manhour adder for all personal protective equipment required for its employees based on using a half face, full face, or powered air purifying respirator for asbestos abatement or lead abatement work or work involving arsenic or hexavalent chromium. This adder is additive to the straight time and overtime rates. This adder includes, but is not limited to, the use of the following consumables, expendables and equipment including all applicable mark-ups and taxes. Contractor supplied Disposable suits for use in containments or other work involving asbestos abatement such as glovebag work or transite removal shall be blue tyvek and shall be reflected in the unit price adder below.

ID	Description	ID	Description
1	Disposable Shorts	9	Repair Parts for Respirators
2	Disposable Suits	10	Cleaning Supplies for respirators
3	Rubber Boots	11	Storage Bags for Respirators
4	Disposable Gloves	12	Supplies for Respirator Fit Testing
5	1/2 Face or Full Face Air Purifying Respirators	13	Soap
6	Powered Air Purifying Respirators	14	Shampoo
7	Charging Units for PAPR's	15	Disposable Towels used for Showers
8	Filter Cartridges for Respirators	16	Cost associated with laundering protective clothing if reusable.

Not included in this unit price are the following items which will be paid for or supplied by Owner on an as-needed basis. If supplied by Contractor they shall be reimbursed at actual invoice cost plus markup from form A or at the rates submitted on Form B.

ID	Description
1	Rental equipment (i.e., shower trailers, negative air machines, etc.)
2	Labor and materials used in building enclosures
3	Labor and material used in asbestos removal and disposal (Refer to Page 12) for reimbursable items used in asbestos removal and disposal).
4	Rain suits
5	Dual cartridges (i.e., Hepa/Sulfur). Owner will pay the added cost of a dual cartridge.
6	Fire retardant disposable coveralls.
7	Supplied air respirators.
8	Respirator fit testing
9	Personal physicals showing fitness to wear a respirator
10	Blood test associated with lead
11	Air sampling for arsenic, asbestos fibers, lead, or associated with working in a confined space nor the equipment required for taking samples and analysis of the samples.

Administration of the unit price adder is as follows:	
1	The unit price adder applies only to craft union manhours including foreman and general foreman. These rates do not apply to superintendent, office manager, timekeeper or safety coordinator manhours.
2	All ST/OT manhours (including paid breaks and clean-up time) are billable with the unit price adder, as long as the person that performs the work involving the use of protective clothing during the timeframe breaks are taken.

PUBLIC VERSION
FORM B

Construction Equipment Rentals For All Work Types (Sheet 1) - Additional Space Provided on Sheets 2 & 3

Refer to Pages 5 & 6 for notes to aid in completion of this form.

Equipment Drive Adjustment Factors: 25% Electric Motor Driven 50% Gas Motor Driven 0% Manual							
*** Highlighted Columns are calculated ***							
Rental Item	Rental Item Description <small>(The text will automatically wrap. Drag down the row to make all text visible)</small>	Hourly Rate	Monthly Rate	Hourly Rate	Hourly Rate	Equipment Drive Type	
		<small>(Monthly Rate/176)</small>		<small>(Over 176 Hours)</small> <small>(Electric Motors Only)</small>	<small>(Over 176 Hours)</small> <small>(Gas Motors Only)</small>	<small>(Select from Pivot Table)</small>	
B1	426 Backhoe Diesel	\$		\$ -	\$	Gas Motor Driven	
B2	90-Ton RT Crane Diesel	\$		\$ -	\$	Gas Motor Driven	
B3	563 Compactor Diesel	\$		\$ -	\$	Gas Motor Driven	
B4	D6 Dozer Diesel	\$		\$ -	\$	Gas Motor Driven	
B5	330 Excavator Diesel	\$		\$ -	\$	Gas Motor Driven	
B6	936 Wheel loader Diesel	\$		\$ -	\$	Gas Motor Driven	
B7	9000 lb Telehandler Diesel	\$		\$ -	\$	Gas Motor Driven	
B8	246 Skid Steer Diesel	\$		\$ -	\$	Gas Motor Driven	
B9	Trencher Diesel	\$		\$ -	\$	Gas Motor Driven	
B10	Trench Padding Machine Diesel	\$		\$ -	\$	Gas Motor Driven	
B11	Pull Behind Trailer	\$		\$ -	\$	Manual	
B12	Pick-up Truck Gas	\$		\$ -	\$	Gas Motor Driven	
B13	Mechanics Truck Diesel	\$		\$ -	\$	Gas Motor Driven	
B14	2000 GAL Water Truck Diesel	\$		\$ -	\$	Gas Motor Driven	
B15	Single Reel Cable Trailer	\$		\$ -	\$	Manual	
B16	Triple Reel Cable Trailer	\$		\$ -	\$	Manual	
B17	Side by Side UTV Gas	\$		\$ -	\$	Gas Motor Driven	
B18	60' Boomlift Diesel	\$		\$ -	\$	Gas Motor Driven	
B19	Pile Driver Diesel	\$		\$ -	\$	Gas Motor Driven	
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Contractor : IEA

Specification: South Bend Solar Spec
 Initial: _____
 Date: 12/14/2018
 Page _____ of _____

**PUBLIC VERSION
FORM B**

Construction Equipment Rentals For All Work Types (Sheet 2) - Use this sheet if additional space is needed.

Refer to Pages 5 & 6 for notes to aid in completion of this form.						
Equipment Drive Adjustment Factors:						
		25% Electric Motor Driven	50% Gas Motor Driven	0% Manual		
*** Highlighted Columns are calculated ***						
Rental Item	Rental Item Description <small>(The text will automatically wrap. Drag down the row to make all text visible)</small>	Hourly Rate <small>(Monthly Rate/176)</small>	Monthly Rate	Hourly Rate <small>(Over 176 Hours) (Electric Motors Only)</small>	Hourly Rate <small>(Over 176 Hours) (Gas Motors Only)</small>	Equipment Drive Type <small>(Select from Pivot Table)</small>
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Contractor : _____

Specification: _____
Initial: _____
Date: _____
Page _____ of _____

PUBLIC VERSION
FORM B

Construction Equipment Rentals For All Work Types (Sheet 3) - Use this sheet if additional space is needed.

Refer to Pages 5 & 6 for notes to aid in completion of this form.

Equipment Drive Adjustment Factors:						
		25% Electric Motor Driven			50% Gas Motor Driven	0% Manual
*** Highlighted Columns are calculated ***						
Rental Item	Rental Item Description <small>(The text will automatically wrap. Drag down the row to make all text visible)</small>	Hourly Rate <small>(Monthly Rate/176)</small>	Monthly Rate	Hourly Rate <small>(Over 176 Hours) <small>(Electric Motors Only)</small></small>	Hourly Rate <small>(Over 176 Hours) <small>(Gas Motors Only)</small></small>	Equipment Drive Type <small>(Select from Pivot Table)</small>
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Contractor : _____

Specification: _____
Initial: _____
Date: _____
Page _____ of _____

ROUND TRIP TRUCKING CHARGES FOR CONSTRUCTION EQUIPMENT							
Plant	Round Trip Miles	Pickup Truck		Flatbed Truck		Tractor Trailer	
		Cost Per Mile	Lump Sum Round Trip Trucking Charge	Cost Per Mile	Lump Sum Round Trip Trucking Charge	Cost Per Mile	Lump Sum Round Trip Trucking Charge
JOB LOCATION EASTERN COAL FIRED PLANTS							
Amos Plant			\$ -		\$ -		\$ -
Big Sandy			\$ -		\$ -		\$ -
Cardinal Plant			\$ -		\$ -		\$ -
Ceredo Generating Station			\$ -		\$ -		\$ -
Clifty Creek			\$ -		\$ -		\$ -
Clinch River Plant			\$ -		\$ -		\$ -
Conesville Plant			\$ -		\$ -		\$ -
Cook Coal Terminal			\$ -		\$ -		\$ -
Dresden Plant			\$ -		\$ -		\$ -
Glen Lyn Plant			\$ -		\$ -		\$ -
Greenville Elec. Gen. Sta.			\$ -		\$ -		\$ -
Kammer Plant			\$ -		\$ -		\$ -
Kanawha River Plant			\$ -		\$ -		\$ -
Kyger Creek			\$ -		\$ -		\$ -
Mitchell Plant			\$ -		\$ -		\$ -
Mountaineer Plant			\$ -		\$ -		\$ -
Robert P. Mone Plant			\$ -		\$ -		\$ -
Rockport Plant			\$ -		\$ -		\$ -
Sporn Plant			\$ -		\$ -		\$ -
JOB LOCATION WESTERN SOLID FUEL FIRED PLANTS							
Dolet Hills			\$ -		\$ -		\$ -
Flint Creek Power Station			\$ -		\$ -		\$ -
Oklunion Power Station			\$ -		\$ -		\$ -
Pirkey Power Station			\$ -		\$ -		\$ -
Turk Power Plant			\$ -		\$ -		\$ -
Welsh Power Station			\$ -		\$ -		\$ -
JOB LOCATION WESTERN NATURAL GAS FIRED PLANTS							
Arsenal Hill			\$ -		\$ -		\$ -
Commanche Station			\$ -		\$ -		\$ -
Knox Lee			\$ -		\$ -		\$ -
Lieberman Plant			\$ -		\$ -		\$ -
Lone Star			\$ -		\$ -		\$ -
Northeastern Power Station			\$ -		\$ -		\$ -
Rio Pecos Power Station			\$ -		\$ -		\$ -
Riverside Power Station			\$ -		\$ -		\$ -
San Angelo Power Station			\$ -		\$ -		\$ -
Southwestern Power Station			\$ -		\$ -		\$ -
J. L. Stall			\$ -		\$ -		\$ -
Tulsa Power Station			\$ -		\$ -		\$ -
Weleetka Power Station			\$ -		\$ -		\$ -
Wilkes			\$ -		\$ -		\$ -
*** Highlighted Columns are calculated ***							
NOTES:							
1	"Round trip trucking charge" means, the portal to portal delivery of equipment to and from Owner's job site.						
2	Round trip trucking charges shall include all cost associated with delivery and return of the equipment from Owner's job site such as labor, food, motels, fuel, road tolls, taxes, overhead and profit.						

Contractor :

Specification: _____
 Initial: _____
 Date: _____
 Page _____ of _____

PUBLIC VERSION
FORM B

NOTES (Refer to Pages 1, 2 & 3)	
Item	Description
1	In the column, "Monthly Rate", enter the monthly rate, the hourly rate will be automatically calculated. Form is formatted to indicate dollars and cents, do not add dollar sign to the number
2	For electric or gas motor driven equipment, in the column "Equipment Driven Type (Electric or Gas)" highlight a cell, a drop down box will appear to the right of the field. Click on the drop down arrow and highlight either "Electric Motor Driven" or "Gas-Combustion". When one or the other of these choices is selected, it will automatically calculate the hourly rental rate. To change it, highlight the cell and delete the selected Driven Type, Gas, gas combustion or gas motor driven means any internal combustion engine.
3	In the "Rental Item #" column, after B1, consecutively number starting B2, B3 etc for all items that you list as a Rental.
4	The term "construction equipment" means tools and construction equipment not considered to be a small tool as defined on Form A. Contractor shall submit hourly and monthly rental rates on this form for its equipment. Rates shall be for all Contractor-supplied equipment that would typically be required in the performance of its work. An adequate description must be included for each piece of equipment to enable Owner to evaluate the quoted rental rate. For each piece of equipment, Contractor shall specify all applicable parameters; such as:
	A Type of equipment; manufacturer, model and year of manufacture;
	B Type and size of power: diesel, gas, electric, horsepower, etc.;
	C Capacity: weight, volume, CFM, blows per minute, etc.;
	D Size: inches, feet, horsepower, etc.;
	E Reach;
	F Weight (for bulldozer, roller, etc.)
	G Mounting: wheel, crawler, truck and trailer; and
	H Attachments.
5	Items appearing on the Small Tools List on Form A shall not be included on Form B as rental items. Reimbursement will not be allowed for any item listed on Form B if said item is named on Form A as a small tool. Any item listed on Form A as a rental item is acceptable to list on Form B.
6	Third party rentals shall be subject to prior approval by Owner. Owner will not reimburse Contractor for third party rentals if the rental item is considered to be a small tool on Form A.
7	Rental rates for Contractor-supplied construction equipment shall not exceed 100% of the monthly rates listed in the latest edition of the "Rental Rate Blue Book B19 for Construction Equipment" adjusted for geographical region as published by Equipment Watch. If a Rental rate in the Blue Book is not available, at the discretion of Owner, a Blue Book rate for a similar piece of equipment or another published rate will be used.
8	Hourly rental rates are determined by dividing the quoted monthly rate by 176. Hourly rental rates shall apply to a maximum of 176 hours in any calendar month after which the monthly rate shall apply with the following exceptions:
	A Gas or diesel engine driven construction equipment which are used more than 176 hours in a given calendar month (or 30 day period such as may apply) will qualify for compensation at 50% of the submitted rate for hours used greater than the 176 hours.
	B Electrical motor driven construction equipment which are used more than 176 hours in a given calendar month (or 30 day period such as may apply) will qualify for compensation at 25% of the submitted rate for hours used greater than the 176 hours.

Notes Continued on Page 6

Contractor :

Specification: _____
Initial: _____
Date: _____
Page _____ of _____

NOTES (Refer to Pages 1, 2 & 3)	
Item	Description
9	Rental Rates provided for herein shall be complete compensation to Contractor for providing and maintaining construction equipment in a safe and efficient operating condition, including the cost of all fuel, lubricants, supplies, tools, parts and labor for routine maintenance; minor and major repairs and major overhauls; and insurance, taxes, depreciation, interest, overhead and profit.
10	Rental rates shall include all accessories associated with the operation of the equipment such as fuel tanks, water & air hoses, nozzles, filters, et. Rental rates for shower trailers shall include water heaters and filters for discharge of the water and a dirty water storage tank if needed. Rental rates for negative air machines and asbestos vacuum cleaners shall include the cost of Hepa filters. Rental rates shall not include operator labor costs.
11	Contractor shall warrant that all equipment it brings to the work site will arrive in first class operating condition and shall be properly maintained. Rental will not be paid on inoperable equipment.
12	Contractor shall not bring on site any of its equipment for which there isn't an approved rental rate. Contractor will not be reimbursed for any of its equipment on Owners work site for the time period the equipment is on site without an approved rental rate. Reimbursement for this equipment will begin on the date the equipment rate has been approved in writing by Owner.
13	For Cost Plus Work, Owner will pay for no more than one pickup truck per shift unless Contractor has demonstrated a legitimate need for additional pickup trucks and has received Owner's Approval.
11	For Cost Plus Work, compensation for Contractors equipment will be for the entire length of time the equipment is specifically required at the Site. Total hours will be determined by the actual time worked by Contractor. For Firm Price Work, Owner will only pay rent on equipment brought to Owners job site for the time period it is actually needed. Rented equipment for specific work activities shall be brought to the job site and removed from the job site in a timely manner. Compensation will not be allowed for equipment sitting idle for excessively long periods of time before work starts or after work is completed.
13	The rate reimbursed for third party rentals shall not exceed the rates submitted on Form B. For example: If Form B shows a rental rate of \$6 per hour for an 8 pack welder and Contractor rented from a third party the same 8 pack welder at \$12 per hour, the maximum Contractor can recover for the 8 pack welder including markup is \$6.
15	Round trip trucking charges to each of Owners work sites that Contractor will be working at, shall be submitted on Form B Page 5 of 5

Contractor : _____

Specification: _____

Initial: _____

Date: _____

Page _____ **of** _____

PUBLIC VERSION

Table 1

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PUBLIC VERSION

PART D1: Commercial Exceptions, Deviations and Clarifications

Reference Document	Section	Exception, Deviation or Clarification	AEP Answer
Appendix 2 EPC Terms & Conditions	Entire Document	CLARIFICATION: IEA has provided detailed exceptions / deviations / clarifications to the EPC Terms and Conditions document in lieu of the other two contract forms – 1) Purchase Order General Terms and Conditions & 2) 2012 Short Form PSA – because IEA understood this to be the form of contract being contemplated for this project.	
Appendix 2 General T&Cs; SOW Rev 0	All	Clarification-- references to acceptance, consent or approval of a party are deemed to require that such acceptance, consent or approval shall not be unreasonably withheld, conditioned, or delayed.	
Appendix 2 General T&Cs; SOW Rev 0	All	Clarification--references to Owner's judgment, rejection, directions, orders, instructions, or requests are deemed to require them to be made on a reasonable basis.	
Appendix 2 General T&Cs	2.3	Clarification requested--these deviations will by necessity be disturbed at least minimally in the process of discovering them; Contractor will not be able to avoid that but can agree to avoid further disturbance after discovery.	
Appendix 2 General T&Cs	2.5	Clarification--consent of Owner not required for removal of Contractor employee who is voluntarily or involuntarily terminated from employment.	
Appendix 2 General T&Cs	5.1	Deviation--Assignment by either party requires written consent of other party. Alternatively, assignment by Owner first requires Owner's assignee to provide Contractor with reasonable evidence of its ability to financially and operationally perform Owner's obligations under the Agreement.	
Appendix 2 General T&Cs	7.7	Clarification--Owner shall be responsible for and shall identify to Contractor any pre-existing hazardous conditions, hazardous materials, or hazardous wastes at the Site.	
Appendix 2 General T&Cs	8.1	Clarification--Subject to proper payment by Owner, title to the Equipment shall be free and clear of all liens and encumbrances.	
Appendix 2 General T&Cs	9.3(a)	Clarification--Owner's use of Contractor's facilities, ladders, and scaffolds is conditioned on Owner executing Contractor's release and indemnification agreement for such use; Owner's compliance with Contractor's site safety requirements; and scheduling such use so as not to impede Contractor's schedule for the Work.	
Appendix 2 General T&Cs	9.4	Clarification--Replace last sentence with "if Owner's Equipment has been incorporated or used up in any defective work, the actual direct cost of such Owner's Equipment shall be backcharged to Contractor.	
Appendix 2 General T&Cs	9.6	Exception--is inconsistent with Section 11.1 in which title and risk of loss pass to Owner upon Final Acceptance.	
Appendix 2 General T&Cs	13.1.3	Exception--Payment of invoices and release of retention due within 30 days.	
Appendix 2 General T&Cs	14.1.3	Clarification--Contractor must agree in writing to a Change Order before it is obligated to perform.	
Appendix 2 General T&Cs	19.2	Exception--Replace with "TO THE EXTENT PERMITTED BY LAW, CONTRACTOR SHALL INDEMNIFY, DEFEND AT ITS EXPENSE, AND SAVE OWNER HARMLESS FROM, ANY LIABILITIES, COSTS AND CLAIMS, INCLUDING JUDGMENTS RENDERED AGAINST, AND FINES AND PENALTIES IMPOSED UPON, OWNER AND REASONABLE ATTORNEYS' FEES AND ALL OTHER COSTS OF LITIGATION (COLLECTIVELY, "LIABILITIES"), ARISING OUT OF THE CONTRACT, INCLUDING INJURIES, DISEASE OR DEATH TO PERSONS, OR DAMAGE TO PROPERTY, AND ENVIRONMENTAL CLAIMS AND LIABILITIES, TO THE EXTENT CAUSED BY CONTRACTOR, ITS EMPLOYEES, AGENTS OR SUBCONTRACTORS, OR IN ANY WAY ATTRIBUTABLE TO THE PERFORMANCE OF THE CONTRACT, EXCEPT THAT CONTRACTOR'S OBLIGATION TO INDEMNIFY OWNER SHALL NOT APPLY TO ANY LIABILITIES ARISING FROM OWNER'S SOLE NEGLIGENCE. TO THE EXTENT PROVIDED IN THIS SECTION, IN STATES OTHER THAN OHIO, MICHIGAN, KENTUCKY, TENNESSEE, MISSOURI, OKLAHOMA, VIRGINIA, AND WEST VIRGINIA, CONTRACTOR AGREES TO INDEMNIFY OWNER FOR LIABILITIES ARISING FROM OWNER'S ACTS AND OMISSIONS, NEGLIGENT OR OTHERWISE. OWNER SHALL HAVE THE RIGHT TO SELECT ITS OWN COUNSEL AND TO HAVE COUNSEL SEPARATE FROM CONTRACTOR, ALL AT CONTRACTOR'S OWNER'S EXPENSE.	
Appendix 2 General T&Cs	19.4	Clarification--insert the word "CONTRACTOR" between the words "ALL" and	
Appendix 2 General T&Cs	Add 19.5	19.5 OWNER'S GENERAL INDEMNITY. OWNER WILL PROTECT, DEFEND, INDEMNIFY AND HOLD HARMLESS CONTRACTOR, CONTRACTOR'S SUBCONTRACTORS AND SUPPLIERS, AND THEIR RESPECTIVE PARTNERS AND THEIR PARENT CORPORATIONS, SUBSIDIARIES, AFFILIATES, AGENTS, OFFICERS, DIRECTORS AND EMPLOYEES (EACH, A "CONTRACTOR INDEMNIFIED PARTY") FROM AND AGAINST ANY AND ALL THIRD-PARTY SUITS, ACTIONS, LOSSES, DAMAGES, CLAIMS OR LIABILITY OF ANY CHARACTER, TYPE OR DESCRIPTION, INCLUDING, BUT NOT LIMITED TO, ALL EXPENSES OF LITIGATION, COURT COSTS AND ATTORNEYS' FEES, FOR INJURY OR DEATH TO ANY PERSON OR DAMAGE TO ANY PROPERTY, TO THE EXTENT CAUSED BY ANY NEGLIGENT ACT OR OMISSION (INCLUDING STRICT LIABILITY), GROSS NEGLIGENCE OR WILLFUL MISCONDUCT OF OWNER, ITS CONTRACTORS (BUT NOT INCLUDING CONTRACTOR) OR ITS SUBCONTRACTORS, AGENTS OR EMPLOYEES, ARISING OUT OF THIS AGREEMENT, INCLUDING (A) RELATING TO INJURY TO OR DEATH OF ANY PERSON, INCLUDING EMPLOYEES OF OWNER; OR (B) RESULTING FROM LOSS OR DAMAGE TO PROPERTY.	
Appendix 2 General T&Cs	20	Clarification--add the following: "Section 20.2 The Contractor's aggregate liability for Liquidated Damages shall be limited to a maximum amount equal to ten percent (10%) of the Contract Price."	

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Appendix T&Cs	2	General	20	1.1 Clarification—add the following: "Section 20.3 Except to the extent arising from the negligence or willful misconduct of Contractor or its Subcontractors at any tier, in no event shall Contractor be liable to Owner for any damages, claims, demands, suits, causes of action, losses, costs, expenses and/or liabilities (including any Liquidated Damages) under or in connection with the Contract in excess of an amount equal to one hundred percent (100%) of the Contract Price, as adjusted for Change Orders, regardless of whether such liability arises out of breach of contract, guarantee or warranty, tort, product liability, indemnity, contribution, strict liability or any other legal theory; except that the preceding limitation of liability shall not apply to, and no credit shall be issued against such liability for, Contractor's indemnity obligations stated in Article 19. Notwithstanding any of the foregoing, this limitation of liability shall not apply to damages for which insurance proceeds are received from insurance required to be provided pursuant to Article 18, it being the parties' specific intent that this limitation shall not relieve the insurers' obligations for such insured risks."
Appendix T&Cs	2	General	21.1	Clarification—add "Subject to Owner's proper payment pursuant to this Contract and" to the beginning of the first sentence.
Appendix T&Cs	2	General	Article 25	Clarification—add usual Owner Events of Default (i.e. filing of bankruptcy, failure to pay Contractor, etc.)
Appendix T&Cs	2	General	26.1	Clarification—Contractor liable for its failure to perform on time solely if caused by
Appendix T&Cs	2	General	28.1	Clarification—Contractor requests at least 3 days' notice for suspension.
Appendix T&Cs	2	General	Article 29	Clarification—add Contractor right to terminate upon Owner Event of Default.
Appendix T&Cs	2	General	29.1.2	Clarification—Owner shall not have the right to take possession of or utilize equipment, tools or materials owned or leased by Contractor or its subcontractors.
Appendix T&Cs	2	General	29.1.3	Exception—Contractor to be paid for work completed in accordance with the contract within 30 days of termination. If Owner's completion of the work (by itself or through 3 rd parties) and Final Acceptance does not occur within 180 days of the date Contractor was to have completed the work according to the project schedule in effect at the time of Owner's termination of Contractor, then Contractor shall not be liable to Owner for any cost of completion that exceeds the unpaid balance of the Contract.
Appendix T&Cs	2	General	29.2.1	Clarification—Contractor requests at least 3 days' notice for termination for convenience.
Appendix T&Cs	2	General	29.2.2	Exception—all work in progress and completed work becomes the property of Owner upon Owner's proper payment under the Contract.
Appendix T&Cs	2	General	29.2.3	Exception—strike the last sentence and insert the following sentence between the second and third sentences of this section: "Further, Contractor shall receive 10% of the value of the terminated portion of the Contract."
Appendix T&Cs	2	General	32.3	Clarification—Subcontracts for work performed on fixed price basis will be have pricing redacted.
Appendix T&Cs	2	General	38.1	Clarification—right to disclose contained in second sentence applies to both Owner and Contractor.
Appendix T&Cs	2	General	Article 41	Exception—applicable law and jurisdiction will be Indiana and Indiana courts.
SOW Rev 0			Article 6	Clarification—all LD categories, time or performance guaranties, and amounts to be discussed with Owner. LDs are Owner's sole and exclusive remedy.
SOW Rev 0			7.1	Clarification—all Contractor financial statements shall be subject to Owner confidentiality obligations
SOW Rev 0			14.1.2	Clarification—Heading of Article 14 of General Terms and Conditions is "Changes in Work and Extra Work".
SOW Rev 0			15.1	Exception—Owner will make agreed milestone payments to Contractor.
SOW Rev 0			15.3	Exception—Payment of invoices and release of retention due within 30 days.
SOW Rev 0			27.2.1	Clarification—Contractor shall only be obligated to get Owner's consent, and to list on Form C, its Major Subcontractors (subcontracts with value of \$250,000 or more)
SOW Rev 0			27.2.2	Clarification—discuss subcontractor provision of Form A and Form B for each
SOW Rev 0			30.1	Clarification—Contractor to provide insurance coverage in accordance with Article 18 (not 16) of the General T&Cs? Please provide referenced supplement that is stated to have modified those requirements.
SOW Rev 0			Article 31	Clarification—Section numbers are numbered 32.1, etc.

PART D2: Technical Exceptions, Deviations and Clarifications		
Reference Document	Section	Exception, Deviation or Clarification
GEN4550 Specification	6.15	Upon review of the geotechnical report, we have included access roads at 16' width with a geotextile base and 6" of aggregate stone in lieu of the specified 15' width and 3" of aggregate stone.
SOW	4.13.2	A single conduit is included to contain both PV Homerun cables.
SOW	4.13.2	No heat trace included as our engineers do not believe it is necessary.
SOW	4.6	Includes a 5-acre construction laydown area; 3-acres will include 6" aggregate base, other 2 will include compacted subgrade.
SOW	4.13.1	Clarification: interconnection scope includes a relay protection system consisting of a pole-mounted recloser with relay controls per AEP specifications, a pole-mounted gang operated air break switch and a pole for AEP's metering PTs and CTs. This equipment will all be located on the project site. Owner will provide metering PTs and CTs as well as the meter for the project.
SOW	4.13.1	Metering data from Owner's meter will be made available to the contractor for testing and commissioning purposes.
SOW	4.6	Drain tile allowance included as follows: 100 up to 6" drain tile repairs, 10,000' of drain tile replacement.
SOW	4.6.7	No final elevations provided for grading. Considering the relatively flat site, we've included an allowance for stripping 6" of topsoil from the site along with minor grading. No mass grading included at this time.
SOW	4.6.3	Preliminary tracker pile design is based on a W6x10.5 pile x 18' in length. Preliminary pile design for fixed tilt rack is based on a 10ga C-Channel pile x 13.5' in length. Final design will be firmed up after site pull testing is completed during the design phase.
GEN 4550 Spec	6.3	Inverters are designed to operate at full load up to the average high temperature of the site (based on IEA's understanding of the RFI response).

PUBLIC VERSION

Appendix 11 – Power Output and Performance Requirements	Exhibit G-2	Section 1.20 defines a "Reference Period" of 1 year for the Energy Performance Test. This time frame is beyond the test time frame that is typical industry standard. This exception is to a 1-year period and anticipates that a performance test can be conducted in a time period of two to three weeks' time as per typical industry standard.	
GEN4550 Spec	4.7	Prefab control room included in scope has a footprint of 12'x12'	
SOW	4.11	Fiber included for communications to/from inverters and SCADA	
SOW	4.13.2	Passive cathodic protection achieved through galvanization of piles; no active cathodic protection included.	
SOW	9.1	12-month warranty included per Section 30.1 of Appendix 2, General Terms and Conditions of EPC. Optional: IEA can offer longer workmanship warranties that can be coupled with the original equipment manufacturers' warranties.	
SOW	26	P&P bond included; Letter of Credit cost is not included.	
GEN4550	6.5	One (1) each met station included per spec.	



BOUNDLESS ENERGY

Diverse and Small Business /Large Business Self- Certification Form

PENALTY FOR FALSE MISREPRESENTATION

PENALTIES FOR FALSE MISREPRESENTATION: 1) FAR 52-219 (e) (4)—Misrepresentations of business status as a small, small disadvantaged, small women-owned, small veteran-owned (including service disabled), and HUBZone small business concern for the purpose of obtaining a subcontract that is to be included as part of or all of a goal contained in the requesting Contractor's subcontracting plan, without remedy, can result in severe penalties. Additionally, 2) -Under 15 U.S.C. 645(d), any person who misrepresents a firm's status in these same categories in order to obtain a contract to be awarded under the preference programs established pursuant to section 8(a), 8(d), 9 or 15 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall (i) Be punished by imposition of fine, imprisonment, or both; (ii) Be subject to administrative remedies, including suspension and debarment; and (iii) Be ineligible for participation in programs conducted under the authority of the Act.

By signing below, the supplier/vendor hereby certifies and represents that the information provided is current, accurate, and complete. The supplier further certifies that it will notify AEP of any changes to said information provided.

I. Supplier Contact information:

Company Name and (DBA): _____
Print or type

Physical Address: _____ City: _____ State: _____ Zip: _____

Authorized Representative: _____ Authorized Signature: _____
Print

Title: _____ Date: _____

Email: _____

Telephone Number: _____ Fax Number: _____

2. Select business types that apply: **(NOTE: A business size must be selected)** Small Business Large Business

Next, provide the NAICS CODE(s): _____

Business code(s) may be referenced at www.naics.com

3. Then, select ALL certified business classification (s) that applies:

- Minority-Owned and Controlled (51% or more) Veteran-Owned (51% or more) Service Disable Veteran-Owned (51% or more)
- Woman-Owned (51% or more) Small Disadvantaged Business (8a) LGBT-Owned HUBZone Certified

If third party certified for any of the above business types please attach copy of your current certification(s)

Definitions and Eligibility Requirements for the above business types may be referenced at SBA.GOV

4. Lastly, select ALL additional minority classification(s) that applies:

- African-American Indian (Sub-Continent) Native-American
- Hispanic-American Asian/Pacific Islander Multi-Ethnic

Thank you for taking the time to complete this supplier Self Certification Form. Please return the completed form along with any supporting certification documentation via Fax to: 614-716-3271 or email to: supplierdiversity@aep.com.

PUBLIC VERSION



Project Input Data - OPTION 1

PROJECT SPECIFICATIONS

VAISALA

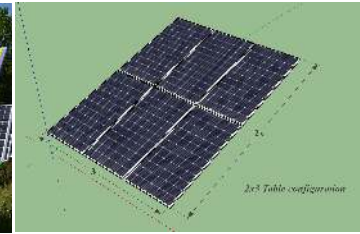
Client name	IEA
Project name	AEP South Bend
Date at which project started operation (if applicable)	n/a
Latitude	41.73
Longitude	-86.1
Elevation	769 ft
AC Capacity [MW]	20
DC Capacity [MW]	25.1694
Total number of modules	63720
Total number of inverters	26 (6 central PCS units)
Modules per string	27
Module Manufacturer and Model	Jinko JKM 395M-72L-V
Inverter Manufacturer and Model	TMEIC SolarWare 840 Universal Power Conditioner System
Mounting Type Select From Drop-Down	Fixed tilt
Tilt angle	25 degrees
Azimuth	180 degrees
Pitch (m) (see picture 1)	8.75
Width of sensitive area (m) (see picture 1)	3.94
Distance from lower edge of array to ground (m)	0.762
Module orientation (landscape or portrait)	portrait
Table or Racking configuration (see picture 2)	2 high in portrait
(If trackers used) Backtracking?	
(If trackers used) Tracker range (min/max rotation)	
Auxiliary loads to subtract from production if any (W/kW)	5.5 Watts loss/kWac (0.15% of total MWh)
Cleaning frequency	depends on Owner preference
Is output curtailed? If so, please provide details.	Grid limit of 20 MW at POI
Number of transformer stages between inverters and energy meter	1
For each transformer stage, please indicate the following	Transformer stage 1 Rating (MVA) 21 MVA (total of 6 LV-MV transformers in parallel) Voltage (kV) 34.5 No-load loss (%) 0.1 Load loss at peak power (%) 0.9 Is night disconnect used? No
	Transformer stage 2 (if any)
	Transformer stage 3 (if any)
If transmission line losses are significant, please specify for each line	Line 1 (if any) Loss (%) 0.5% AC loss at full load (total AC system wire losses)
	Line 2 (if any)
	Line 3 (if any)
	Line length (km) Resistance per unit length (Ω/m) Conductors per phase
Please specify power factor, if not equal to 1	

*Please provide manufacturer datasheet, and PVsyst .pan file if available

*Please provide manufacturer datasheet, and PVsyst .ond file if available



Picture 1



Picture 2

Please provide separately any system-specific loss calculations that have been performed (e.g. AC and DC wiring, auxiliary losses, transmission line losses, soiling)
Please provide separately any information relevant for shading analysis
Please provide separately any other relevant documentation for energy modeling (e.g. single-line diagrams)

IEA Design and Modeling Notes:

DC wiring loss has been calculated at average of 1.2% at STC conditions based on our DC wiring design
AC wiring loss has been calculated at maximum of 0.5% at STC conditions
The project is modeled to have a Grid Limit at the POI such that inverters will be configured to output enough power to overcome transformer and AC wire ohmic losses.
Horizon shading analysis on this site (outside objects) is considered negligible
PVsyst has been used to model yearly DC losses and AC losses are post-processed after the inverter.
Single Line Diagrams have been provided as part of the submittal package
Energy yield 8760 and post processing spreadsheet are provided as part of the submittal package
Meteorological data from Clean Power Research's Solar Anywhere subscription was used for this analysis.

PUBLIC VERSION



Project Input Data - OPTION 2

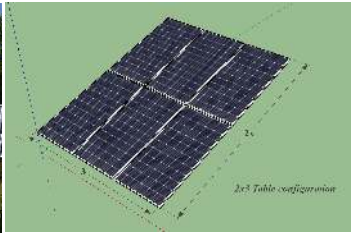
PROJECT SPECIFICATIONS

VAISALA

Client name	IEA		
Project name	AEP South Bend		
Date at which project started operation (if applicable)	n/a		
Latitude	41.73		
Longitude	-86.1		
Elevation	769 ft		
AC Capacity [MW]	20		
DC Capacity [MW]	24.885		
Total number of modules	63000		
Total number of inverters	26 (6 central PCS units)		
Modules per string	25		
Module Manufacturer and Model	Jinko JKM 395M-72L-V <i>*Please provide manufacturer datasheet, and Pvsyst .pan file if available</i>		
Inverter Manufacturer and Model	TMEIC SolarWare 840 Universal Power Conditioner System <i>*Please provide manufacturer datasheet, and Pvsyst .ond file if available</i>		
Mounting Type Select From Drop-Down	1-axis horizontal East-West tracker		
Tilt angle	0 degrees nominal		
Azimuth	180 degrees		
Pitch (m) (see picture 1)	5.93		
Width of sensitive area (m) (see picture 1)	1.95		
Distance from lower edge of array to ground (m)	0.762		
Module orientation (landscape or portrait)	portrait		
Table or Racking configuration (see picture 2)	1x in portrait along tracker torque tube		
(If trackers used) Backtracking?	Yes		
(If trackers used) Tracker range (min/max rotation)	52/52 degrees		
Auxiliary loads to subtract from production if any (W/kW)	8.3 Watts loss/kWac (0.2% of total MWh)		
Cleaning frequency	depends on Owner preference		
Is output curtailed? If so, please provide details.	Grid limit of 20 MW at POI		
Number of transformer stages between inverters and energy meter	1		
For each transformer stage, please indicate the following	Transformer stage 1	Transformer stage 2 (if any)	Transformer stage 3 (if any)
Rating (MVA)	21 MVA (total of 6 LV-MV transformers in parallel)		
Voltage (kV)	34.5		
No-load loss (%)	0.1		
Load loss at peak power (%)	0.9		
Is night disconnect used?	No		
If transmission line losses are significant, please specify for each line	Line 1 (if any)	Line 2 (if any)	Line 3 (if any)
Loss (%)	0.5% AC loss at full load (total AC system wire losses)		
Line length (km)			
Resistance per unit length (Ω/m)			
Conductors per phase			
Please specify power factor, if not equal to 1			



Picture 1



Picture 2

*Please provide separately any system-specific loss calculations that have been performed (e.g. AC and DC wiring, auxiliary losses, transmission line losses, soiling)
Please provide separately any information relevant for shading analysis
Please provide separately any other relevant documentation for energy modeling (e.g. single-line diagrams)*

IEA Design and Modeling Notes:

DC wiring loss has been calculated at average of 1.2% at STC conditions based on our DC wiring design
AC wiring loss has been calculated at maximum of 0.5% at STC conditions
The project is modeled to have a Grid Limit at the POI such that inverters will be configured to output enough power to overcome transformer and AC wire ohmic losses.
Horizon shading analysis on this site (outside objects) is considered negligible
Pvsyst has been used to model yearly DC losses and AC losses are post-processed after the inverter.
Single Line Diagrams have been provided as part of the submittal package
Energy yield 8760 and post processing spreadsheet are provided as part of the submittal package
Meteorological data from Clean Power Research's Solar Anywhere subscription was used for this analysis.

PUBLIC VERSION



Project Input Data - OPTION 3

PROJECT SPECIFICATIONS

VAISALA

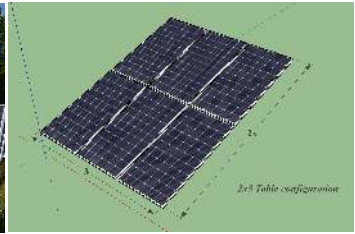
Client name	IEA
Project name	AEP South Bend
Date at which project started operation (if applicable)	n/a
Latitude	41.73
Longitude	-86.1
Elevation	769 ft
AC Capacity [MW]	20
DC Capacity [MW]	25.17048
Total number of modules	58536
Total number of inverters	26 (6 central PCS units)
Modules per string	6
Module Manufacturer and Model	First Solar Series 6 430 W (FX-6430)
Inverter Manufacturer and Model	TMEIC SolarWare 840 Universal Power Conditioner System
Mounting Type Select From Drop-Down	Fixed tilt
Tilt angle	25 degrees
Azimuth	180 degrees
Pitch (m) (see picture 1)	8.97
Width of sensitive area (m) (see picture 1)	4.04
Distance from lower edge of array to ground (m)	0.762
Module orientation (landscape or portrait)	portrait
Table or Racking configuration (see picture 2)	2 high in portrait
(If trackers used) Backtracking?	
(If trackers used) Tracker range (min/max rotation)	
Auxiliary loads to subtract from production if any (W/kW)	5.5 Watts loss/kWac (0.15% of total yearly MWh)
Cleaning frequency	depends on Owner preference
Is output curtailed? If so, please provide details.	Grid limit of 20 MW at POI
Number of transformer stages between inverters and energy meter	1
For each transformer stage, please indicate the following	Transformer stage 1 Rating (MVA) 21 MVA (total of 6 LV-MV transformers in parallel) Voltage (kV) 34.5 No-load loss (%) 0.1 Load loss at peak power (%) 0.9 Is night disconnect used? No
	Transformer stage 2 (if any)
	Transformer stage 3 (if any)
If transmission line losses are significant, please specify for each line	Line 1 (if any) Loss (%) 0.5% AC loss at full load (total AC system wire losses)
	Line 2 (if any)
	Line 3 (if any)
	Line length (km)
	Resistance per unit length (Ω/m)
	Conductors per phase
Please specify power factor, if not equal to 1	

*Please provide manufacturer datasheet, and PVsyst .pan file if available

*Please provide manufacturer datasheet, and PVsyst .ond file if available



Picture 1



Picture 2

Please provide separately any system-specific loss calculations that have been performed (e.g. AC and DC wiring, auxiliary losses, transmission line losses, soiling)
Please provide separately any information relevant for shading analysis
Please provide separately any other relevant documentation for energy modeling (e.g. single-line diagrams)

IEA Design and Modeling Notes:

DC wiring loss has been calculated at average of 1.2% at STC conditions based on our DC wiring design
AC wiring loss has been calculated at maximum of 0.5% at STC conditions
The project is modeled to have a Grid Limit at the POI such that inverters will be configured to output enough power to overcome transformer and AC wire ohmic losses.
Horizon shading analysis on this site (outside objects) is considered negligible
PVsyst has been used to model yearly DC losses and AC losses are post-processed after the inverter.
Single Line Diagrams have been provided as part of the submittal package
Energy yield 8760 and post processing spreadsheet are provided as part of the submittal package
Meteorological data from Clean Power Research's Solar Anywhere subscription was used for this analysis.

PUBLIC VERSION



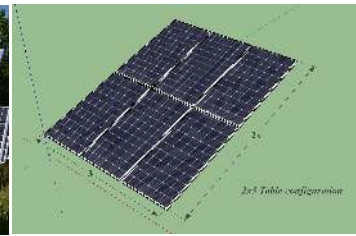
Client name	IEA
Project name	AEP South Bend
Date at which project started operation (if applicable)	n/a
Latitude	41.73
Longitude	-86.1
Elevation	769 ft
AC Capacity [MW]	20
DC Capacity [MW]	25.36524
Total number of modules	58968
Total number of inverters	26 (6 central PCS units)
Modules per string	6
Module Manufacturer and Model	First Solar Series 6 430 W (FX-6430)
Inverter Manufacturer and Model	TMEIC SolarWare 840 Universal Power Conditioner System
Mounting Type Select From Drop-Down	1-axis horizontal East-West tracker
Tilt angle	0 degrees nominal
Azimuth	180 degrees
Pitch (m) (see picture 1)	6.08
Width of sensitive area (m) (see picture 1)	1.96
Distance from lower edge of array to ground (m)	0.762
Module orientation (landscape or portrait)	portrait
Table or Racking configuration (see picture 2)	1x in portrait along tracker torque tube
(If trackers used) Backtracking?	No
(If trackers used) Tracker range (min/max rotation)	52/52 degrees
Auxiliary loads to subtract from production if any (W/kW)	8.3 Watts loss/kWac (0.2% of total yearly MWh)
Cleaning frequency	depends on Owner preference
Is output curtailed? If so, please provide details.	Grid limit of 20 MW at POI
Number of transformer stages between inverters and energy meter	1

*Please provide manufacturer datasheet, and PVSyst .pan file if available

*Please provide manufacturer datasheet, and PVSyst .ond file if available



Picture 1



Picture 2

For each transformer stage, please indicate the following	Transformer stage 1	Transformer stage 2 (if any)	Transformer stage 3 (if any)
Rating (MVA)	21 MVA (total of 6 LV-MV transformers in parallel)		
Voltage (kV)	34.5		
No-load loss (%)	0.1		
Load loss at peak power (%)	0.9		
Is night disconnect used?	No		

If transmission line losses are significant, please specify for each line	Line 1 (if any)	Line 2 (if any)	Line 3 (if any)
Loss (%)	0.5% AC loss at full load (total AC system wire losses)		
Line length (km)			
Resistance per unit length (Ω/m)			
Conductors per phase			

Please specify power factor, if not equal to 1

Please provide separately any system-specific loss calculations that have been performed (e.g. AC and DC wiring, auxiliary losses, transmission line losses, soiling)
Please provide separately any information relevant for shading analysis
Please provide separately any other relevant documentation for energy modeling (e.g. single-line diagrams)

IEA Design and Modeling Notes:

DC wiring loss has been calculated at average of 1.2% at STC conditions based on our DC wiring design
AC wiring loss has been calculated at maximum of 0.5% at STC conditions
The project is modeled to have a Grid Limit at the POI such that inverters will be configured to output enough power to overcome transformer and AC wire ohmic losses.
Horizon shading analysis on this site (outside objects) is considered negligible
PVSyst has been used to model yearly DC losses and AC losses are post-processed after the inverter.
Single Line Diagrams have been provided as part of the submittal package
Energy yield 8760 and post processing spreadsheet are provided as part of the submittal package
Meteorological data from Clean Power Research's Solar Anywhere subscription was used for this analysis.
First Solar recommends not to backtrack for their technology on single-axis trackers.

BIDDER'S RESPONSE SUMMARY: IEA

Complete the following form and return it with BIDDER's Proposal. Energy and power output values shall be at the Point of Interconnection (POI). Expected values are to be provided with BIDDER's base bid (see Section 5.2).

OPTION #1: 2019 Proposed System using Fixed Tilt and Jinko:

Racking Manufacturer (Selected)	<u>GameChange Solar</u>
Row Spacing (back of row to front of row)	<u>28.7</u> ft
Fixed Tilt Angle	<u>25 degrees</u>
Total Acreage Used	<u>88</u> acres
Inverter Manufacturer/Model	<u>TMEIC Ninja 840 kVA</u>
Inverter Capacity	<u>21.840 MVA site total</u>
Module Make/Model	<u>Jinko JKM 395M-72HL-V 395w</u>
System rating at STC	<u>25.1694</u> MW _{DC}

Schedule:

Overall Construction Duration, from NTP to Substantial Completion	<u>April-Dec (36)</u> weeks
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BIDDER shall include a conventional Gantt chart that outlines primary activities to be included as part of the EPC schedule for design, procurement and construction of the Project. Furthermore, a Key Date Schedule shall be included in Attachment E.

Annual Energy Production:

Expected First Year	<u>32,166.3</u> MWh _{AC}
Expected Second Year	<u>31,941.1</u> MWh _{AC}

Guaranteed Power Output:

DC/AC Conversion Ratio	<u>1.26</u> DC/AC
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Degradation Rate:

Fixed Tilt System	<u>0.5</u> %
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PUBLIC VERSION

OPTION #2: 2019 Proposed System using Single Axis Tracking and Jinko:

Tracker Manufacturer (Selected)	<u>Array Technologies Inc.</u>
Row Spacing (back of row to front of row)	<u>19.45</u> ft
Tilt Range	<u>52/-52 degrees</u>
Total Acreage Used	<u>133</u> acres
Inverter Manufacturer/Model	<u>TMEIC Ninja 840 kVA</u>
Inverter Capacity	<u>21.840 MVA site total</u>
Module Make/Model	<u>Jinko JKM 395M-72HL-V 395w</u>
System rating at STC	<u>24.885</u> MW _{DC}

Schedule:

Overall Construction Duration,
from NTP to Substantial Completion April-Dec (36) weeks

BIDDER shall include a conventional Gantt chart that outlines primary activities to be included as part of the EPC schedule for design, procurement and construction of the Project. Furthermore, a Key Date Schedule shall be included in Attachment E.

Annual Energy Production:

Expected First Year	<u>36,178.9</u> MWh _{AC}
Expected Second Year	<u>35,925.6</u> MWh _{AC}

Guaranteed Power Output:

DC/AC Conversion Ratio 1.24 DC/AC

Degradation Rate:

Tracker System 0.5 %

PUBLIC VERSION

OPTION #3: 2020 Proposed System using Fixed Tilt and First Solar:

Racking Manufacturer (Selected)	<u>GameChange Solar</u>
Row Spacing (back of row to front of row)	<u>29.42</u> ft
Fixed Tilt Angle	<u>25 degrees</u>
Total Acreage Used	<u>88</u> acres
Inverter Manufacturer/Model	<u>TMEIC Ninja 840 kVA</u>
Inverter Capacity	<u>21.840 MVA site total</u>
Module Make/Model	<u>First Solar FS-6 / 430w Series 6</u>
System rating at STC	<u>25.17048</u> MW _{DC}

Schedule:

Overall Construction Duration, from NTP to Substantial Completion	<u>April-Dec (36)</u> weeks
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BIDDER shall include a conventional Gantt chart that outlines primary activities to be included as part of the EPC schedule for design, procurement and construction of the Project. Furthermore, a Key Date Schedule shall be included in Attachment E.

Annual Energy Production:

Expected First Year	<u>31,960.3</u> MWh _{AC}
Expected Second Year	<u>31,736.6</u> MWh _{AC}

Guaranteed Power Output:

DC/AC Conversion Ratio	<u>1.26</u> DC/AC
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Degradation Rate:

Fixed Tilt System	<u>0.5</u> %
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PUBLIC VERSION

OPTION #4: 2020 Proposed System using Single Axis Tracking and First Solar:

Tracker Manufacturer (Selected)	<u>Array Technologies Inc.</u>
Row Spacing (back of row to front of row)	<u>19.94</u> ft
Tilt Range	<u>52/-52 degrees</u>
Total Acreage Used	<u>133</u> acres
Inverter Manufacturer/Model	<u>TMEIC Ninja 840 kVA</u>
Inverter Capacity	<u>21.840 MVA total</u>
Module Make/Model	<u>First Solar FS-6 / 430w Series 6</u>
System rating at STC	<u>25.356</u> MW _{DC}

Schedule:

Overall Construction Duration,
from NTP to Substantial Completion April-Dec (36) weeks

BIDDER shall include a conventional Gantt chart that outlines primary activities to be included as part of the EPC schedule for design, procurement and construction of the Project. Furthermore, a Key Date Schedule shall be included in Attachment E.

Annual Energy Production:

Expected First Year	<u>36,787.7</u> MWh _{AC}
Expected Second Year	<u>35,530.2</u> MWh _{AC}

Guaranteed Power Output:

DC/AC Conversion Ratio	<u>1.27</u> DC/AC
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Degradation Rate:

Tracker System	<u>0.5</u> %
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ANNUAL ENERGY PRODUCTION – OPTIONS #1 & #2

BIDDER shall provide an Excel file with BIDDER’s estimate of the annual hourly (8,760 hours/year) energy production for their proposed Project design, as specified in the RFP Documents and based on the BIDDER developed Site Layout, to be provided as Attachment B.

BIDDER shall provide estimates of annual energy production from an energy model. Bidder shall provide model documentation as stated in Attachment D. The output from the energy model will result in the Average Expected Energy Generation (AEG), which should be reported in the table below for the first two years of operation.

Option #1 – 2019 Fixed Tilt Mounting System / Jinko Modules:

Site	Size		1 st Year	2 nd Year	Capacity Factor
	DC (MW)	AC (MW)	AEG (MWh/yr)	AEG (MWh/yr)	%
Option 1	25.1694	20.0	32,166.3	31,941.1	18.3

Option #2 – 2019 Single Access Tracker System Upgrade / Jinko Modules (Option):

Site	Size		1 st Year	2 nd Year	Capacity Factor
	DC (MW)	AC (MW)	AEG (MWh/yr)	AEG (MWh/yr)	%
Option 2	24.885	20.0	36,178.9	35,925.6	20.6

The hourly energy production shall be reported in terms of net AC output at the revenue meter (i.e. including all losses up to the POI).

ANNUAL ENERGY PRODUCTION – OPTIONS #3 & #4

BIDDER shall provide an Excel file with BIDDER’s estimate of the annual hourly (8,760 hours/year) energy production for their proposed Project design, as specified in the RFP Documents and based on the BIDDER developed Site Layout, to be provided as Attachment B.

BIDDER shall provide estimates of annual energy production from an energy model. Bidder shall provide model documentation as stated in Attachment D. The output from the energy model will result in the Average Expected Energy Generation (AEG), which should be reported in the table below for the first two years of operation.

Option #3 – 2020 Fixed Tilt Mounting System / First Solar Modules:

Site	Size		1 st Year	2 nd Year	Capacity Factor
	DC (MW)	AC (MW)	AEG (MWh/yr)	AEG (MWh/yr)	%
Option 3	25.1705	20.0	31,960.3	31,736.6	18.2

Option #4 – 2020 Single Access Tracker System Upgrade / First Solar Modules (Option):

Site	Size		1 st Year	2 nd Year	Capacity Factor
	DC (MW)	AC (MW)	AEG (MWh/yr)	AEG (MWh/yr)	%
Option 4	25.356	20.0	36,787.7	35,530.2	20.6

The hourly energy production shall be reported in terms of net AC output at the revenue meter (i.e. including all losses up to the POI).

DESIGN PERFORMANCE FACTOR – 2019 OPTIONS

BIDDER shall provide a design performance factor table for each month of the year that the BIDDER is willing to guarantee based on OWNER’s Performance Acceptance Test. These values will be the Design Performance Factor that will be guaranteed as part of the EPC Agreement with successful BIDDER.

Design Performance Factor		
Month	OPTION 1 Fixed Tilt Design PR	OPTION 2 Single Axis Tracking Design PR
January	0.708457	0.69716
February	0.779242	0.779769
March	0.80525	0.831376
April	0.820614	0.842465
May	0.837114	0.842938
June	0.833911	0.837643
July	0.836155	0.840505
August	0.830434	0.833617
September	0.84052	0.84495
October	0.86803	0.872694
November	0.851394	0.86119
December	0.752051	0.768036

Provide:

1. BIDDER’s basis and calculations for the Design Performance Factor.
2. A breakdown of auxiliary load assumptions.

See last page.

DESIGN PERFORMANCE FACTOR – 2020 OPTIONS

BIDDER shall provide a design performance factor table for each month of the year that the BIDDER is willing to guarantee based on OWNER’s Performance Acceptance Test. These values will be the Design Performance Factor that will be guaranteed as part of the EPC Agreement with successful BIDDER.

Design Performance Factor		
Month	OPTION 3 Fixed Tilt Design PR	OPTION 4 Single Axis Tracking Design PR
January	0.657013	0.606572
February	0.734619	0.704773
March	0.782923	0.793975
April	0.808432	0.820583
May	0.838998	0.836154
June	0.845227	0.840307
July	0.858767	0.858836
August	0.854358	0.857446
September	0.855084	0.849478
October	0.856344	0.834985
November	0.819785	0.787661
December	0.695091	0.66076

Provide:

1. BIDDER’s basis and calculations for the Design Performance Factor.
2. A breakdown of auxiliary load assumptions.

See last page.

PUBLIC VERSION

1. □ BIDDER's basis and calculations for the Design Performance Factor.

The Design Performance Factor is understood to mean the "Performance Ratio" as defined by B. Marion et. al in the NREL Conference Paper NREL/CP-520-37358 titled "Performance Parameters for Grid-Connected PV Systems". IEA's calculation of the Performance Ratio reflects the PVSyst models that IEA generated for all the system options proposed and are based on the Clean Power Research meteorological data set. The Performance Ratio calculation reflects energy measured at the POI which is understood to be the power meter at 34.5kV at the project site and so incorporate all system losses including DC, AC and transformer losses. These calculations also include assumptions for snow and soiling losses that are summarized in the 8760 profiles submitted.

2. □ A breakdown of auxiliary load assumptions.

IEA has included auxiliary loads that include nighttime transformer losses, tracker drive motor losses (when applicable), auxiliary power that includes relay and telemetry loads, communication loads and HVAC loads for the control building on the site.



Construction Waste Management Implementation Plan

Overview:

On-site construction waste implementation plan will incorporate the removal of waste from the jobsite according to the following items:

- Disposing of non-hazardous construction waste/material
- Recycling non-hazardous construction waste/material
- Salvaging non-hazardous demolition waste/material

Site Materials:

Excess/unusable onsite material will be sorted into dumpsters labeled either 1) construction waste or 2) Salvageable/Recyclable material. Multiple dumpsters may be used for each depending upon the variance of material expected to be delivered to the site. The overall goal will be to divert as much material as possible from a landfill.

Expected waste material to be produced by the site:

- Aggregate
- Concrete
- Geotextile
- Spare parts such as wiring, conduit, harnesses, tracker/rack material other accessories
- Lumber
- Metals
- SWPPP materials
- Packaging materials such as paper, cardboard, boxes, plastic, crates

Site Implementation Plan:

Site execution will include the following steps:

- Plan implementation with site team.
- An on-site employee will be named waste management coordinator; this employee will also have other responsibilities.
- Training will occur in order to make sure the entire site staff understands waste management for the project.
- Site waste controls will be implemented to assure the plan will be followed and the site is kept as clean and as organized as possible.
- Hazardous wastes, if encountered, will be handled according to local regulations.



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Material Tracking:

Site supervision will provide a report for materials based upon the following:

- Whether the material is recycled, salvaged, or landfill bound material
- Hauler/location for disposal
- Quantity of materials hauled

Disposal Site:

Disposal site will be determined prior to construction but will be use one of the following locations:

- Waste Management
- Republic Services
- Michiana Recycling & Dispose

PUBLIC VERSION

CONTRACTOR ACQUIRED PERMITS

BIDDER to list all permits and regulatory approvals required to complete the scope as described herein:

Permit/Approval	Agency
401 Water Quality Certification	IDEM
404 Dredge & Fill Permit	USACE
Utility/Construction Permit	St. Joseph County
Driveway Permit(Commerical)	St. Joseph County
SWPPP Permit	St. Joseph County
Electrical Permit	St. Joseph County
Building Permit	St. Joseph County
Application for Construction Design Release (ACDR) Category D	IN Gov



CERTIFICATE OF LIABILITY INSURANCE

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement.

Table with 2 main columns: PRODUCER/INSURED and CONTACT/INSURER(S). Includes details for Lockton Insurance Brokers, LLC and IEA Constructors, Inc., and lists five insurers: Twin City Fire, Hartford Fire, Trumbull, Hartford Casualty, and American Guarantee and Liab. Ins. Co.

COVERAGES WHIC001 CERTIFICATE NUMBER: REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES.

Main table with columns: INSR LTR, TYPE OF INSURANCE, ADDL INSD, SUBR WVD, POLICY NUMBER, POLICY EFF, POLICY EXP, LIMITS. Rows include Commercial General Liability, Automobile Liability, Umbrella and Excess Liability, Workers Compensation, and 2nd Layer Excess.

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required) RE: Certificate Holder(s) is Additional Insured(s) as per the attached endorsement or policy language.

CERTIFICATE HOLDER CANCELLATION See Attachments

Table with 2 columns: Certificate Holder information and Cancellation notice. Includes a signature line for the Authorized Representative.

POLICY NUMBER: 72 ECX WQ0020

COMMERCIAL GENERAL LIABILITY
CG 20 10 04 13

**THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.
ADDITIONAL INSURED - OWNERS, LESSEES, OR
CONTRACTORS - SCHEDULED PERSON OR ORGANIZATION**

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

SCHEDULE

Name Of Additional Insured Person(s) Or Organization(s)	Location(s) Of Covered Operations
All, except Additional Insureds that are insured under a separate additional insured endorsement on this policy	All Locations
Information required to complete this Schedule, if not shown above, will be shown in the Declarations.	

A. Section II - Who Is An Insured is amended to include as an additional insured the person(s) or organization(s) shown in the Schedule, but only with respect to liability for "bodily injury", "property damage" or "personal and advertising injury" caused, in whole or in part, by:

1. Your acts or omissions; or
2. The acts or omissions of those acting on your behalf;

in the performance of your ongoing operations for the additional insured(s) at the location(s) designated above.

However:

1. The insurance afforded to such additional insured only applies to the extent permitted by law; and
2. If coverage provided to the additional insured is required by a contract or agreement, the insurance afforded to such additional insured will not be broader than that which you are required by the contract or agreement to provide for such additional insured.

B. With respect to the insurance afforded to these additional insureds, the following additional exclusions apply:

This insurance does not apply to "bodily injury" or "property damage" occurring after:

1. All work, including materials, parts or equipment furnished in connection with such work, on the project (other than service, maintenance or repairs) to be performed by or on behalf of the additional insured(s) at the location of the covered operations has been completed; or

2. That portion of "your work" out of which the injury or damage arises has been put to its intended use by any person or organization other than another contractor or subcontractor engaged in performing operations for a principal as a part of the same project.

C. With respect to the insurance afforded to these additional insureds, the following is added to **Section III – Limits Of Insurance:**

If coverage provided to the additional insured is required by a contract or agreement, the most we will pay on behalf of the additional insured is the amount of insurance:

1. Required by the contract or agreement; or
2. Available under the applicable Limits of Insurance shown in the Declarations; whichever is less.

This endorsement shall not increase the applicable Limits of Insurance shown in the Declarations.

PUBLIC VERSION

POLICY NUMBER: 72 ECX WQ0020

COMMERCIAL GENERAL LIABILITY
CG 20 37 04 13

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.
ADDITIONAL INSURED - OWNERS, LESSEES OR CONTRACTORS - COMPLETED OPERATIONS

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART
PRODUCTS/COMPLETED OPERATIONS LIABILITY COVERAGE PART

SCHEDULE

Name Of Additional Insured Person(s) Or Organization(s)	Location And Description Of Completed Operations
All, except Additional Insureds that are insured under a separate additional insured endorsement on this policy	All Location
Information required to complete this Schedule, if not shown above, will be shown in the Declarations.	

A. Section II - Who Is An Insured is amended to include as an additional insured the person(s) or organization(s) shown in the Schedule, but only with respect to liability for bodily injury" or "property damage" caused, in whole or in part, by your work at the location designated and described in the Schedule of this endorsement performed for that additional insured and included in the "products-completed operations hazard"
However:
1. The insurance afforded to such additional insured only applies to the extent permitted by law; and
2. If coverage provided to the additional insured is required by a contract or agreement, the insurance afforded to such additional insured will not be broader than that which you are required by the contract or agreement to provide for such additional insured.

B. With respect to the insurance afforded to these additional insureds, the following is added to **Section III - Limits Of Insurance:**
If coverage provided to the additional insured is required by a contract or agreement, the most we will pay on behalf of the additional insured is the amount of insurance:
1. Required by the contractor agreement; or
2. Available under applicable Limits of Insurance shown in the Declarations;
whichever is less.
This endorsement shall not increase the applicable Limits of Insurance shown in the Declarations.

POLICY NUMBER: 72 ECX WQ0020

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

**AMENDMENT OF OTHER INSURANCE CONDITION -
PRIMARY OR PRIMARY AND NON-CONTRIBUTORY WHEN
REQUIRED BY CONTRACT**

This endorsement modifies insurance provided under the following:

COVERAGE COMMERCIAL GENERAL LIABILITY COVERAGE PART (EXCESS)
COMMERCIAL GENERAL LIABILITY COVERAGE PART (EXCESS - BROAD FORM)

With respect to other insurance available to person or organization who is an additional insured under this Coverage Part, the following is added to Paragraph 4., **Other Insurance** of **Section IV - Commercial General Liability Conditions:**

4. Other Insurance

If other valid and collectible insurance is available to the insured for a loss we cover under Coverages **A** or **B** of this Coverage Part, our obligations are limited as follows:

a. Primary Insurance When Required By Contract

If you have agreed in a written contract, written agreement or permit that this insurance be primary, then subject to the "self-insured retention", this insurance is primary except when Paragraph **c.** below applies. If other insurance is also primary, we will share with all that other insurance by the method described in Paragraph **d.** below.

b. Primary And Non-Contributory To Other Insurance When Required By Contract

If you have agreed in a written contract, written agreement, or permit that this insurance is primary and non-contributory with the additional insured's own insurance, then subject to the "self-insured retention", this insurance is primary except when Paragraph **c.** below applies and we will not seek contribution from that other insurance.

Paragraphs **a.** and **b.** do not apply to other to which the additional insured has been added as an additional insured.

c. Excess Insurance

(1) This insurance is excess over any of the other insurance, whether primary, excess, contingent or on any other basis:

(a) Your Work

That is Fire, Extended Coverage, Builder's Risk, Installation Risk or similar coverage for "your work";

(b) Aircraft, Auto Or Watercraft

If the loss arises out of the maintenance or use of aircraft, "autos" or watercraft to the extent not subject to Exclusion **g.** of Section **I** - Coverage **A** - Bodily Injury And Property Damage Liability; or

(c) Property Damage to Borrowed Equipment Or Use Of Elevators

If the loss arises out of "property damage" to borrowed equipment or the use of elevators to the extent not subject to Exclusion **j.** of Section **I** - Coverage **A** - Bodily Injury And Property Damage Liability.

(2) When this insurance is excess over other insurance, we will pay only our share of the amount of the loss, if any, that exceeds the sum of:

(a) The total amount that all such other insurance would pay for the loss in the absence of this insurance; and

(b) The total of all deductible and self-insured amounts under all that other insurance.

(3) We will share the remaining loss, if any, with any other insurance that is not described in this Excess Insurance provision and was not bought specifically to apply in excess of the Limits of Insurance shown in the Declarations of this Coverage Part.

d. Method Of Sharing

If all of the other insurance permits contribution by equal shares, we will follow this method also. Under this approach each insurer contributes equal amounts until it has paid its applicable limit of insurance or none of the loss remains, whichever comes first.

If any of the other insurance does not permit contribution by equal shares, we will contribute by limits. Under this method, each insurer's share is based on the ratio of its applicable limit of insurance to the total applicable limits of insurance of all insurers.

PUBLIC VERSION

Policy Number: 72 ECX WQ0020

COMMERCIAL GENERAL LIABILITY
CG 24 04 05 09

**WAIVER OF TRANSFER OF RIGHTS OF RECOVERY
AGAINST OTHERS TO US**

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART
PRODUCTS/COMPLETED OPERATIONS LIABILITY COVERAGE PART

SCHEDULE

<p>Name Of Person Or Organization:</p> <p>Any person or organization as required by contract or agreement.</p>
<p>Information required to complete this Schedule, if not shown above, will be shown in the Declarations.</p>

The following is added to Paragraph 8.
**Transfer Of Rights Of Recovery Against
Others To Us of Section IV - Conditions:**

We waive any right of recovery we may have against the person or organization shown in the Schedule above because of payments we make for injury or damage arising out of your ongoing operations or "your work" done under a contract with that person or organization and included in the "products-completed operations hazard". This waiver applies only to the person or organization shown in the Schedule above.

PUBLIC VERSION

POLICY NUMBER: 72 UEL WQ0019

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

**ADDITIONAL INSURED AND
RIGHTS OF RECOVERY AGAINST OTHERS**

This endorsement modifies insurance provided under the following:

BUSINESS AUTO COVERAGE FORM

A. Any person or organization whom you are required by contract to name as additional insured is an "insured" for LIABILITY COVERAGE but only to the extent that person or organization qualifies as an "insured" under the WHO IS AN INSURED provision of Section II - LIABILITY COVERAGE.

B. For any person or organization for whom you are required by contract to provide a waiver of subrogation, the loss Condition - TRANSFER OF RIGHTS OF RECOVERY AGAINST OTHERS TO US is applicable.

Form HA 99 13 01 87 Printed in U.S.A.

WORKERS COMPENSATION AND EMPLOYERS LIABILITY INSURANCE POLICY

WC 04 03 06 (Ed. 4-84)

WAIVER OF OUR RIGHT TO RECOVER FROM OTHERS ENDORSEMENT - CALIFORNIA

This endorsement changes the policy to which it is attached effective on the inception date of the policy unless a different date is indicated below.
(The following "attaching clause" need be completed only when this endorsement is issued subsequent to preparation of the policy.)

Endorsement Effective 12/31/2017 at 12:01 A.M. standard time, forms a part of

Policy No. 72 WV WQ0018 Endorsement No.

Issued to Infrastruture and Energy Alternatives, LLC

Premium (if any) \$

We have the right to recover our payments from anyone liable for an injury covered by this policy. We will not enforce our right against the person or organization named in the Schedule. (This agreement applies only to the extent that you perform work under a written contract that requires you to obtain this agreement from us.)

You must maintain payroll records accurately segregating the remuneration of your employees while engaged in the work described in the Schedule.

The additional premium for this endorsement shall be % of the California workers' compensation premium otherwise due on such remuneration.

Schedule

Person or Organization

Job Description

ALL PERSONS AND/OR ORGANIZATIONS THAT ARE REQUIRED BY WRITTEN CONTRACT OR AGREEMENT WITH THE INSURED, EXECUTED PRIOR TO THE ACCIDENT OR LOSS, THAT WAIVER OF SUBROGATION BE PROVIDED UNDER THIS POLICY FOR WORK PERFORMED BY YOU FOR THAT PERSON AND/OR ORGANIZATION.

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

**WAIVER OF OUR RIGHT TO RECOVER
FROM OTHERS ENDORSEMENT**

Endorsement Number:

Policy Number: 72 WV WQ0018

Effective Date: 12/31/2017 Effective hour is the same as stated on the Information Page of the policy.

Named Insured and Address: Infrastructure and Energy Alternatives, LLC
2647 Waterfront Parkway East Drive
Indianapolis, IN 46214

We have the right to recover our payments from anyone liable for an injury covered by this policy. We will not enforce our right against the person or organization named in the Schedule.

This agreement shall not operate directly or indirectly to benefit anyone not named in the Schedule.

SCHEDULE

ANY PERSON OR ORGANIZATION FROM WHOM YOU ARE REQUIRED BY CONTRACT OR AGREEMENT TO OBTAIN THIS WAIVER FROM US.
ENDORSEMENT IS NOT APPLICABLE IN KY, NH, NJ OR ANY MO CONSTRUCTION RISK.

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

**TEXAS WAIVER OF OUR RIGHT TO
RECOVER FROM OTHERS ENDORSEMENT**

Endorsement Number:

Policy Number: 72 WV WQ0018

Effective Date: 12/31/2017 Effective hour is the same as stated on the Information Page of the policy.

Named Insured and Address: Infrastructure & Energy Alternatives, LLC
2647 Waterfront Parkway East Drive
Indianapolis, IN 46214

Schedule

This endorsement applies only to the insurance provided by the policy because Texas is shown in Item 3.A. of the Information Page.

of the operations described in the Schedule where you are required by a written contract to obtain this waiver from us.

We have the right to recover our payments from anyone liable for an injury covered by this policy. We will not enforce our right against the person or organization named in the Schedule, but this waiver applies only with respect to bodily injury arising out

This endorsement shall not operate directly or indirectly to benefit anyone not named in the Schedule.

The premium for this endorsement is shown in the Schedule.

1. Special Waiver
Name of person or organization

Blanket Waiver
Any person or organization for whom the Named Insured has agreed by written contract to furnish this waiver.

2. Operations: ALL TEXAS OPERATIONS

3. Premium:
The premium charge for this endorsement shall be 2.0 percent of the premium developed on payroll in connection with work performed for the above person(s) or organization(s) arising out of the operations described.

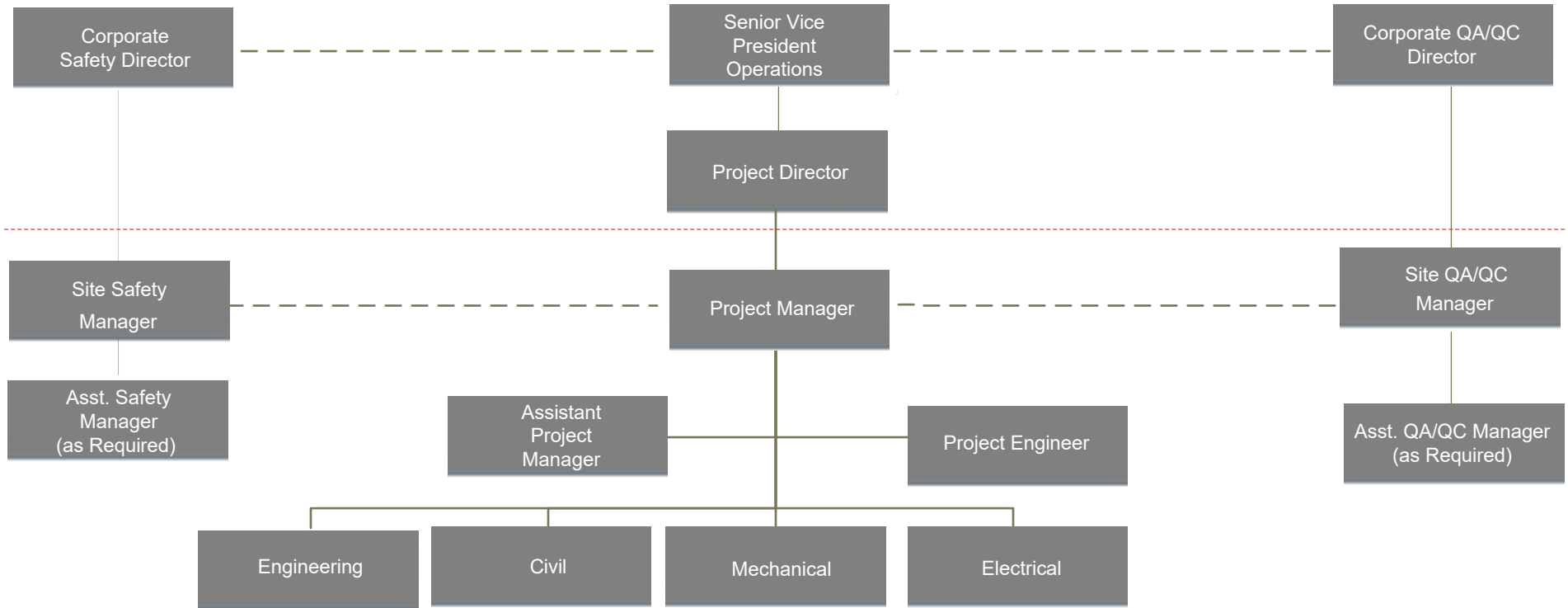
4. Advance Premium:



-
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Typical Solar Project Organizational Chart

PUBLIC VERSION



Note: Employees below red dashed line are considered full time field employees, with a minimum of 80% spent on site

PUBLIC VERSION



Sean Rooney Senior Vice President

As a business unit leader Sean brings over 28 years of professional experience leading teams and executing large scale projects in the energy, petrochemical, and pharmaceutical, industries located in North America, Puerto Rico, and Europe.

Sean has spent the last 10 years of his career within the renewable energy sector responsible for the bottom line P&L for over 600 MWac of utility scale projects located in North America and Hawaii.

EDUCATION

Texas A&M University
B.S. in Construction Science

TRAINING & CERTIFICATIONS

Six Sigma Green Belt

Lean Certification

YEARS OF EXPERIENCE

28 years in Construction
10 years - solar energy

RELEVANT PROJECT EXPERIENCE

- **LAMESA 1 SOLAR:** Lamesa, Texas
Customer: Southern Company; Completed: 2017; Size: 100 MWac; Full EPC project, including substation, single axis tracker and polycrystalline panels.
- **COMANCHE SOLAR:** Pueblo, Colorado
Customer: Xcel Energy; Completed: 2016; Size: 120 MWac; Full EPC project, single axis tracker and polycrystalline panels.
- **MAYWOOD SOLAR:** Indianapolis, Indiana
Customer: Vertellus; Completed: 2014; Size: 10 MWac; Former superfund site, fixed tilt polycrystalline panels.
- **CELINA SOLAR:** Celina, Ohio
Customer: Solar Vision LLC & New Energy Capital; Completed: 2013; Size: 5 MWac; Full EPC project, fixed tilt, polycrystalline panels.
- **KREP SOLAR:** Oahu, Hawaii
Customer: Hanwha Q Cells USA; Completed: 2013; Size: 6 MWac; Full EPC project on former Naval Base, ballasted rack and polycrystalline panels.
- **SKIC SOLAR:** Bakersfield, California
Customer: Algonquin; Completed: 2015; Size: 10 MWac; Full EPC project, single axis tracker and polycrystalline panels.
- **RAMORE SOLAR:** Ramore, Ontario
Customer: Fiera Axium; Completed: 2014; Size: 10 MWac; Full EPC project, fixed tilt, polycrystalline panels.
- **KAPUSKASING SOLAR:** Kapuskasing, Ontario
Customer: Fiera Axium; Completed: 2014; Size: 10 MWac; Full EPC project, fixed tilt, polycrystalline panels.
- **MATTAWISHKWIA SOLAR:** Mattawishkwia, Ontario
Customer: Fiera Axium; Completed: 2014; Size: 10 MWac; Full EPC project, fixed tilt, polycrystalline panels.

**More than 25 additional projects not listed including a variety of
fixed tilt and tracking systems from 2008-2017**

PUBLIC VERSION



Mick McDaniel

Vice President of Solar Business Development

As the Vice President of Solar Business Development for IEA Renewable Energy, Mick develops the market strategy to support IEA's solar and energy storage business. Prior to joining IEA, Mick worked for some of the renewable industry's high-profile solar technology and construction companies where he served in both vice president and managing director roles. Mick has a successful background in building technical organizations with a proven track record in renewable energy, power electronics, and critical back-up power.

EDUCATION

Indiana University
Bachelor of Arts

LICENSES

Certified PV Installer (Nevada)

NFPA 70E Electrical Safety

First Aid / CPR

YEARS OF EXPERIENCE

In the Industry: 12

RELEVANT PROJECT EXPERIENCE

- **WESTSIDE SOLAR:** Westside, Fresno County, California
Customer: Nextera Energy; Completed: 2016; Size: 20 MWac; Full EPC project with single axis tracker and polycrystalline PV panels.
- **WHITNEY POINT SOLAR:** Westside, Fresno County, California
Customer: Nextera Energy; Completed: 2016; Size: 20 MWac; Full EPC project with single axis tracker and polycrystalline PV panels.
- **BROWNS VALLEY ENERGY STORAGE:** Browns Valley, California
Customer: PG&E; Completed: 2016; Size: 500 kW / 4 MWhr battery system; Full EPC for utility energy storage project.
- **KINGBIRD SOLAR PHASE 2:** Rosamond, California
Customer: First Solar; Completed: 2015; Size: 40 MWac; Plans & specs for electrical and mechanical scopes with fixed tilt racking and thin film PV panels.
- **SILVER STATE SOUTH SOLAR PHASE 1:** Primm, Nevada
Customer: First Solar; Completed: 2015; Size: 127 MWac; Plans & specs for electrical scope with single axis tracker and thin film PV panels.
- **MOAPA SOLAR PHASE 2:** Moapa, Nevada
Customer: First Solar; Completed: 2015; Size: 50 MWac; Plans & specs for electrical scope with fixed tilt racking and thin film PV panels.
- **MOAPA SOLAR PHASE 1:** Moapa, Nevada
Customer: First Solar; Completed: 2014; Size: 72 MWac; Plans & specs for electrical scope with fixed tilt racking and thin film PV panels.
- **GOOGLE ENERGY STORAGE:** Mountain View, California;
Customer: Google; Completed: 2015; Size: 2 MWac; Full EPC (less owner furnished equipment) for multiple energy storage projects
- **FACEBOOK SOLAR EXPANSION:** Menlo Park, California
Customer: Facebook; Completed: 2015; Size: 1 MWac; Full EPC for rooftop solar on multiple campus office buildings.





Mick McDaniel

Vice President of Solar Business Development

RELEVANT PROJECT EXPERIENCE

- **MESQUITE SOLAR PHASE 1:** Arlington, Arizona
Customer: Sempra; Completed: 2012; Size: 150 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **SARNIA SOLAR:** Ontario, Canada
Customer: Enbridge; Completed: 2009; Size: 20 MWac; Full EPC for 2 x 10MW projects with fixed tilt racking and thin film PV panels.
- **BLYTHE SOLAR:** Sarnia, Ontario, Canada
Customer: NRG; Completed: 2009; Size: 21 MWac; Full EPC project with fixed tilt racking and thin film PV panels.
- **EL DORADO / COPPER MOUNTAIN 1 SOLAR:** Boulder City, Nevada
Customer: Sempra; Completed: 2008; Size: 10 MWac; Full EPC project with fixed tilt racking and thin film PV panels.

PUBLIC VERSION



Greg Duke

Director of Business Development

As a seasoned business executive with over 25 years in the North American power industry, Greg is responsible for managing key client relationships, identifying revenue-generating opportunities, as well as negotiating EPC contracts. He also works closely with Executive Management to actively secure the organization's long-term financial growth by setting and implementing market-based strategies.

EDUCATION

Durham College; Oshawa, ON
Business Management

TRAINING & CERTIFICATIONS

Power Systems Specialized
Health & Safety Core Certified

YEARS OF EXPERIENCE

In the Industry: 16

SOLAR PROJECT EXPERIENCE

- **COCHRANE - ALITIBI STATION SOLAR:** Ontario, Canada
Customer: Northland Power; Completed: 2016; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **T.A. ACACIA WEST ANTELOPE SOLAR:** Lancaster, California
Customer: Canadian Solar; Completed: 2015; Size: 20 MWac; Plans & specs project with single axis tracker and polycrystalline PV panels.
- **MARSH HILL SOLAR:** Ontario, Canada
Customer: SunEdison; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **ILLUMINATION SOLAR:** Ontario, Canada
Customer: Canadian Solar; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **BEAM LIGHT SOLAR:** Ontario, Canada
Customer: Canadian Solar; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **LUNAR LIGHT SOLAR:** Ontario, Canada
Customer: Canadian Solar; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **SOL LUCE SOLAR:** Ontario, Canada
Customer: CC&L; Completed: 2015; Size: 100 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **BRUINING SOLAR:** Ontario, Canada
Customer: SunEdison; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **FOTOLIGHT SOLAR:** Ontario, Canada
Customer: Canadian Solar; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **SOLAR SPIRIT:** Ontario, Canada
Customer: SunEdison; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.

PUBLIC VERSION



Greg Duke Director of Business Development

SOLAR PROJECT EXPERIENCE

- **LINDSAY SOLAR:** Ontario, Canada
Customer: SunEdison; Completed: 2015; Size: 20 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **COCHRANE - EMPIRE STATION SOLAR:** Ontario, Canada
Customer: Northland Power; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **COCHRANE - MARTIN MEADOWS STATION SOLAR:** Ontario, Canada
Customer: Northland Power; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **ORO SOLAR:** Ontario, Canada
Customer: Canadian Solar; Completed: 2014; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **DAVID BROWN SOLAR:** Ontario, Canada
Customer: Saturn Power; Completed: 2014; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **SPARKLE LIGHT SOLAR:** Ontario, Canada
Customer: Canadian Solar; Completed: 2014; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.

More than 16 additional projects not listed including a variety of carport, fixed tilt and tracking systems from 2010-2014.

WIND ENERGY PROJECT EXPERIENCE

- Enbridge Wind Farm: Ontario, Canada
Customer: Enbridge; Completed: 2008; Size: 181.5 MW; Balance of plant project with 115 Vestas V82 turbines.
- East Lake St. Clair Wind Farm: Ontario, Canada
Customer: International Power; Completed: 2013; Size: 99 MW; Full EPC project with 55 Vestas V90 turbines.

**More than 700 MW of additional wind energy projects not listed.
Additional wind project experience ranging from 50-100 MW with full EPC or BOP scope of work from 2004-2009**

PUBLIC VERSION



Meisa Kassis Solar Project Executive

As a project executive for IEA Renewable Energy, Meisa Kassis is responsible for all aspects of the large-scale projects she oversees. With a history of successful, complex Design/Build projects, Meisa's ability to manage the technical and budget-intensive aspects of large projects makes her a critical member of IEA's project management team. She has worked on several high-profile solar photovoltaic (PV) projects for utility customers and public organizations. Meisa has also managed one of the largest ground-mount solar plants in the United States and has completed numerous fast-track PV projects facing extreme weather conditions on time and without compromising safety.

EDUCATION

California Polytechnic State University, San Luis Obispo

B.S. in Electrical Engineering
Minor in Construction Management

TRAINING & CERTIFICATIONS

OSHA - 30 Certified

LEED® Accredited Professional

NFPA 70E Electrical Safety

First Aid / CPR

YEARS OF EXPERIENCE

In the Industry: 11

RELEVANT PROJECT EXPERIENCE

- **WESTSIDE SOLAR:** Westside, Fresno County, California
Customer: Nextera Energy; Completed: 2016; Size: 20 MWac; Full EPC project including substation, single axis tracker and polycrystalline PV panels.
- **WHITNEY POINT SOLAR:** Westside, Fresno County, California
Customer: Nextera Energy; Completed: 2016; Size: 20 MWac; Full EPC project including substation, single axis tracker and polycrystalline PV panels.
- **COPPER MOUNTAIN SOLAR PHASE 4:** Boulder City, California
Customer: Sempra; Completed: 2016; Size: 96 MWac; Plans & specs project with single axis tracker and polycrystalline PV panels.
- **BROWNS VALLEY ENERGY STORAGE:** Browns Valley, California
Customer: PG&E; Completed: 2016; Size: 500 kW / 4 MWhr battery system; Full EPC for utility energy storage project.
- **KINGBIRD SOLAR PHASE 2:** Rosamond, California
Customer: First Solar; Completed: 2015; Size: 40 MWac; Plans & specs for electrical and mechanical scopes with single axis tracker and thin film PV panels.
- **SILVER STATE SOUTH SOLAR PHASE 1:** Primm, Nevada
Customer: First Solar; Completed: 2015; Size: 127 MWac; Plans & specs for electrical scope, single axis tracker and thin film PV panels.
- **MOAPA SOLAR PHASE 2:** Moapa, Nevada
Customer: First Solar; Completed: 2015; Size: 50 MWac; Plans & specs for electrical scope with fixed tilt racking and thin film PV panels.
- **MOAPA SOLAR PHASE 1:** Moapa, Nevada
Customer: First Solar; Completed: 2015; Size: 72 MWac; Plans & specs for electrical scope with fixed tilt racking and thin film PV panels.
- **SOLAR STAR PHASE 2:** Rosamond, California
Customer: Sunpower; Completed: 2015; Size: 279 MWac; Plans & specs for electrical scope with single axis tracker and polycrystalline PV panels.



Meisa Kassis Solar Project Executive

SOLAR PROJECT EXPERIENCE

- **COPPER MOUNTAIN SOLAR PHASE 3:** Boulder City, California
Customer: Sempra & ConEd Development; Completed: 2015; Size: 250 MWac;
Plans & specs project with fixed tilt racking and polycrystalline PV panels.
- **GATES SOLAR: Huron:** Fresno County, California
Customer: PG&E; Completed: 2013; Size: 20 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **HURON SOLAR:** Fresno County, California
Customer: PG&E; Completed: 2012; Size: 20 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **STROUD SOLAR:** Helm, Fresno County, California
Customer: PG&E; Completed: 2011; Size: 20 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **WESTSIDE SOLAR:** Five Points, Fresno County, California
Customer: PG&E; Completed: 2011; Size: 15 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **FIVE POINTS SOLAR:** Five Points, Fresno County, California
Customer: PG&E; Completed: 2011; Size: 15 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **SCE PORTERVILLE SOLAR:** Porterville, Tulare County, California
Customer: SCE; Completed: 2011; Size: 6.7 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.

More than 15 additional projects not listed including a variety of rooftop, carport, fixed tilt and tracking systems from 2006-2012.

PUBLIC VERSION



Jeff Haines

Project Executive - Medium Voltage

As a Project Executive, Medium Voltage with IEA, Jeff Haines is responsible for all aspects of the Medium Voltage self perform underground utility works performed by IEA. Including the assurance that all works are performed to attain the highest levels of safety, quality, schedule and profitability for IEA and its customers.

Jeff's ability to manage people and the technical and budget-intensive aspects of large projects makes him a critical member of IEA's solar operations team.

EDUCATION

Western Michigan University

Bachelors in Construction
Management

Minor in Business Administration

TRAINING & CERTIFICATIONS

Alliant Energy - High Voltage
Training

PMA - Project Manager Training

AGC - Supervisory Training

AGC - Labor Contract Training

AGC - Labor Contract
Negotiation Training

YEARS OF EXPERIENCE

Heavy Civil - 16

Renewable Energy - 10

SOLAR PROJECT EXPERIENCE

- **IEA SOLAR:** Austin, Texas
Customer: Austin Municipal Power; Completed: 2013; Size: 35 MWac; Plans & specs project with single axis tracker and polycrystalline PV panels.
- **SAN ANTONIO SOLAR:** San Antonio, Texas
Customer: San Antonio Power; Completed: 2014; Size: 40 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **COMANCHE SOLAR:** Pueblo, Colorado
Customer: Xcel Energy; Completed: 2016; Size: 120 MWac; Plans & specs project with single axis tracker and polycrystalline PV panels.
- **LAMESA 1 SOLAR:** La Mesa, Texas
Completed: 2017; Size: 100 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.

WIND ENERGY PROJECT EXPERIENCE

- **CEDAR POINT WIND:** Lincoln, Elbert & Arapahoe Counties
Developed & built by: RES Americas; Completed: 2011; Size: 252 MW; Full EPC project with 139 Vestas V90 1.8 MW turbines.
- **BUFFALO DUNES WIND:** Garden City, Kansas
Customer: Enel Green Power; Completed: 2014; Size: 250 MW; Full EPC project with 135 GE 1.85 MW turbines.
- **MEHOOPANY WIND:** Scranton, Pennsylvania
Customer: BP Renewables; Completed: 2012; Size: 141 MW; Full EPC Project with 88 GE XLE 1.6 MW turbines.
- **TWIN RIDGES WIND:** Somerset County, Pennsylvania
Customer: EverPower; Completed: 2012; Size: 139.4 MW; Balance of plant contract with 68 REpower 2.05 MW turbines.
- **KEECHI WIND:** Jack County, Texas
Developed & built by: RES Americas; Completed: 2015; Size: 110 MW; Full EPC project with 55 Vestas V100 2.0 MW turbines

**More than 12 additional wind energy projects not listed.
Additional wind project experience ranging from 100-250 MW with full
EPC or BOP scope of work from 2007-2017.**



PUBLIC VERSION

Joe Alt Project Executive

As a Senior Project Executive, Joe has overseen field operations on many projects within the US and Canada with an emphasis on implementing best practices. He has been responsible for staffing, productivity, safety, and quality assurance. He has supervised large crews of sub-contract as well as company staff and craft employees. Joe has been involved in most of IEA's 500MW of solar and has also managed or worked on projects that have installed over 600 wind turbines to date.

EDUCATION

University of Maryland
Bachelors of Science;
Constructions Management

John Hopkins University
MBA

TRAINING & CERTIFICATIONS

NCCCO Rigging Certification

Fall Protection

PMP Certification

10 Hour & 30 Hour OSHA

First Aid / CPR

International Brotherhood of
Carpenters Apprentice

YEARS OF EXPERIENCE

27 years in Construction
20 years in Wind Energy
4 years in Solar Energy

SOLAR PROJECT EXPERIENCE

- **AURORA SOLAR:** Waconia, Minnesota
Customer: Enel Green Power NA; Completed: 2017; Size: 10 MWac; Plans & specs project with single axis tracker and polycrystalline PV panels.
- **COCHRANE - ABITIBI STATION SOLAR:** Ontario, Canada
Customer: Northland Power; Completed: 2016; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **T.A. ACACIA WET ANTELOPE SOLAR:** Lancaster, California
Customer: Canadian Solar; Completed: 2015; Size: 20 MWac; Plans & specs project with single axis tracker and polycrystalline PV panels.
- **MARSH HILL SOLAR:** Ontario, Canada
Customer: SunEdison; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **ILLUMINATION SOLAR:** Ontario, Canada
Customer: Canadian Solar; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **BEAM LIGHT SOLAR:** Ontario, Canada
Customer: Canadian Solar; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **LUNAR LIGHT SOLAR:** Ontario, Canada
Customer: Canadian Solar; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **SOL LUCE SOLAR:** Ontario, Canada
Customer: CC&L; Completed: 2015; Size: 100 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **BRUINING SOLAR:** Ontario, Canada
Customer: SunEdison; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **FOTOLIGHT SOLAR:** Ontario, Canada
Customer: Canadian Solar; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.

Joe Alt Project Executive

SOLAR PROJECT EXPERIENCE

- **SOLAR SPIRIT:** Ontario, Canada
Customer: SunEdison; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels
- **LINDSAY SOLAR:** Ontario, Canada
Customer: SunEdison; Completed: 2015; Size: 20 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **COCHRANE - EMPIRE STATION SOLAR:** Ontario, Canada
Customer: Northland Power; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **COCHRANE - MARTIN MEADOWS STATION SOLAR:** Ontario, Canada
Customer: Northland Power; Completed: 2015; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **ORO SOLAR:** Ontario, Canada
Customer: Canadian Solar; Completed: 2014; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.
- **DAVID BROWN SOLAR:** Ontario, Canada
Customer: Saturn Power; Completed: 2014; Size: 10 MWac; Full EPC project with fixed tilt racking and polycrystalline PV panels.

More than 25 additional projects not listed including a variety of carport, fixed tilt and tracking systems from 2008-2010

WIND ENERGY PROJECT EXPERIENCE

- **SHILOH III WIND FARM:** Solano County, California
Customer: EDF Renewable Energy; Completed: 2011; Size: 100 MW; Balance of plant project with 50 REpower 2.0 MW turbines.
- **CALIFORNIA RIDGE WIND FARM:** Vermillion & Champaign County, Illinois
Customer: Invenegy; Completed: 2012; Size: 200 MW; Full EPC project with 125 GE 1.6 SLE turbines.
- **MEADOW LAKE 3 & 4 WIND FARM:** White County, Indiana
Customer: EDP Renewables; Completed: 2010; Size: 202.5 MW; Full EPC project with 69 GE SLE turbines and 47 Suzlon S88 turbines.
- **TOP CROP WIND FARM:** LaSalle County, Illinois
Customer: EDP Renewables; Completed: 2009; Size: 102 MW; Full EPC project with 68 GE SLE turbines.

More than 1,000 MW of additional wind energy projects not listed. All projects were EPC or BOP scope of work from 1997-2017



MANPOWER LOADING CHART

6325 Digital Way, Suite 460
Indianapolis, IN 46278

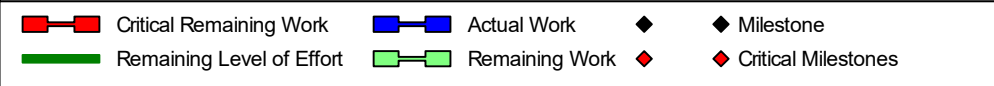
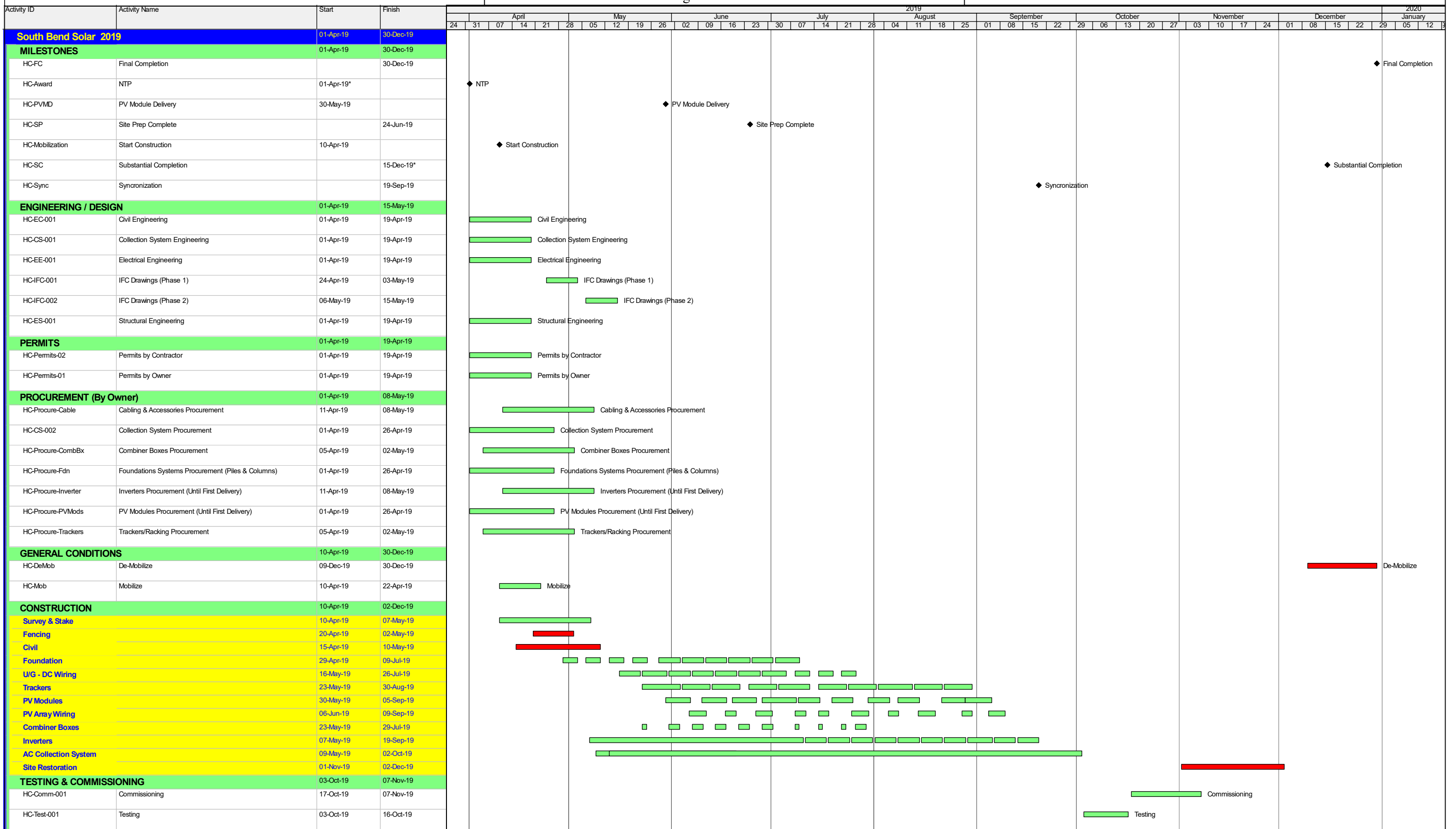
South Bend Solar

12/14/2018

Site Activity	April				May				June				July				Aug				Sept				Oct				Nov				Dec							
	WK1	WK2	WK3	WK4	WK1	WK2	WK3	WK4	WK1	WK2	WK3	WK4	WK1	WK2	WK3	WK4	WK1	WK2	WK3	WK4	WK1	WK2	WK3	WK4	WK1	WK2	WK3	WK4	WK1	WK2	WK3	WK4	WK1	WK2	WK3	WK4				
Survey/Stake		█	█	█																																				
Fencing					█	█	█	█																																
Civil			█	█	█	█	█	█																																
Foundation							█	█	█	█	█	█	█	█	█	█	█	█	█	█																				
Underground DC Wiring									█	█	█	█	█	█	█	█	█	█	█	█																				
Trackers													█	█	█	█	█	█	█	█	█	█	█	█																
PV Modules													█	█	█	█	█	█	█	█	█	█	█	█																
PV Array Wiring													█	█	█	█	█	█	█	█	█	█	█	█																
Combiner Boxes													█	█	█	█	█	█	█	█	█	█	█	█																
Inverters													█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█												
AC Collection									█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█												
Site Restoration																													█	█	█	█	█	█	█	█				
Testing/Commissioning																													█	█	█	█	█	█	█	█	█	█		
Manpower Crew Size	0	6	12	18	12	12	20	22	34	50	54	54	54	54	54	54	46	34	34	34	34	34	34	22	10	10	16	12	12	12	12	12	12	12	12	12	6	6	0	0

White Construction

South Bend Solar 2019
High Level Schedule



White Construction

**South Bend Solar 2020
High Level Schedule**

Activity ID	Activity Name	Start	Finish	2020												2021																															
				March				April				May				June				July			August			September			October			November			December			January									
				01	08	15	22	29	05	12	19	26	03	10	17	24	31	07	14	21	28	05	12	19	26	02	09	16	23	30	06	13	20	27	04	11	18	25	01	08	15	22	29	06	13	20	27
South Bend Solar 2020																																															
MILESTONES																																															
HC-FC	Final Completion		29-Dec-20																					◆	Final Completion																						
HC-Award	NTP	01-Apr-20*																						◆	NTP																						
HC-PVMD	PV Module Delivery	29-May-20																						◆	PV Module Delivery																						
HC-SP	Site Prep Complete		23-Jun-20																					◆	Site Prep Complete																						
HC-Mobilization	Start Construction	10-Apr-20																						◆	Start Construction																						
HC-SC	Substantial Completion		15-Dec-20*																					◆	Substantial Completion																						
HC-Sync	Synchronization		16-Sep-20																					◆	Synchronization																						
ENGINEERING / DESIGN																																															
HC-EC-001	Civil Engineering	01-Apr-20	21-Apr-20																					█	Civil Engineering																						
HC-CS-001	Collection System Engineering	01-Apr-20	21-Apr-20																					█	Collection System Engineering																						
HC-EE-001	Electrical Engineering	01-Apr-20	21-Apr-20																					█	Electrical Engineering																						
HC-IFC-001	IFC Drawings (Phase 1)	24-Apr-20	05-May-20																					█	IFC Drawings (Phase 1)																						
HC-IFC-002	IFC Drawings (Phase 2)	06-May-20	15-May-20																					█	IFC Drawings (Phase 2)																						
HC-ES-001	Structural Engineering	01-Apr-20	21-Apr-20																					█	Structural Engineering																						
PERMITS																																															
HC-Permits-02	Permits by Contractor	01-Apr-20	21-Apr-20																					█	Permits by Contractor																						
HC-Permits-01	Permits by Owner	01-Apr-20	21-Apr-20																					█	Permits by Owner																						
PROCUREMENT (By Owner)																																															
HC-Procure-Cable	Cabling & Accessories Procurement	13-Apr-20	08-May-20																					█	Cabling & Accessories Procurement																						
HC-CS-002	Collection System Procurement	01-Apr-20	28-Apr-20																					█	Collection System Procurement																						
HC-Procure-CombBx	Combiner Boxes Procurement	07-Apr-20	04-May-20																					█	Combiner Boxes Procurement																						
HC-Procure-Fdn	Foundations Systems Procurement (Piles & Columns)	01-Apr-20	28-Apr-20																					█	Foundations Systems Procurement (Piles & Columns)																						
HC-Procure-Inverter	Inverters Procurement (Until First Delivery)	13-Apr-20	08-May-20																					█	Inverters Procurement (Until First Delivery)																						
HC-Procure-PVMods	PV Modules Procurement (Until First Delivery)	01-Apr-20	28-Apr-20																					█	PV Modules Procurement (Until First Delivery)																						
HC-Procure-Trackers	Trackers/Racking Procurement	07-Apr-20	04-May-20																					█	Trackers/Racking Procurement																						
GENERAL CONDITIONS																																															
HC-DeMob	De-Mobilize	09-Dec-20	29-Dec-20																					█	De-Mobilize																						
HC-Mob	Mobilize	10-Apr-20	22-Apr-20																					█	Mobilize																						
CONSTRUCTION																																															
Survey & Stake																																															
Fencing																																															
Civil																																															
Foundation																																															
U/G - DC Wiring																																															
Trackers																																															
PV Modules																																															
PV Array Wiring																																															
Combiner Boxes																																															
Inverters																																															
AC Collection System																																															
Site Restoration																																															
TESTING & COMMISSIONING																																															
HC-Comm-001	Commissioning	11-Nov-20	25-Nov-20																					█	Commissioning																						
HC-Test-001	Testing	28-Oct-20	10-Nov-20																					█	Testing																						

█ Critical Remaining Work
 █ Actual Work
 ◆ Milestone
 ◆ Critical Milestones
█ Remaining Level of Effort
 Remaining Work
◆ Critical Milestones

PUBLIC VERSION

American Electric Power - References Template

Referring company: IEA Constructors, Inc

Company Name	Contact Name	E-mail address	Phone Number	Comments
Canadian Solar	Dylan Marx	Dylan.Marx@canadiansolar.com	519-837-7881 Ext 2334	
Algonquin Power & Utilities Corp	Rupert Crighton	Rupert.Crighton@algonquinpower.com	800-937-5449	
Invenery, LLC	Art Fletcher	AFletcher@inveneryllc.com	312-582-1502	

Example:				
American Electric Power	John E Doe	john.e.doe@aep.com	(614) 999-9999	



1 M

SAMPLE

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For The Installation of Solar Photovoltaic (PV) Modules Revision 0

THIS DOCUMENT WHETHER CONTAINING PATENTABLE OR NON-PATENTABLE SUBJECT MATTER, EMBODIES THE PROPRIETARY AND CONFIDENTIAL INFORMATION OF WCI THIS INFORMATION IS LOANED IN CONFIDENCE WITH THE UNDERSTANDING THAT IT WILL NOT BE REPRODUCED, USED OR DISCLOSED FOR ANY PURPOSE EXCEPT THE LIMITED PURPOSE FOR WHICH IT WAS LOANED. THIS DOCUMENT SHALL BE RETURNED TO WCI UPON DEMAND.

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2.0 Introduction and Statement of Authority and Responsibility

This Site Quality Manual demonstrates and documents Infrastructure & Energy Alternatives (IEA) commitment to maintaining a high-level of quality and strong customer service within an environment that has safety as a first priority, and is devoted to delivering services and projects that constantly meet or exceed the customer requirements and fosters continual improvement.

The Company endorses the concept that total quality services and products are based on principles where quality is a functional responsibility of each individual and segment of the IEA organization. Managers and key personnel at all levels are responsible for giving full attention to quality in managing and performing their respective activities. All employees have the ability to stop work, the responsibility and authority to identify quality problems, to initiate and provide solutions to quality problems, to verify implementation, and to resolve deficiencies that affect quality.

Each Project Manager, Construction Manager, Project Engineer / Superintendent, Site Quality Control Manager, Craft Foreman, as well as all other company employees as assigned, will be responsible for implementing the requirements of this plan in their area of assigned responsibility.

Any issues, differences or nonconformance that cannot be resolved in accordance with this plan shall be brought to the attention of the Senior Quality Control Manager for resolution and/or the Corporate Quality Control Director for resolution.

2.1 Conformance and Compliance Standards

This Site Quality Manual is intended to demonstrate conformance to the ISO 9001:2008 international standard. The Site Quality Manual is a reference guide (G-4220-02) and supplements IEA's ISO 9001:2008 Compliant Lean QMS Map® (Manual—QM-4220). The Site Quality Manual is limited to its intended application and design scope and does not control the ISO 9001:2008 quality requirements of WCI nor IEA.

This plan does not control the installation, alignment, and performance of Solar Equipment and software. This specific information is contained within vendor manuals, documents and programs. Commissioning is outside the scope of this manual and is under the direction of Others.

2.2 Other Relevant Standards

In addition to the conformance and compliance standards, IEA may from time to time use other standards documents as guidance in its operations and Quality Management System. These may include but are not limited to current editions of the following:

American Concrete Institute (ACI): the leading authority and resource worldwide for the development and distribution of consensus-based standards, technical resources, educational and training programs, certification programs and proven expertise for individuals and organizations involved in concrete design, construction and materials.

American Society of the International Association for Testing and Materials (ASTM): is an international standards organization that develops and publishes voluntary consensus technical

standards for a wide range of materials, products, systems, and services.

With the exception of ISO 9001:2008 these are not auditable standards and are used solely for guidance.

2.3 Services Offered

Infrastructure & Energy Alternatives, LLC (IEA) was formed back in 2011 and chartered with building an integrated portfolio of energy and water infrastructure service companies. The product of IEA is the service of providing contracting, engineering, installation, and plant maintenance for various construction projects ranging from heavy highway, biomass, solar, along with other projects in the renewable energy marketplace.

2.4 Subcontracted Supplied Services and Materials

2.4.1 This section is not applicable.

2.4.2 Before being considered for an invitation to bid, critical subcontractors and suppliers go through a prequalification process to review availability, Quality Control, Safety, Financial Capacity Eligibility, and previous work history.

2.4.3 Subcontractors and Suppliers are required to implement their own respective Quality Plan commensurate to this plan with the work to be performed and the materials provided. Each subcontractor is responsible for the distribution and control of their respective plan and program manual as stated in their controlling document.

2.4.4 Critical Suppliers and Subcontractors are monitored for performance during construction activities through the use of Surveillance Reports and/or field audits to help assure compliance to contract, drawings, and specifications/code.

2.4.5 The Project Manager has the responsibility for the controlled distribution of project documents to the subcontractor(s)/supplier(s) and the Subcontractor's/Supplier's Site Manager is responsible for issuance within the Subcontractor's/Supplier's Company.

2.4.6 Testing agencies will submit appropriate certifications and credentials to the Site Quality Manager for review and filing prior to performing any testing on site.

2.4.7 All subcontractors and suppliers are required to provide records of calibration for their equipment (if applicable). The Site Quality Manger shall review these records and ensure compliance with project requirements.

2.5 Purpose of This Manual

IEA's overall commitment to quality in work practice and customer service is defined through its Core and Support Business Processes. Through each of these business processes, the Quality Management System is aligned with the goals and strategic direction of the organization. The Quality Management System as described in the Quality Manual defines IEA's commitment:

- a. by demonstrating its ability to consistently provide quality service that meets customer and applicable regulatory requirements,
- b. by addressing customer satisfaction through the effective application of the system, including processes for continual improvement and the prevention of nonconformity,
- c. through employee empowerment, especially for innovative action to improve the company's performance, and
- d. through orderly change management that will maintain a high level of service in schedule-driven complex and fast-paced projects.

The Lean Quality Management System Map® (QM-4220) provides an overview of the quality policies and key requirements for the organization. The Lean QMS Map® is the source of reference for all matters dealing with quality. It is available for inspection by our customers, potential customers, and third party quality auditors.

2.6□ QMS Scope and Exclusions

Scope: Civil and commercial construction, project management and construction project design.

Exclusions: ISO 9001 clause 7.5.2 Validation of processes for production and service provision.

Outsourced Process: ISO 9001 clause 7.3 Design and Development.

2.7□ Distribution and Review

2.7.1□ Circulation List

The Quality Manual System is maintained on the IEA SharePoint network as a read-only document that is available to all employees and to other interested and authorized parties. All copies printed from the network are uncontrolled reference copies need not be labeled as such.

2.7.2□ Procedures for Updating the Quality Management System

The Quality Management System will be reviewed by IEA Management and revised as required. After management review, the Quality Management System is updated (if needed) by incorporating all approved changes. The Management Representative may approve minor changes and updates to the Quality Management System. The revision date is updated, and the document is re-approved and released as a new issue in its entirety. The revision date on the cover refers to the entire document.

2.7.3□ Procedures for Updating the Site Quality Manual (G-4220-02)

- 2.7.3.1□ This site quality manual serves as an informative guide to explain the Lean QMS Map® (Manual). It is the responsibility of WCI to provide and maintain an effective Quality Plan throughout the duration of the contract. To accomplish our overall goal of completing the timely construction of these facilities in compliance with the contract documents while providing a safe work environment for our employees and subcontractors. WCI shall provide and ensure the performance of sufficient inspection and testing of all work performed incident to this construction effort. These tests and inspections include subcontracted as well as self-performed work. All tests and inspections will be performed to provide the quality of

Site Quality Control Plan

materials, workmanship, and functional performance requirements mandated by the contract documents.

2.7.3.2□ The Site Quality Manual describes the program used by IEA to control the quality of field activities performed in the installation of solar modules.

2.7.3.3□ The Site Quality Manual does not control the installation, alignment, and performance of Equipment and software that is controlled by other vendor manuals, documents and programs.

2.7.3.4□ The Corporate Quality Control Director is responsible for the contents of the site quality control manual and revisions there in. The Corporate Quality Control Director will review the site manual as required to assure compliance with QMS requirements.

2.7.3.5□ At the request of the customer, site plan adjustments that are unique to a project may be made in the site quality manual as required by contract, specifications, and applicable code. These changes will be considered plan addenda. When such changes are made, they will be added to this plan as addenda and not revisions. *Any field changes are prohibited.*

2.7.3.6□ Changes in titles, document forms and material that do not change the intent of the site quality plan are not considered to be a revision. In addition, special addenda can be issued to address governmental, site and/or customer/contract specific requirements.

2.7.3.7□ The forms referenced in this plan are controlled inspection records and cannot be substituted.

3.0□ Terms and Definitions

For the purpose of this document, the terms and definitions given in ISO 9001 apply. Throughout this document, whenever the term “product” occurs, it can also mean “service”. The following have been defined as:

Quality: is defined as a product’s compliance with its design specifications. These specifications include the customer’s requirements and local statutory and regulatory legislation (ISO 9001:2005).

Quality Management System (QMS): is defined as a system established to ensure achievement of the quality objectives by the quality policy adopted by top management in accordance to the requirements of the standard (ISO 9001:2008).

4.0□ Quality Management System

4.1□ General Requirements

IEA has established, documented and implements and effective QMS as a means of ensuring that the services provided conform to specified requirements, to foster an environment of continual improvement, and to identify its position as a leading EPC contractor in the renewable energy marketplace. The Site Quality Manual is intended to be a reference guide (G-4220-02) and supplements IEA’s ISO 9001:2008 Compliant Lean QMS Map® (Manual—QM-4220).

This site Quality Manual is limited to its intended application and design scope and does not control the ISO 9001:2008 quality requirements of IEA.

- 4.1.1 The Core Processes describe all the processes that are necessary for the organization to realize and deliver the desired service to its Customers. QM-4220 is an overview of the processes and their interactions within the system.
- 4.1.2 The support processes describe all other business requirements that are necessary to manage and control resources and to conduct business in an orderly manner. The support processes are implemented and managed in accordance with the applicable requirements of the International Standard.
- 4.1.3 The sequence and interaction of the Core and Support Business Processes are described in Section 5.4.2 QMS Planning of QM-4220 where the criteria and methods required to ensure the effective operation and control of these processes are defined and documented.
- 4.1.4 The entire QMS documentation and other key information necessary to support the operation and monitoring of the organization's business processes are available to all employees and other parties requiring access on the SharePoint network.
- 4.1.5 Appropriate levels and types of monitoring and measurement of core and support processes have been determined and are documented in relevant policies and procedures.
- 4.1.6 The Lean QMS Map® (Manual) includes policies and procedures for implementation of actions required to achieve planned results and for continual improvement of the business processes.
- 4.2 Documentation Requirements
 - 4.2.1 General
 - 4.2.1.1 IEA has defined and documented quality procedures consistent with the requirements of the standard. The quality procedures further describe criteria, methods, detail activities, responsibilities, and the quality assurance measures that are required to ensure the effective operation and control of the business processes. The QMS also includes other documents and records required by the organization to ensure the effective operation and control of the business process. The degree of documentation is consistent with: the methods used, the complexity and interaction of the business processes, and the skills needed and training required by the personnel involved in carrying out these activities.
 - 4.2.1.2 The Documentation Hierarchy consists of three levels. Level 1: Lean QMS Map® (Manual). Level 2: Policies and Procedures including this Site Quality Manual (guide). Level 3: Work Instructions.
 - 4.2.1.3 The QMS is maintained, updated and continually improved as the organization seeks better business practices.
 - 4.2.2 Quality Manual

4.2.2.1□ A Lean QMS Map® (Manual) has been established and maintained. This includes the scope of the QMS, including details of and justification for any exclusions; documented procedures or reference to them; a description of the sequence and interaction of the processes included in the QMS.

4.2.2.2□ The QMS Map® (Manual) is a controlled document subject to the requirements of section 4.2.3 Control of Documents.

4.2.3□ Control of Documents

IEA ensures that pertinent issues of documents and data that relate to the requirements of the QMS are controlled. This control also extends to documents of external origin that are maintained solely by WCI, such as customer drawings or requirements, performance standards, and other industry specifications. This policy is implemented by SP-4230.

Any document that is kept controlled in an electronic folder is designated uncontrolled when downloaded from the folder of origin.

4.2.3.1□ Document Approval and Issue:

All documents and data that relate to the requirements of the QMS and the Standard are reviewed and approved for suitability by authorized personnel prior to use or release. Where use is made of computer-based files, special attention is paid to appropriate approval, access, distribution, and archiving procedures.

All electronic QMS documents are stored in protected folders. Update access privileges to these folders are limited to the designated document control administrator.

A list of documents, identifying the current revision status of each, is established and is readily available. Appropriate documents are available at all locations where operations essential to the effective functioning of the Lean QMS Map® (Manual) are performed, or they may be readily obtained.

4.2.3.2□ Document and Data Changes:

Personnel are required to identify required changes in documents and are encouraged to suggest improvements. Changes to documents are reviewed and approved by the same function/organization that performed the original review and approval, unless specifically designated otherwise. Access to appropriate background is provided. The nature of the changes are recorded.

4.2.3.3□ Obsolete Documents:

Electronically maintained documents are promptly removed from active files when they become obsolete. They may be maintained for the document retention period in file areas not accessible to general users.

After a revision issue, obsolete documents are promptly removed from points of issue and use. The obsolete master document is archived and may be retained for legal and/or knowledge preservation purposes.

4.2.3.4 □ Documents of External Origin:

IEA is subject to various government regulations. When there is a need to refer to any of these regulations, access is gained through the regulatory agency system. Our presumption is that the link on that site goes to the most current edition of the regulation. Any other copies of these regulations are not authorized for use. These and other situations are further documented in SP-4230.

Customer Documents: The Customer will furnish applicable documents as defined in the contract. The Project Manager is responsible for conducting a review of all Customer provided documents. All Customer documents will be maintained and controlled the same as IEA documents unless otherwise stated in the contract.

4.2.4 □ Control of Quality Records

Quality Records are a special case of quality documents. For example, a blank form is a document. A completed form is a record.

IEA maintains quality records to demonstrate conformance to specified requirements and the effective operation of the Lean QMS Map® (Manual). Record control provides for the identification, collection, indexing, filing, access, storage, maintenance, and disposition of quality records. Pertinent customer and supplier records are an element of this data.

Quality records are legible and are stored and retained in such a manner that they are readily retrievable. Storage facilities provide an environment that minimized damage, deterioration and prevents loss. Retention times of quality records are established and recorded. A records control matrix is documented to aid control. SP-4240 has been established to implement the above policies and to control Lean QMS Map® records.

5.0 □ Management Responsibility

5.1 □ Management Commitment

The top management of IEA is committed to the development and improvement of an effective Quality Management System. This commitment is demonstrated by communicating to the organization the importance of meeting all customer, regulatory, and legal requirements; establishing an IEA quality policy for total commitment to excellence and the associated quality objectives; conducting management reviews; identifying and acquisition of controls, processes, equipment, fixtures, resources, and skills needed to achieve the required quality. The associated quality management activities are described in Section 6—Resource Management.

5.2 □ Customer Focus

Top management of IEA ensures that customer needs and expectations are determined, converted into requirements, and fulfilled with the aim of meeting or exceeding those

expectations. The specific needs of our customers are determined through continual verbal and written communication as well as periodic visits to their facilities to better understand their individual needs and/or expectations. It is the responsibility of all personnel that interface with customers to access stated or implied needs and bring them to the attention of top management so that they may be addressed. To continually improve, the organization also monitors, measures, and analyzes customer satisfaction throughout the business cycle.

5.3 Quality Policy

The top management of IEA has defined and documented the Quality Policy. This policy includes the organization's commitment for meeting customer requirements and continual improvement.

The top management of IEA ensures that the Quality Policy is understood. This is accomplished through training, communication, and displays. The Policy is implemented by means of documentation and training about the Quality Management System to meet the requirements of the Standard. The Policy is maintained through QMS audits and corrective and preventative action and reviewed for continuing suitability through Management Reviews. Further, this Quality Policy is supported by the quality objectives listed in the Lean QMS Map® (Section 5.4.1 Quality Objectives).

Quality Policy Statement: IEA is committed to operate every aspect of the business to those standards that offer the highest possible quality of service to all customers. This is supported by a progressive management style that encourages the Quality culture throughout the Company.

The Quality Policy is communicated and implemented throughout all operations of IEA and embodies Management's mandate to achieve:

- To consistently meet our customers ever changing expectations by understanding their needs, requirements and delivering projects that they and us can be proud of.
- By nurturing the experience and skills of our people to ensure the highest standards of workmanship and professionalism in everything we do.
- Compliance to respective standards and guidelines (ISO 9001:2008), regulatory and statutory legislation, and IEA's corporate defined requirements.
- Customer satisfaction by compliance & fulfillment of customer requirements.
- Employee empowerment, through the education and training of employees.
- Continual improvement of processes and systems.
- A safe and healthful work environment, with minimized risk to employees.
- Satisfactory response to the needs of interested parties.

5.4 Planning

5.4.1 Quality Objectives

Top management of IEA establishes quality objectives at all relevant functions and levels within the organization. The objectives are derived from IEA's Quality Policy and corporate policies. The quality objectives are documented (Annual Quality Objectives) and are reviewed by top management.

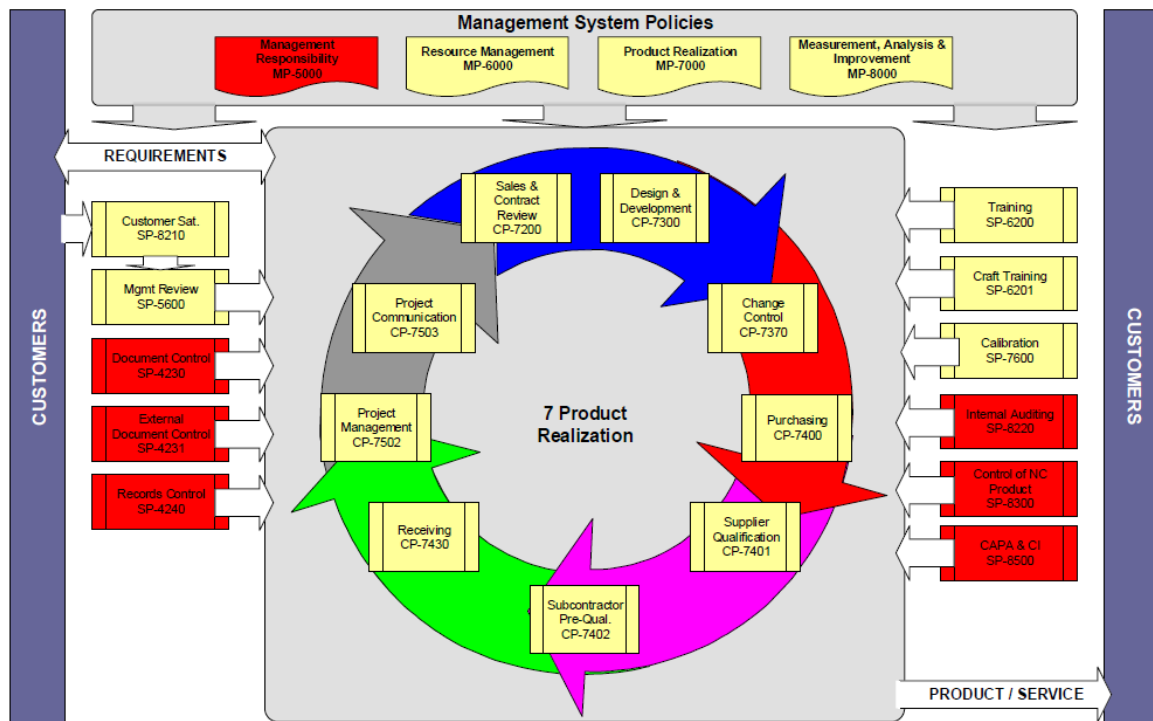
Site Quality Control Plan

The quality objectives are measurable and consistent with the quality policy, including commitment to continual improvement. Quality objectives include those needed to meet all contracted requirements.

5.4.2 Quality Management System Planning

Top management of IEA has identified and planned the resources needed to achieve its quality objectives. The results are documented in management reviews. Quality planning addresses continual improvement of the QMS and assures that change is conducted in a controlled manner so that the integrity of the QMS is maintained during this change.

The Quality Plan identifies the core and support processes of the QMS, and is documented in the form of references to associated Quality Procedures. The Core Processes (CP-) represent how opportunity is turned into profitable outcomes. Its effectiveness is maintained and enhanced by Support Processes (SP-). The identified Core and Support Processes are indicated in Figure 1.



Lean QMS MAP® Figure 1

Each Core and Support Process has a process owner who has the prime responsibility for ensuring that the process achieves its objectives and is under continual review for improvement.

The Quality Plan describes the overall plan for quality assurance. The quality plan consists of: the core business processes and their interactions, the support processes and their interactions, the Project Management Process and Responsibility matrix, and appropriate outputs of management review, such as supporting resources.

The Quality Plan is assessed for on-going suitability and effectiveness during management review meetings.

5.5 Responsibility, Authority and Communication

5.5.1 Responsibility and Authority

5.5.1.1 Top management of IEA has defined business functions and their interrelations with the organization, including responsibilities and authorities; and those are communicated in order to facilitate effective quality management.

5.5.1.2 IEA ensures the responsibility, authority and interrelationship of personnel who manage, perform, and verify work affecting quality have the organizational freedom and authority to: initiate action to prevent the occurrence of any nonconformance relating to service, process, and Quality Management System; Identify and record any problems relating to the service, process and QMS; Initiate, recommend, or provide solutions through designated channels; Verify the implementation of solutions; Control further processing, delivery or installation on nonconforming product until the deficiency or unsatisfactory condition has been corrected.

5.5.1.3 The IEA organizational chart (Figure 2) for solar projects shows the organization of the company and the relationships to IEA corporate management. Relationships to other parts of IEA corporate structure are documented by IEA and are available on the SharePoint network.

5.5.1.4 The Project Manager is responsible for overseeing the construction of the project, as well as all other related contract work. The Project Manager reports to the designated Project Director.

5.5.1.5 The Construction Manager is responsible for directing all construction activities, which includes: supervision of all Project Superintendents, as well as the administration of the Equipment/Logistics Manager(s), and Site Administrative Assistant. The Construction Manager is responsible, along with the Site Quality Control Manager, to implement the Quality Program and Plan, and interfaces with the Project Superintendents to implement all work activities of the Craft Labor.

5.5.1.6 The Site Quality Control Manager reports to the Senior QA/QC Manager. The Corporate Quality Control Director is responsible for supervision of IEA Site Quality Assurance/Control, implementation of this or any subcontractor's plan, technical direction in Quality Control to IEA personnel, controlling contents, revisions, and reviewing quality plans.

5.5.1.7 Other than Discipline Engineers, The Site Quality Control Manager may appoint a Site Quality Specialist, NDE Technician, Civil Specialist, Mechanical Specialist, or other technically specialized personnel to the project commensurate with the scope of work to be performed. These technical specialists report functionally to the Site Quality Control Manager and administratively to the Project Manager and are responsible for providing direction in their specific area of authority for the project. The Site Quality Control Manager can assign field technical responsibility to a Site Quality Specialist.

5.5.2 Management Representative

The top management of IEA has appointed the Corporate Quality Director as its Management Representative. This individual, irrespective of other responsibilities, has the defined authority to: Ensure that the processes of the QMS are defined; Ensure that the Quality Management System requirements are established, implemented and maintained in accordance to the Standard; Report to top management of the performance of the QMS, including needs for improvement; Promote awareness of customer requirements throughout the organization.

The Management Representative also acts as the liaison between the company and other third parties on matters concerning the Quality Management System.

5.5.3 Internal Communications

Top management of IEA ensures that communication is maintained between its various levels and functions regarding the processes of the QMS and their effectiveness. This is accomplished via various quality meetings, lessons learned opportunities, and internal publications.

5.6 Management Review

5.6.1 General

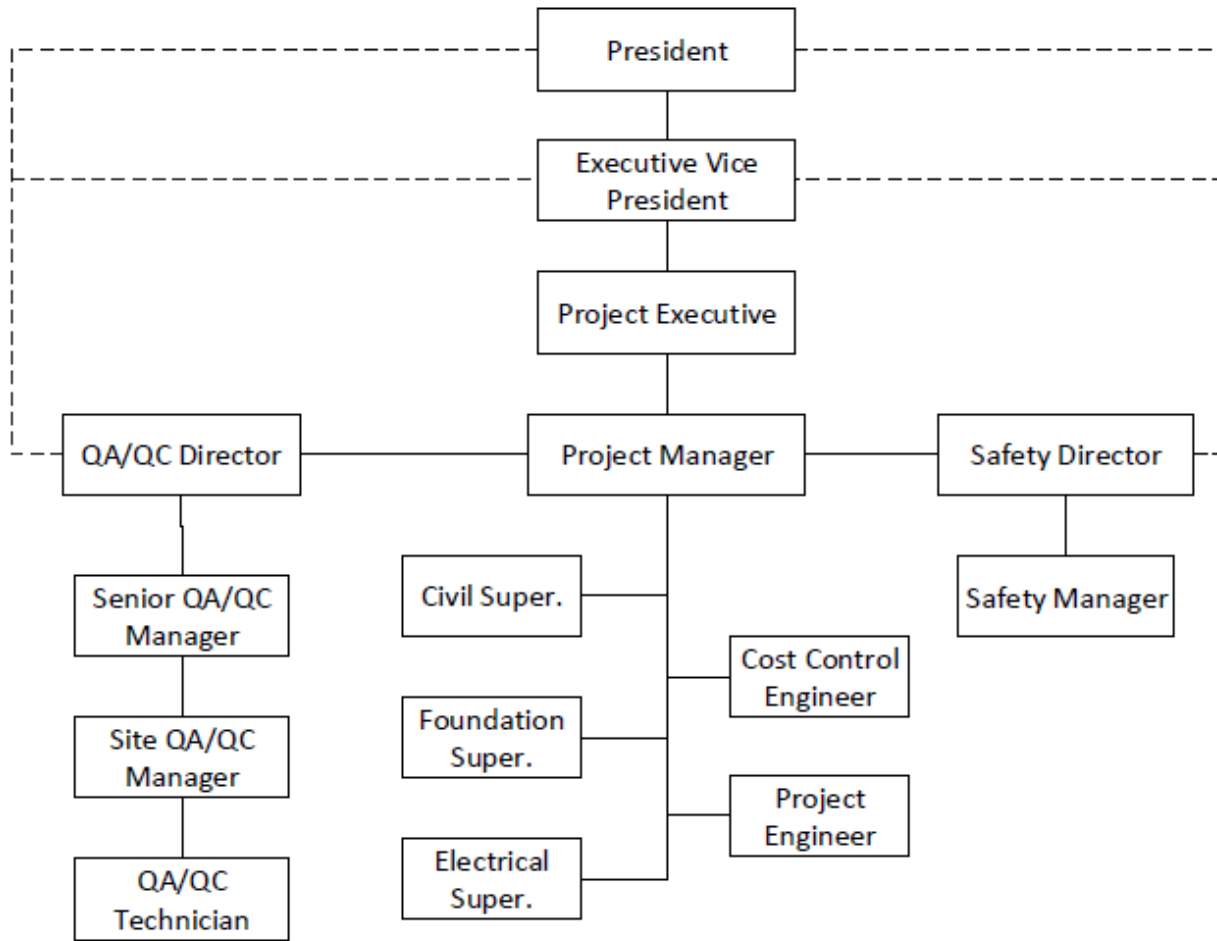
Top management of WCI reviews the QMS at planned intervals to ensure its continuing suitability, adequacy and effectiveness. The review evaluates the need for changes to the organization's QMS, including its quality policy and quality objectives. Results of management reviews are documented.

5.6.2 Review Input

Inputs to management review include but are not limited to current performance and improvement opportunities related to: results of audits, customer feedback, process performance and product performance, status of preventative and corrective actions, follow-up actions from earlier management reviews, changes that could affect the QMS, and recommendations for improvement of the system.

5.6.3 Review Output

The outputs from the management review include but are not limited to decisions and actions related to: improvement of effectiveness of the QMS and its processes; improvement of product related to customer requirements; and resource needs.



Organization Figure 2

6.0 Resource Management

6.1 Provision of Resources

Top management of IEA determines and provides, in a timely manner, the resources needed: to implement, maintain and improve the effective operations of the QMS processes, and to enhance customer satisfaction by meeting requirements. These resources are assessed and reviewed on a periodic basis consistent with annual and strategic business planning activities.

6.2 Human Resources

6.2.1 Assignment of Personnel

Personnel who are assigned responsibilities directly or indirectly affecting conformity to service (product) requirements are determined to be qualified and competent based on education, training, skills, and experience.

6.2.2 Competence, Awareness and Training

IEA identifies training needs and provides for the training of all personnel performing activities affecting quality. Personnel performing specific assigned tasks are qualified on the basis of appropriate education, training, observed skills, and experience as required. A training plan is prepared by department with periodic updates.

Training is provided either on or off the job, internally or externally as appropriate. The ongoing effectiveness of training is periodically assessed by observation, proficiency testing or other appropriate means. IEA ensures that personnel are aware of the relevance and importance of their jobs and how they contribute to the achievement of the quality objectives.

SP-6220 in the Lean QMS Map® (Manual) implement the above policies.

6.3 Infrastructure

Top management of IEA identifies, provides and maintains the facilities and infrastructure it needs to achieve quality including: workspace and associated facilities, including utilities, process equipment, hardware and software; supporting services such as telephone, computer networks, etc. MP-6000 on the Lean QMS Map® has been established to further describe and implement this policy.

6.4 Work Environment

Top management of IEA identifies and manages the human and physical factors of the work environment needed to achieve conformity of service of quality. MP-6000 on the Lean QMS® Map has been established to further describe and manage this policy as well as to define the physical environmental requirements.

7.0 Service Realization

7.1 Planning of Service Realization

7.1.1 This section describes the document control process (SP-4230) for review and distribution of management policies, process forms, specifications, drawings, procedures, instructions and other documents.

7.1.2 The purpose, scope and responsibility for controlling each type of document is defined on the document record master list (F-4220-01).

7.2 Customer-Related Processes

7.2.1 Determining of Requirements to the Product

IEA determines customer requirements including service and/or product requirements specified by the customer. These customer requirements include, but are not limited to: specific project requirements and specifications, the requirements for availability and delivery with associated costs, contract requirements not specified by the customer but necessary for project construction, and obligations related to the contract, including regulatory and legal

requirements. CP-7200 on the Lean QMS Map® is established to implement and provide further guidance regarding customer-related processes.

7.2.2 □ Review of the Requirements Related to the Product

IEA ensures that the customer requirements are fully understood and the company has the capability to meet them. Before acceptance of a project, a thorough review is conducted to ensure that the requirements are adequately defined and documented, contract requirements differing from those previously expressed are resolved, and the organization has the ability to meet the defined requirements.

Where the customer provides no documented statement of the expected requirements, the customer requirement is confirmed by the organization before acceptance. Where the customer requirements have changed, the organization ensures that relevant documents are amended and the relevant personnel are made aware of the changed requirements.

7.3 □ Design and Development

IEA is not a design firm and currently outsources the design and development of a project to qualified outside parties. Where applicable, drawings, specifications, etc. will be uploaded, stored and issued to the subcontractors through email or via paper copy.

7.3.1 □ Design and Development Planning

Through CP-7300 IEA manages the interfaces between the different groups involved in the design and development process to ensure effective communication and clear assignment of responsibility. During the design and development planning, IEA reviews, verifies, and validates what is appropriate to each design and development stage, and the responsibilities and authorities for design and development.

7.3.2 □ Design and Development Inputs

Inputs relating to the project requirements are determined in accordance with CP-7300. These inputs include, but are not limited to: functional and performance requirements, applicable statutory and regulatory requirements, information derived from previous similar designs (when applicable), and other requirements essential for design and development.

7.3.3 □ Design and Development Outputs

Outputs of design and development shall be in accordance with CP-7300 where the design outputs shall: meet the input requirements for design and development; provide appropriate information for purchasing, production and service provision; contain and/or reference product acceptance criteria, and specify the characteristics of the product that are essential for its safe and proper use.

7.3.4 □ Design and Development Review

During suitable stages, systematic reviews of design and development are performed in accordance with CP-7300. These reviews evaluate the ability of the results of design and

development to meet project requirements, and identify any problems and propose necessary actions. Participants in these reviews include representatives of the functions concerned with the design and development stages being reviewed.

7.3.5 □ Design and Development Verification

Verification of the design is performed in accordance with CP-7300 to ensure that the design and development outputs have met the design and development input requirements.

7.3.6 □ Design and Development Validation

Design and development validation is performed in accordance to CP-7300 to ensure that the resulting product is capable of meeting the requirements for the specified application or intended use, where known. Wherever practical, validation shall be completed prior to the delivery of implementation of the product.

7.3.7 □ Control of Design and Development Changes

Design and development changes shall be identified and records maintained in accordance with CP-7300. Changes are reviewed, verified and validated, as appropriate, and approved before implementation. The review of design and development changes shall include evaluation of the effect of the changes on constituent parts and product already delivered.

7.4 □ Purchasing

7.4.1 □ Purchasing Process

Purchasing is controlled and maintained through CP-7400 in the Lean QMS Map® for outside materials, suppliers and services not provided by the customer/manufacturer/supplier that may affect the quality of the installed system and components.

The Project Manager has total responsibility for site procurement. The Project Manager initiates purchase requests and then reviews the subsequent purchase order to assure that provisions for traceability, identification and quality requirements are specified for items and materials as applicable. Purchase Orders clearly define the specified technical requirements to ensure the quality of the products.

Critical Suppliers and Subcontractors are assessed according to CP-7401 (Supplier Qualification) and CP-7402 (Subcontractor Qualification). Purchases are made from approved sources only and are selected from a critical supplier/subcontractor list (F-7401-03).

Critical Suppliers and Subcontractors are monitored for performance during construction activities through the use of QA/QC Activity Surveillance Reports (F-7502-05) and field audits. Critical Suppliers and Subcontractors are evaluated based upon quality, performance, and service provided.

The customer may verify for themselves that the purchased products or service conform to the relevant requirements.

7.4.2 Purchasing Information

The Purchase Order contains information describing the product or service ordered, including: identifying reference codes, appropriate drawings, inspection instructions, the requirements for qualification of personnel, and the quality standard to be applied.

All appropriate and relevant contract issues have been supplied to the IEA purchasing department. All purchasing documents are reviewed by the Project Manager and/or site team and approved to ensure the adequacy of specified requirements contained in the purchasing documents prior to their release.

7.4.3 Verification of Purchased Product

IEA identifies and implements the activities necessarily for verification of purchased products and/or services to ensure that purchase specifications are met. Through CP-7430 (Receiving) on the Lean QMS Map® this ensures that incoming material is not used or processed until it has been inspected or otherwise verified to specified requirements. Verification of conformance is in accordance with the contract requirements, project specifications, quality requirements, and material certification.

7.5 Production and Service

7.5.1 Control of Production of Service Provision

IEA carries out its defined production and service activities under the following controlled conditions: availability of product information, availability of process instructions, use of suitable process equipment, use of measuring and monitoring devices, implementation of process monitoring and measurements, and product inspection and acceptance criteria.

7.5.2 Validation of Processes

IEA has excluded clause 7.5.2 of the ISO Standard. All processes of the QMS can be validated by subsequent monitoring and measurement. Therefore, this sub-clause has been excluded from the scope of the QMS.

7.5.3 Identification and Traceability

IEA ensures appropriate identification and traceability of product at all stages of product realization: e.g. during receiving, inventory, work in progress, inspection, testing, finished goods, shipping and delivery. This system includes the following at a minimum: part numbers, lot numbers, job numbers, work order numbers, sales order numbers, project numbers, etc.

7.5.4 Customer Property

IEA exercises care with customer property while it is under our control or being used by the organization. Customer property, including products, tooling, equipment, returnable packaging, and intellectual property (information provided in confidence), proprietary information, is normally identified, verified, stored, used, and controlled in the same manner as company-

owned property, unless there are other specific requirements. Any loss, damaged, or deterioration of customer property is promptly reported to the customer.

Solar Modules: will remain packaged until the time of installation so as not to expose the module to sunlight. The packaging material will be inspected visually for damage. Any on site measurements required to verify proper manufacturing tolerances of any specific Manufacturer/Supplier/Customer supplied materials will be the sole responsibility of the Manufacturer/Supplier/Customer. *IEA will not accept responsibility, take possession of, or be responsible for the purchase of any special tooling required to check the Manufacturer's/Supplier's/Customer's original manufacturing requirements or tolerances outlined in the component manufacturing specifications or fabrication process.*

7.5.5 □ Preservation of Product

Products (including purchased materials and components, customer-owned products, parts and subassemblies, and the finished products) are protected and preserved during all stages of construction.

7.6 □ Control of Monitoring and Test Equipment

The calibration process SP-7600 ensures that adequately calibrated measuring and monitoring devices for tools, gauges and other inspection, measuring and testing equipment used in the activities affecting quality assures proper range, type and accuracy are controlled to provide consistent measurement requirements, and that these measurement results are traceable to National Standards.

This section does not intend to imply the need for special calibration and control on rulers, tape measures, levels and other devices when commercial practices provide adequate accuracy for the application.

This section does not intend to imply the need for special calibration and control of test hardware consisting of jigs, fixtures and templates.

7.6.1 □ Site Monitoring

7.6.1.1 □ The Site Quality Manager and the Project Manager are responsible for the site calibration program, including maintaining a list of all measuring and test equipment requiring periodic calibration. The Site Quality Manager is assigned the responsibility to assure that calibration records are maintained and current and a calibration tag is affixed to calibrated equipment. When it is impractical to use a tag, an alternative method may be used.

7.6.1.2 □ The Site Quality Manager will determine the required corrective action when a tool, gage or measurement instrument is found out of calibration as per SP-7600. Items measured by the tool, gauge or instrument in question since the last valid calibration, shall be considered unacceptable and treated as a nonconformance, until the Site Quality Control Manager has determined that the applicable requirements have been met. Tooling suspected being out of Tolerance will be listed on the "Out of Tolerance Evaluation of Tooling" (F-7502-99) and inspected or evaluated for site use. If the evaluation deems that the tool is out of tolerance, the tool will be removed, sent to a Calibration Laboratory for recalibration and issuance back to

the site. All work performed with the out of tolerance tool will be inspected for compliance with a calibrated tool.

7.6.1.3 Equipment furnished by the Customer requiring calibration and control will be calibrated and controlled by the Customer.

7.6.1.4 Equipment furnished by the Manufacturer/Supplier or its representatives requiring calibration and control will be calibrated and controlled by the Manufacturer/Supplier.

7.6.1.5 All subcontractors and suppliers are required to provide records of calibration for their equipment.

8.0 Measurement, Analysis & Improvement

8.1 General

IEA's methodology for planning and implementing measurement, analysis and improvement is stated on page 3 of the Lean QMS® Map (QM-4220). This methodology effectively integrates the DMAIC (Define, Measure, Analyze, Improve, Control) approach into the fabric of the QMS.

Process owners and process users are familiar with basic statistical concepts, such as variation, stability, process capability, and over-adjustment, as appropriate. Where applicable, explanation and discussion of these concepts are included in individual training.

8.2 Monitoring and Measurement

8.2.1 Customer Satisfaction

IEA monitors information on customer satisfaction and/or dissatisfaction as one of the measurements of performance of the QMS. The Quality Manager determines the methods for obtaining and using this information.

8.2.2 Internal Audit

IEA conducts periodic internal audits at planned intervals to determine whether quality management system conforms to the requirements of the Standard and is being effectively implemented and maintained. Audits are conducted by Independent third-party organizations, such as a qualified consultant or consulting firm.

The results of the internal audits are documented and brought to the attention of the personnel having responsibility for the area audited. Management personnel responsible for the area take timely corrective action of the deficiencies found during the audit. Follow-up activities verify and record the implementation of the corrective action, report the verification results, and close out the audit. Subsequent audits verify the effectiveness of the corrective actions taken. Results of internal audits and the corrective action are submitted for management review.

8.2.3 Monitoring and Measurement of Processes

IEA has defined process measureable (in the form of quality objectives and metrics) within each process of the QMS. Furthermore, QMS processes are monitored by a variety of approaches and techniques as appropriate for a particular process and its importance. These include: Internal Audits (SP-8220); Monitoring trends in corrective and preventive action requests; Measuring product conformity and monitoring quality performance data and trends (quality objectives and associated metrics); and Measuring and monitoring customer satisfaction.

8.2.4 Monitoring and Measurement of Product

IEA has defined and depicted in-process and final inspection criteria for product measurement at specific points within each core process map. All product that does not meet the defined inspection criteria is processed through the Non-conforming Product Process (SP-8300).

8.3 Control of Nonconforming Product

IEA ensures that the service or materials provided that do not meet project requirements are identified, controlled, where possible to prevent unintended use and is corrected if required. This policy is implemented in SP-8300. This procedure includes provisions for: Identification, documentation, evaluation, segregation (where practical), disposition of nonconforming service/material, and for notification of the functions concerned; Assigning responsibility for the review and the authority for disposition of nonconforming service; Correction of nonconforming service/material and re-installation or replacement of the affected area after correction to demonstrate conformity (if necessary); Handling of nonconforming service/material when detected after installation.

8.3.1 Where applicable, a preventative maintenance program will be initiated to perform the mechanical, electrical and lubrication requirements on equipment prior to start up. All preventative maintenance will be documented concerning when, what, and by whom the maintenance was performed. If the Solar manufacturer has a specific formatted document to record the long-term storage of equipment, this document will be used to record the preventive maintenance program.

8.4 Analysis of Data

IEA determines, collects and analyzes appropriate data to demonstrate the suitability and effectiveness of the QMS and to evaluate where continual improvement can be made. The main areas of focus are: suppliers, internal process metrics, and customers. This data is used to determine: trends, customer satisfaction, interested party feedback, process effectiveness and efficiency, supplier contribution, quality objective performance, economics of quality, benchmarking, and competitiveness.

8.5 Improvement

8.5.1 Continual Improvement

WCI seeks to continually improve the effectiveness and efficiency of the QMS through the use of the quality policy, quality objectives, audit results, analysis of data, corrective and preventative actions and management review. Internal audit results and quality performance data are analyzed by management to assess the effectiveness of the QMS and current

organizational performance. Opportunities and priorities for improvement are identified by comparing present quality performance to goals and aspirations defined in the quality policy. Improvement projects are defined either as corrective or preventive actions or as quality objectives.

8.5.2 □ Corrective Action

IEA takes corrective action to eliminate the cause of the identified nonconformities in order to prevent reoccurrence. Correction actions are appropriate to the impact of the problems encountered.

SP-8500 defines the requirements for: identifying nonconformities (including customer complaints); determining the cause of the nonconformity; evaluating the need for actions to ensure that nonconformities do not recur; determining and implementing the corrective actions needed; recording the results of action taken; review and evaluation of corrective action taken to assess its effectiveness.

8.5.3 □ Preventative Action

IEA identifies preventative actions to eliminate the causes of identified potential nonconformities to prevent initial occurrence. Appropriate sources of information such as processes and work operations results that affect product quality, concessions, audit results, quality records, and customer complaints are analyzed to detect preventive action possibilities. Preventative actions that are appropriate to the impact of the potential problems.

9.0 □ Site Specific Addenda

END OF DOCUMENT

First Solar Series 6™ Thin Film Modules

NEXT GENERATION SOLAR TECHNOLOGY



Higher Energy Yield. Lower LCOE. Superior Return.

First Solar Series 6™ photovoltaic (PV) modules deliver the highest power output for large-scale solar projects. This landmark module features our proven thin film technology to deliver more energy, more efficiently than ever before. For asset and power generation owners, engineers and installers, this means more power per module, reduction of balance of system costs and enabling a lower Levelized Cost of Electricity (LCOE) for a superior return on investment.



NEW DESIGN MEANS MORE BENEFITS FOR YOUR BOTTOM LINE

The Series 6 thin film module was developed using over a decade of engineering expertise and a track record of more than 17 gigawatts (GW) of modules produced. This experience, combined with input from customers and industry experts allows us to provide our proven module technology in a larger form factor with a more economical design. The results deliver more benefits and cost-efficiencies for your application, including:

More Watts Per Module

These easy-to-install, thin film modules deliver more watts per connection (420+ watts) than 72-cell silicon modules (<400 watts).

Reduced Shipping Costs

The under-mount frame is designed to enable a horizontal stacking configuration, optimizing shipping density, reducing breakage and minimizing waste.

Best Environmental Profile

With the smallest CO₂ footprint, lowest water use and fastest energy payback, Series 6 modules are the industry's most eco-efficient PV solution.

Reduced Maintenance Costs

The innovative under-mount frame design provides the cleaning benefits of a frameless module.



INNOVATIVE
UNDER-MOUNT FRAME



HIGHEST POWER,
MOST WATTS PER MODULE



MOUNTING SLOT ALLOWS FOR QUICK INSTALLATION



LOWER INSTALLATION COSTS

Series 6 modules are designed for a quick and easy, two-person installation. The under-mount frame allows for versatile mounting to common fixed-tilt and tracking systems to minimize onsite engineering to reduce material costs, while enabling more watts per lift. Additionally, the dual junction box design eliminates the need for wire management for module-to-module connections.



DUAL JUNCTION BOXES REDUCE MODULE-TO-MODULE WIRE MANAGEMENT

MORE ENERGY IN REAL WORLD CONDITIONS

First Solar Series 6 modules offer exceptional performance that delivers on the financial promise of your project, with:

More MWh per Installed MW

Series 6 modules deliver up to 8% more energy per watt installed than conventional silicon modules in many climates.

Superior Temperature Coefficient and Spectral Response

Our innovative thin film technology features a low temperature coefficient of $-0.32\%/^{\circ}\text{C}$, resulting in more annual energy, especially in hot climates.

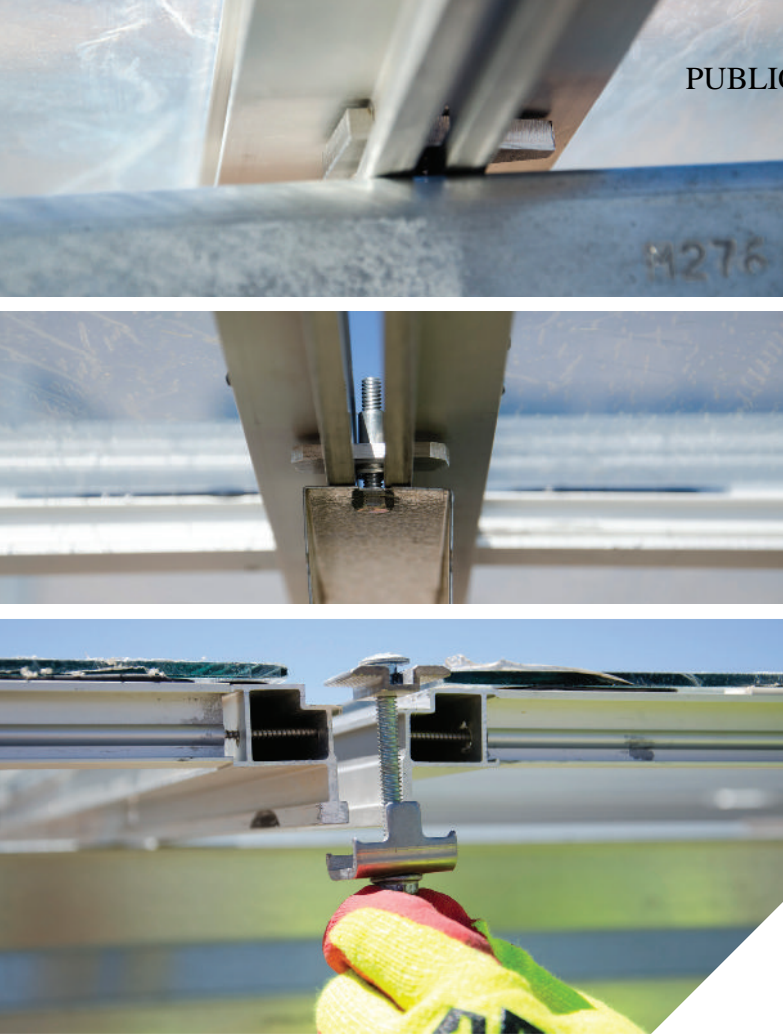
First Solar modules are also less sensitive to the reductions of specific wavelengths of available light in humid climates. As a result, these modules have a superior spectral response behavior compared to c-Si modules that translates into up to 4% more annual energy in high humidity conditions.

Better Shading Response

Series 6 modules are less sensitive to power loss from shading through their unique cell design. With Series 6, only the shaded area is impacted; typical silicon modules turn off disproportionately large portions due to their electrical design.

Industry-Leading Long-Term Reliability

First Solar Series 6 modules are built with methods and processes adapted from Series 4, one of the most tested solar modules in the industry. This technology is independently tested and certified for reliable performance beyond IEC standards in high temperature, high humidity, extreme desert, coastal applications, and passes the industry PID tests to ensure robust performance in the harshest environments.



THE ADVANTAGE OF COLLABORATIVE DESIGN

Developing next-generation technology required a next-generation approach. First Solar launched an extensive listening campaign with leading mounting structure providers, our partners in the field, to identify controlling factors that would help define maximum watts-per-lift while retaining two-person installation teams. We also turned to these partners for direct input on every aspect of the module to ensure we designed and built a superior product for the market.

The result is a module that will have among the lowest costs per-watt-installed in the market, optimized for more than 40 fixed-tilt and tracker mounting systems.

40+ STRUCTURE PROVIDERS
With more on the way!

FIRST SOLAR IS YOUR PROVEN ENERGY PARTNER

At First Solar, innovation is at the core of everything we do. Through an unwavering commitment to research and development we are continually discovering new and inventive solar energy solutions, while making today's PV technologies more efficient. Our Series 6 modules are the latest technological achievement in our long history of industry advancements.

As your energy partner, we maintain a strong balance sheet that is backed by a lengthy track record of meeting or exceeding performance expectations. That is why First Solar solutions are widely recognized as the most bankable in the industry.

MIT TECHNOLOGY REVIEW

TOP 50
2017 SMARTEST
COMPANIES



SECURE YOUR NEXT GENERATION OF ENERGY PROFITABILITY

Learn how First Solar Series 6 modules will deliver a superior return on your energy investment with higher yields, reduced risk and a lower LCOE. For more information, contact us and let's start the conversation.

firstsolar.com/S6 | info@firstsolar.com

Best Quality And Priced Pile Driven Fixed Tilt Systems



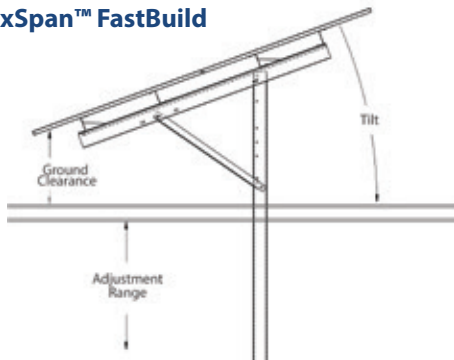
32 MW - NC - MaxSpan™ System - Installed for Leading Utility

FAST INSTALL & HANDLES SLOPING GROUND

Industry's longest spans and fewest foundations: as few as 190 per MW for 2 up portrait and 130 per MW for 3 up portrait

LESS PILES
UNMATCHED SPAN
UP TO 15%
TERRAIN SLOPES

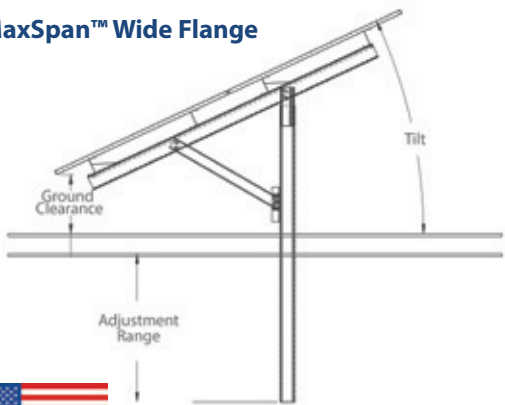
MaxSpan™ FastBuild



Supports all poly, glass and thin film modules

Rugged design enables 150mph [67.06 m/s] wind and 90 psf [4.31 kPa] snow loads

MaxSpan™ Wide Flange



Turnkey install, pull test and geotech services available

Galvanized Z purlins have integrated trays for easy wire management

5° to 35° tilt with multiple inter-row spacing options





Technical Data Sheet



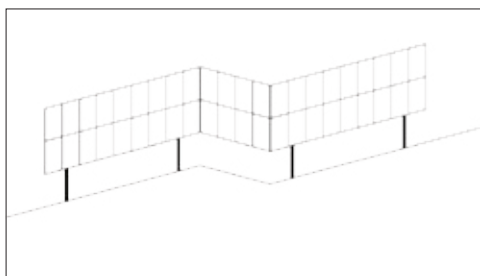
MaxSpan™ FastBuild's rugged beam and brace rapidly attach to pile with just six bolts and nuts - fewest parts in the industry



MaxSpan™ WideFlange's telescoping post bracket with up to 5 inches vertical adjustment for fast top of pile leveling



Patent pending articulating purlin connection to navigate sloping terrain



Articulating purlin connections to navigate up to 15% terrain slopes

Features

MaxSpan™ FastBuild

StickyPile™: G235 galvanized steel (HDG available), purlins, beams & braces: G90 galvanized steel

20 men install 1.55MW per week

Three axes of adjustability demanded by installers for navigating real world site conditions where significant adjustability in the field is required

The unmatched span capability of MaxSpan™ means there are fewer foundations than competing systems, which means less piles and less pile installation cost. As few as 190 piles per MW

Standard system has 3.5" [8.89cm] vertical adjustability

Optional post extenders allow 10" [25.4cm] vertical adjustability

MaxSpan™ Wide Flange

Industry's most flexible racking system handles undulating ground conditions

Telescoping post bracket with over 5" [12.7cm] vertical adjustment for fast top of pile leveling

Multiple options with Wide Flange

Test & Certification

- Meet IBC and ASCE standards for structural loading
- ETL / UL 467 GameChange top mount clamps or star washers included
- ETL / UL 2703 tested
- Wind tunnel tested by industry leader CPP
- Independent assessment by Black & Veatch
- Warranty 20 years - Made in USA

Calculations

- 100% code compliant designs for any locality
- Structural PE drawings & calculations for foundation & racking structure
- Available 2 up in portrait and 4 up in landscape poly as well as multiple glass on glass module configurations incl. First Solar Series 4 & 6™
- Design loads according to IBC 2006 or 2009

Pull Test, Geotech & Installation Services

- Free pull test on orders over 5 MW
- Vertical and lateral capacity of the post is determined by pull test
- Test data is then analyzed by our in-house engineering team in parallel with geotechnical report to give the most efficient embedment depths, spans and post type
- Turnkey installation of piles, racks and modules available

Material

- Post: G235 galvanized steel (HDG ASTM123 option also available)
- Galvanized Purlins, NS Beam, Brace: G90 galvanized steel
- Star washer or ETL / UL top mount teathed module clamp: stainless steel
- Associated hardware: Magnacoat 3/8", 1/2" and 3/4" x 1" hex or serrated flange hex bolts, 3/8", 1/2" and 3/4" serrated flange nuts HDG or magnacoat, 3/4" washers; stainless steel 1/4" - 20" serrated flange nuts, 1/4" - 20" x 3/4" hex bolts; or if mounting modules using stainless steel module mounting clamps: 1/4" - 20" x 2 1/2" hex bolts, or 1 1/2" - 2 1/2" T-bolts, stainless steel 1/4" - 20" serrated flange nuts



DuraTrack® HZ v3

RELIABILITY IS POWER.

167X

fewer components than
competitive trackers

99.9996%

Uptime Reliability

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3901 Midway Place NE
Albuquerque, NM 87109 USA

+1 505.881.7567
+1 855.TRACKPV (872.2578)
+1 505.881.7572

sales@arraytechinc.com

arraytechinc.com

THE MOST RELIABLE TRACKER UNDER THE SUN

HIGHEST POWER DENSITY.

Higher density means more power and more profit. DuraTrack HZ v3 offers the unique ability to maximize the power density of each site, boasting 6% more density than our closest competitor.

LEADING TERRAIN ADAPTABILITY.

Uneven terrain? Hill yes! Our flexibly linked architecture, with articulating driveline joints and forgiving tolerances, create the most adaptable system in market for following natural land contours and creates the greatest power generation potential from every site.

FEWER COMPONENTS. GREATER RELIABILITY.

Less is more. Array was founded on a philosophy of engineered simplicity. Minimizing potential failure points (167 times fewer components than competitors), DuraTrack HZ v3 consistently delivers higher reliability and an unmatched uptime of 99.99%.

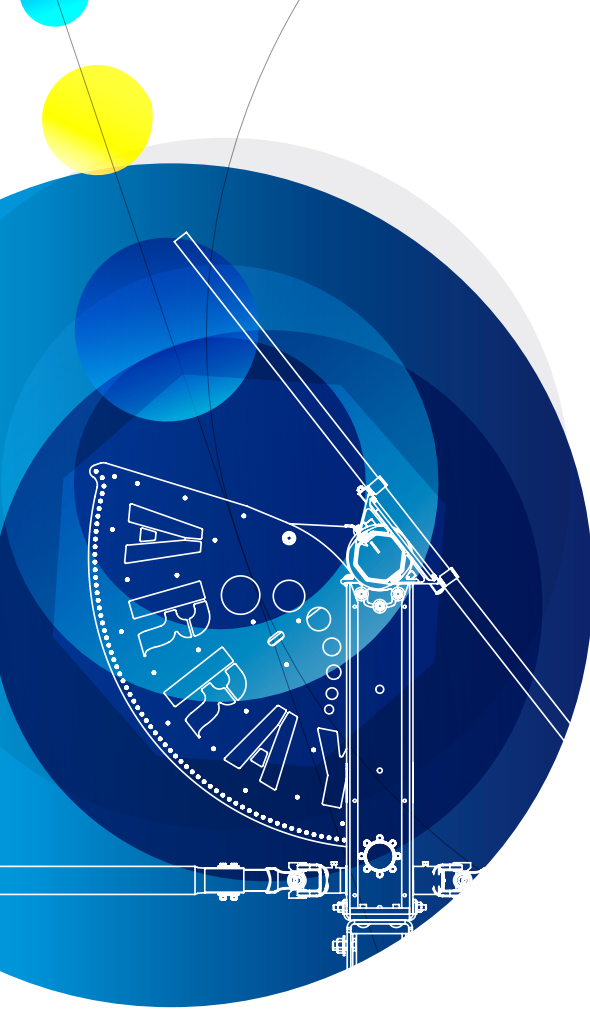
FAILURE-FREE WIND DESIGN.

DuraTrack HZ v3 was designed and field tested to withstand some of the harshest conditions on the planet. It is the only tracker on the market that reliably handles wind events with a fully integrated, fully automatic wind-load mitigation system.

ZERO SCHEDULED MAINTENANCE.

Three decades of solar tracker system design, engineering and testing has resulted in uncompromising reliability. Maintenance-free motors and gears, fewer moving parts, and industrial-grade components means maintenance-free energy generation.

PUBLIC VERSION



DuraTrack® HZ v3

COST VERSUS VALUE

We believe value is more than the cost of a tracking system. It's about building with forgiving tolerances and fewer parts so construction crews can work efficiently. It means protecting your investment with a failure-free wind management system. It also includes increasing power density. But most of all, value is measured in operational uptime, or reliability. Ours is 99.996%... and we're still improving on it.

THE GLOBAL LEADER IN RELIABILITY

Array has spent decades designing and perfecting the most reliable tracker on the planet. Fewer moving parts, stronger components and intelligent design that protects your investment in the harshest weather are but a few of the innovative differences that keep your system running flawlessly all day and you resting easy at night.

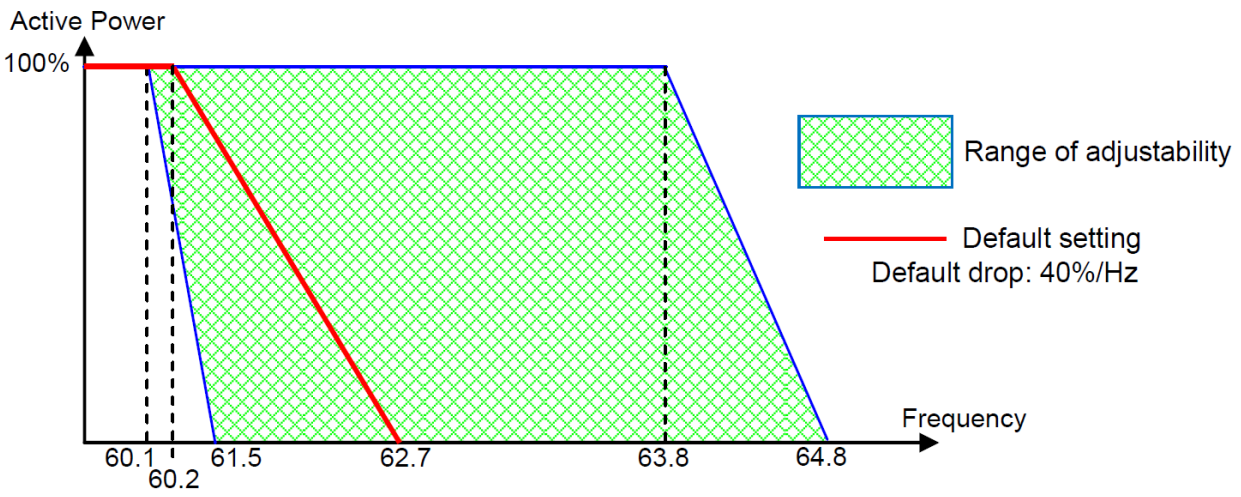
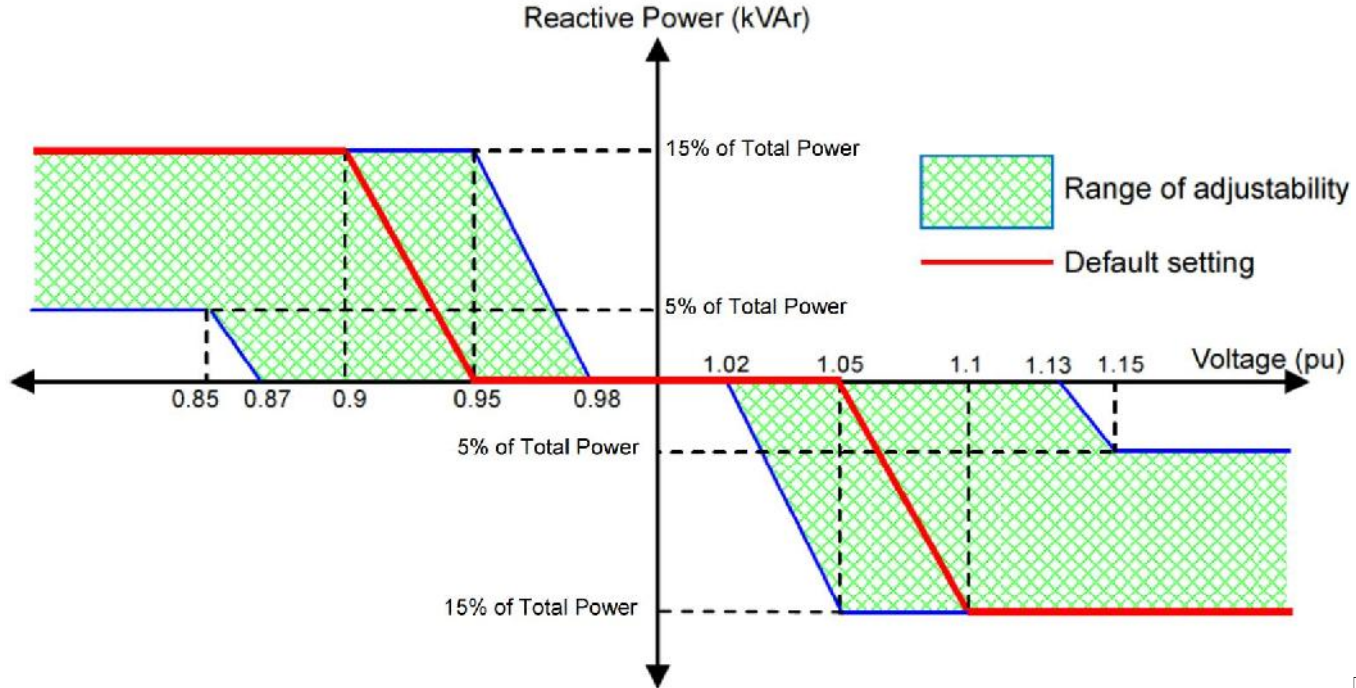
STRUCTURAL & MECHANICAL FEATURES/SPECIFICATIONS	
Tracking Type	Horizontal single axis
kW per Drive Motor	Up to 907 kW DC using 360W crystalline
String Voltage	Up to 1,500V DC
Maximum Linked Rows	28
Maximum Row Size	80 modules (crystalline, 1,000V DC) & 90 modules (crystalline, 1,500V DC)
Drive Type	Rotating gear drive
Motor Type	2 HP, 3 PH, 480V AC
Motors per 1 MW AC	Less than 2
East-West / North-South Dimensions	Site / module specific
Array Height	54" standard, adjustable (46" min height above grade)
Ground Coverage Ratio (GCR)	Flexible, 28-45% typical, others supported on request
Terrain Flexibility	N-S tolerance: 0°-8.5° Standard, option to increase Driveline: 40° in all directions
Modules Supported	Most commercially available, including frameless crystalline and thin film
Tracking Range of Motion	± 52°
Operating Temperature Range	-30°F to 130°F (-34°C to 55°C)
Module Configuration	Single-in-portrait standard. Two-or-three in landscape (framed or frameless), four-in-landscape (thin film) also available.
Module Attachment	Single fastener, high-speed mounting clamps with integrated grounding. Traditional rails for crystalline in landscape, custom racking for thin film and frameless crystalline per manufacturer specs.
Materials	HDG steel and aluminum structural members
Allowable Wind Load (IBC 2012)	135 mph, 3-second gust exposure C
Wind Protection	Passive mechanical system relieves wind and obstruction damage — no power required
ELECTRONIC CONTROLLER FEATURES/SPECIFICATIONS	
Solar Tracking Method	Algorithm with GPS input
Control Electronics	MCU plus Central Controller
Data Feed	MODBUS over Ethernet to SCADA system
Night-time Stow	Yes
Tracking Accuracy	± 2° standard, field adjustable
Backtracking	Yes
INSTALLATION, OPERATION & MAINTENANCE	
PE Stamped Structural Calculations & Drawings	Yes
On-site Training & System Commissioning	Yes
Connection Type	Fully bolted connections, no welding
In-field Fabrication Required	No
Dry Slide Bearings & Articulating Driveline Connections	No lubrication required
Scheduled Maintenance	None required
GENERAL	
Annual Power Consumption (kWh per 1 MW)	400 kWh per MW per year, estimated
Land Area Required per 1 MW	Approx. 5 to 5.75 acres per MW @ 33% GCR (site and design specific)
Energy Gain vs. Fixed-Tilt	Up to 25%, site specific
Warranty	10 year structural, 5 year drive & control components
Patent Numbers	US patent 8,459,249. US patent 9,281,778. US patent 9,581,678 B2 and patents pending
Codes and Standards	UL Certified (3703 & 2703)



CONFIDENTIAL INFORMATION

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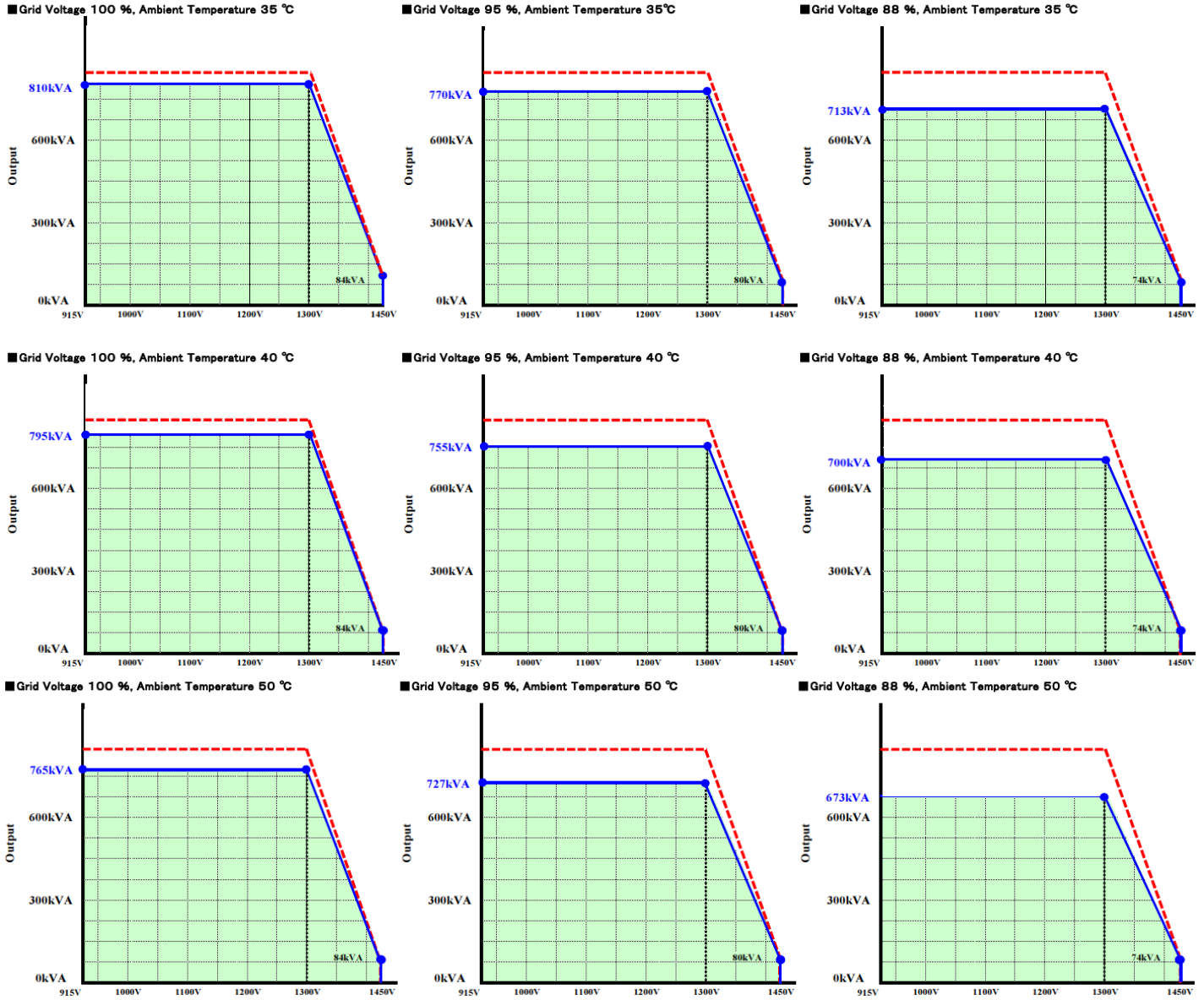
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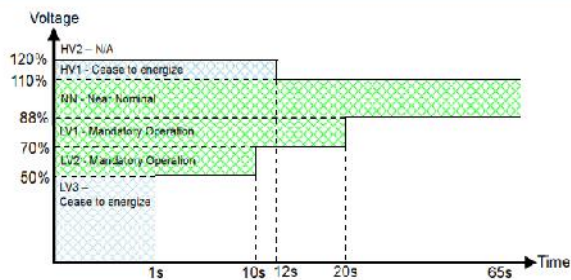
840kVA/840kW PV Inverter Power Characteristics

Cases based on various Temperatures and Grid Voltages



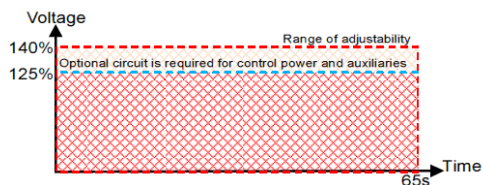


Rule 21



Name	Description	Default setting		
		% of nominal	trip time	
OVR	OVR4	Grid overvoltage detection level 4	120%	-
	OVR3	Grid overvoltage detection level 3	110%	12s
	OVR2	Grid overvoltage detection level 2	110%	12s
	OVR1	Grid overvoltage detection level 1	110%	12s
UVR	UVR1	Grid undervoltage detection level 1	88%	20s
	UVR2	Grid undervoltage detection level 2	70%	10s
	UVR3	Grid undervoltage detection level 3	50%	1s
	UVR4	Grid undervoltage detection level 4	50%	1s
Cease to energize	Cease to energize for overvoltage	110%	-	
	Cease to energize for undervoltage	50%	-	

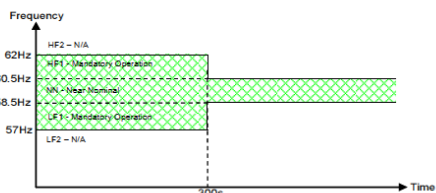
Range of Adjustability



Remarks:

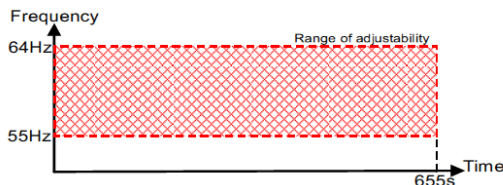
- 1) For voltage settings over 125%, an optional circuit is required for the control power supply.
- 2) The inverter is not set to supply reactive power during the fault above the settings prior to the fault.
- 3) For overvoltage events, there may be an impact on power quality when the DC voltage is close to the minimum.
- 4) Current may be not perfectly sinusoidal for some asymmetrical faults.

Rule 21



Name	Description	Default setting		
		Frequency	Trip time	
OFR	OFR3	Grid over-frequency detection level 3	62Hz	-
	OFR2	Grid over-frequency detection level 2	60.5Hz	300s
	OFR1	Grid over-frequency detection level 1	60.5Hz	300s
UFR	UFR1	Grid under-frequency detection level 1	58.5Hz	300s
	UFR2	Grid under-frequency detection level 2	58.5Hz	300s
	UFR3	Grid under-frequency detection level 3	58.5Hz	300s
	UFR4	Grid under-frequency detection level 4	58.5Hz	300s
	UFR5	Grid under-frequency detection level 5	57Hz	-

Range of adjustability



Remarks:

- 1) Maximum continuous operation is 64Hz for UL1741-SA compliant inverters and 63Hz for other models



Table 2.4.4: PV Only @50°C

Panel Rating	AC Voltage	1 PCS	2PCS	3PCS	4PCS	5PCS	6 PCS
920kW	690VAC	840 kW	1680 kW	2520 kW	3360 kW	4200 kW	5040 kW
880kW	660VAC	800 kW	1600 kW	2400 kW	3200 kW	4000 kW	4800 kW
840kW	630VAC	765 kW	1530 kW	2295 kW	3060 kW	3825 kW	4590 kW
800kW	600VAC	730 kW	1460 kW	2190 kW	2920 kW	3650 kW	4380 kW



Table 2.4.5: ESS Only @25°C

Panel Ration	AC Voltage	1 PCS	2PCS	3PCS	4PCS	5PCS	6 PCS
840kW	630VAC	840 kW	1680 kW	2520 kW	3360 kW	4200 kW	5040 kW
800kW	600VAC	800 kW	1600 kW	2400 kW	3200 kW	4000 kW	4800 kW
630kW	480VAC	630 kW	1260 kW	1890 kW	2520 kW	3150 kW	3780 kW

Table 2.4.6: ESS Only @35°C

Panel Ration	AC Voltage	1 PCS	2PCS	3PCS	4PCS	5PCS	6 PCS
840kW	630VAC	810 kW	1620 kW	2430 kW	3240 kW	4050 kW	4860 kW
800kW	600VAC	772 kW	1544 kW	2316 kW	3088 kW	3860 kW	4632 kW
630kW	480VAC	606 kW	1212 kW	1818 kW	2424 kW	3030 kW	3636 kW

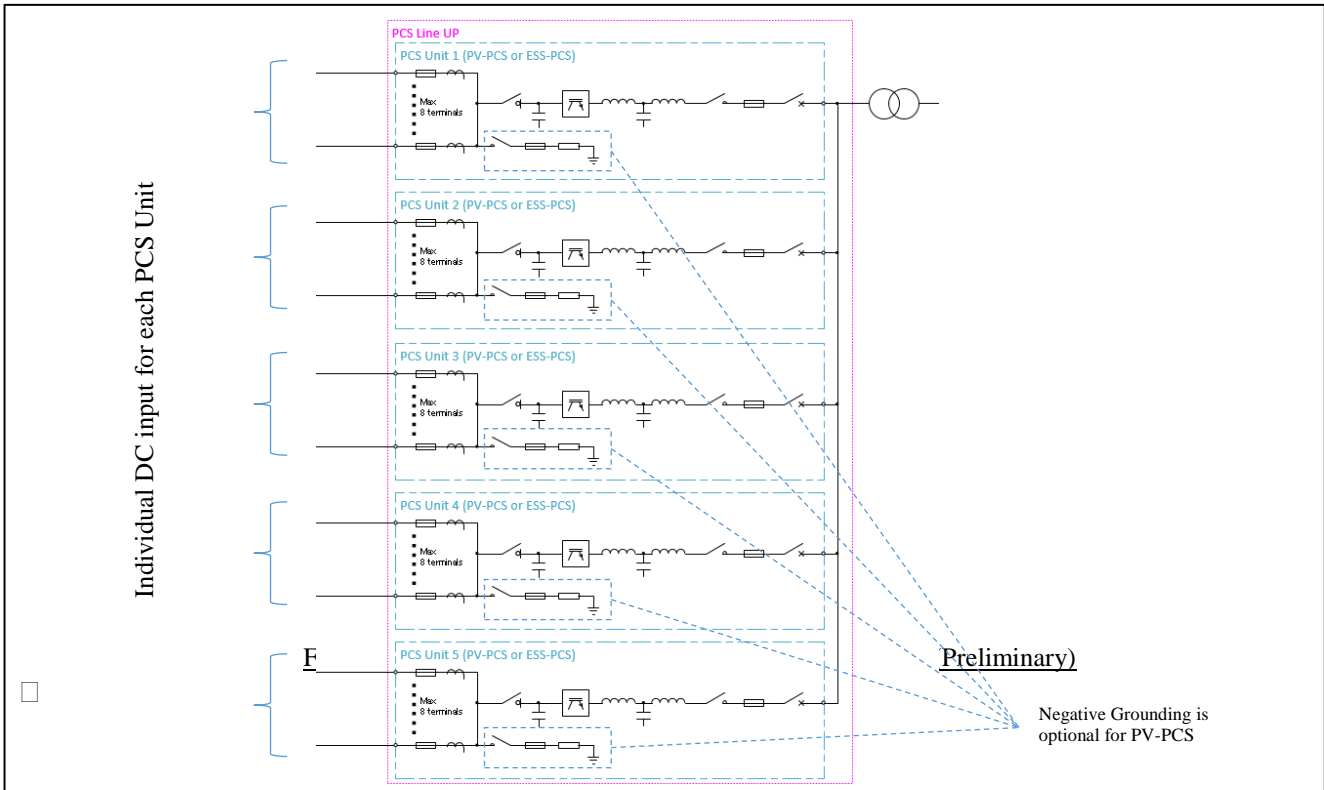
Table 2.4.7: ESS Only @40°C

Panel Ration	AC Voltage	1 PCS	2PCS	3PCS	4PCS	5PCS	6 PCS
840kW	630VAC	795 kW	1590 kW	2385 kW	3180 kW	3975 kW	4770 kW
800kW	600VAC	758 kW	1516 kW	2274 kW	3032 kW	3790 kW	4548 kW
630kW	480VAC	594 kW	1188 kW	1782 kW	2376 kW	2970 kW	3564 kW

Table 2.4.8: ESS Only @50°C

Panel Ration	AC Voltage	1 PCS	2PCS	3PCS	4PCS	5PCS	6 PCS
840kW	630VAC	765 kW	1530 kW	2295 kW	3060 kW	3825 kW	4590 kW
800kW	600VAC	730 kW	1460 kW	2190 kW	2920 kW	3650 kW	4380 kW
630kW	480VAC	570 kW	1140 kW	1710 kW	2280 kW	2850 kW	3420 kW

Individual DC input for each PCS Unit



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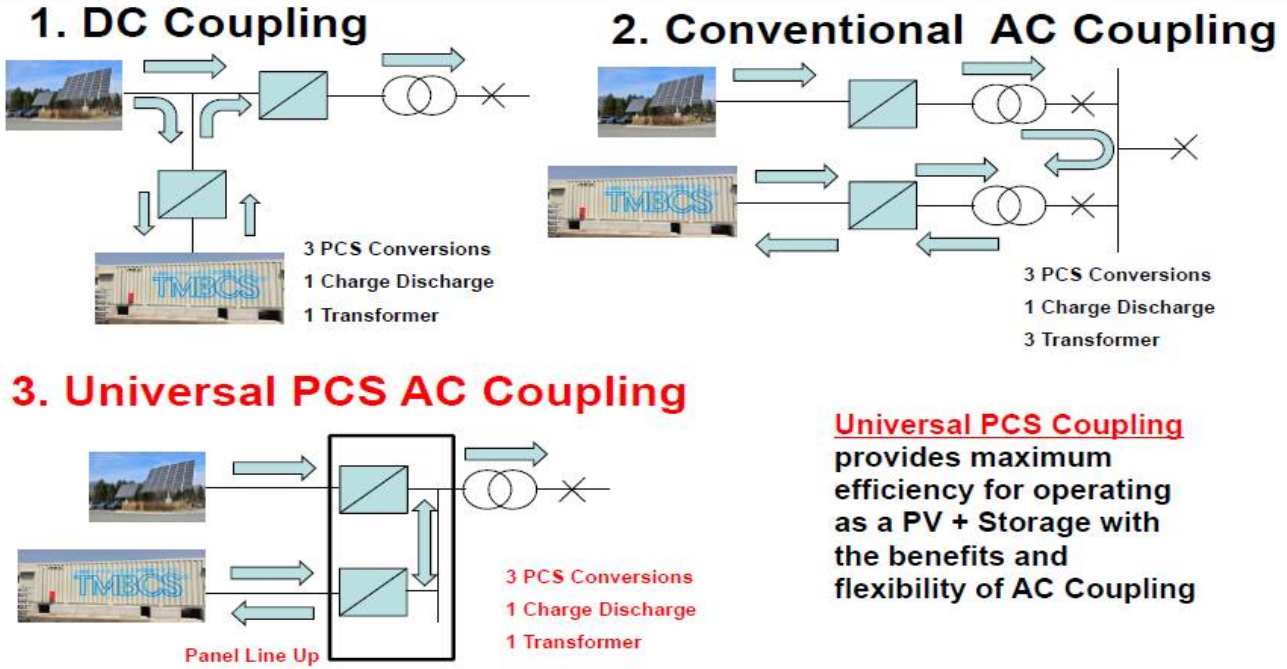
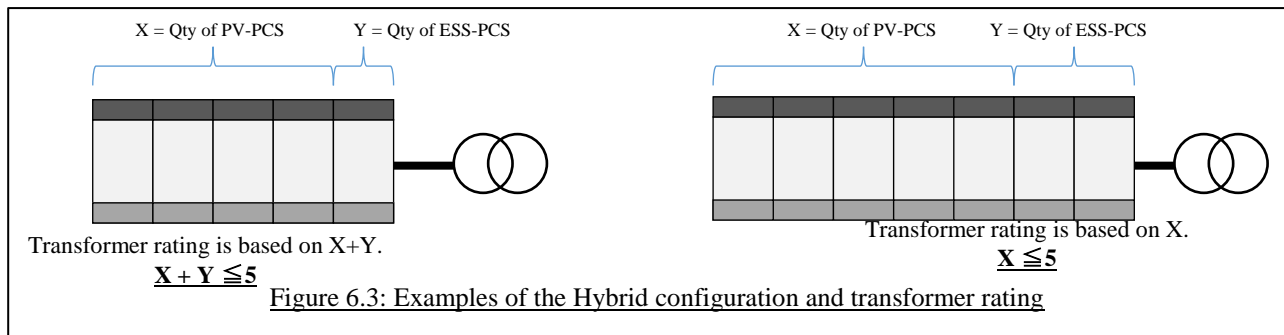


Figure 2.5.2 Comparisons of DC Coupling/Conventional AC Coupling/Universal PCS AC Coupling

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South Bend Solar (“the Project”) consists of a solar photovoltaic development in Indiana being developed by Indiana Michigan (I&M) Power Company, the owner (“Owner”) and primary operator. American Electric Power is the contractor and secondary operator that will have day-to-day control over the project construction activities. The major civil works described here will include:

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The success of the Project will require an experienced EPC team, IEA (“Contractor”) once awarded the Project will have an assigned team that will include a Project Manager, Engineering Manager, and Project Engineer(s). This early works team will be tasked with managing engineering and procurement of major equipment and long lead items for the Project. The early works team will conduct weekly status calls, and detail out an engineering deliverables schedule to Owner showing key dates for deliverables from Owner and to be delivered by Contractor. It is anticipated by Contractor that foundation design verification can be conducted during this time, including test foundation installation and subsequent deflection and pull testing.

Appointments will be made with the various Authorities Having Jurisdiction for purposes of permitting and to ensure a complete permit matrix is developed and no issues will occur to affect the project schedule.



CIVIL IMPLEMENTATION

GENERAL

Contractor will design all systems in accordance with applicable codes and standards. Contractor will ensure the design includes road improvements necessary for construction equipment, delivery vehicles and operation and maintenance traffic. The road design will meet any state and local transportation standards, codes, and conditional use permit stipulations and conditions.

Contractor will perform required Site preparation works including earthworks, erosion control, and SWPPP. Contractor will attempt to minimize earthwork and vegetation disruption for the installation of the Plant to the extent it is compliant with the use permits. Until Final Acceptance is achieved, Contractor will be responsible for maintaining dust control in accordance with state and county requirements, and providing Site maintenance as needed.

To ensure long-term cable integrity, Contractor will protect any direct burial cabling with adequate bedding materials. Contractor will account for any land contours that may affect PV electrical generation in the PV system performance estimate. Contractor will take measures to prevent accumulation of standing water

Detailed requirements for the civil and environmental elements of the Plant are included in this section.

GEOTECHNICAL ANALYSIS

All geotechnical investigation will be carried out by personnel with specialized training and experience in soil mechanics and foundation engineering. The geotechnical investigation will be performed in accordance with relevant ASTM Standards. All geotechnical testing, analysis, evaluation, and design methodologies will be published methods that are generally accepted.

At a minimum, the following will be included in the analysis:

- Review of the publicly available geotechnical information and reports (e.g., soils and geologic maps and literature, photographs, hydroelectric reports, groundwater reports, water well data, etc.).
- Review of any owner provided preliminary geotechnical information.
- Coordination and mobilization of the services team for subsurface exploration of the Site including working with the local utilities to identify and mark any existing underground utilities (e.g., cables, gas lines, piping, water, communication, etc.).
- Documentation of the Site study to determine the presence of faults, ground fissures, and other potential geologic hazards that could affect the structural design and construction of the Plant.
- Documentation of methodology and results of laboratory testing performed on collected soil samples from the borings and test pits including an evaluation of the in-place moisture content, dry density, gradation, plasticity, consolidation characteristics, collapse potential, expansivity, shear strength, resistivity, chloride content, sodium sulfate content, and solubility potential will be conducted.
- Analyze the corrosive nature of the soil including a recommendation for the type of cement to be used for the concrete foundations and required corrosion protection for underground steel, including rigid metal conduit.



GEOTECHNICAL REPORT

The Geotechnical Report is subject to the Owner's approval prior to implementation of the design and will include, but is not limited to, the following information;

- Records of all geotechnical investigations and soil tests performed. A brief description will be provided of each test, including the test equipment, laboratory testing methods, and results, along with a reference to the applicable code or standard to which the work was undertaken;
- Plans showing the location of the Plant and locations of all soil sample/tests on and off the Site (i.e., exploratory test pits or bore holes, penetrometer tests, etc.);
- General geological description of region and its formation;
- If filling is required, a description of soil types on the Site and those proposed for the general filling of the Site;
- Schedule of physical and derived engineering properties of in-situ soil, including but not limited to in-place moisture content and dry density, gradation, plasticity, consolidation characteristics, collapse potential, expansivity, shear strength, resistivity, chloride content, sodium sulfate content, and solubility potential (total salts) will be conducted;
- Statement on recent calibration or certification of test equipment used;
- If reclamation is required, then a recommendation on the treatment of the reclaimed Site to meet the performance criteria of the Owner;
- Summary of expected loads (short and long term) from the main structures/buildings;
- Statement on suitability of soil types to support the expected loads;
- Recommended foundation design types for the different structures including the viability of driven piles as the support for the PV racking supports. If piles are a viable option, recommended drive frequency and minimum size and spacing requirements will be provided.
- Susceptibility of soils to liquefaction under earthquake or vibration from rotating machinery;
- Recommended design methods and formulas for determining allowable soil pressures for willow and deep foundations;
- Recommended allowable soil pressures and appropriate safety factors or load factors to be used for different load cases/combinations. both limit state stresses and elastic design (allowable stress) stresses will be provided; and
- Assessment of probable settlement of the Site and foundations under short and long-term loading conditions with due reference to the general filling of the Site. This will include a predicted time schedule for the settlements.
- Maximum allowable pile loads (e.g. vertical pull-out capacity test).

TOPOGRAPHICAL SURVEY

Owner will provide the topological survey to the contractor. If not provided by the Owner, the Contractor will perform a survey suitable for establishing topographic mapping. The optimum Site elevation(s) for the most efficient and economical operation of the Plant will be determined by the Contractor and submitted to the Owner for approval along with detailed calculations on which the Contractor has based its assumptions in determining the optimum level(s) and flood/drainage considerations. The contractor will determine the final Site elevations during the detailed design of the Plant and these will be subject to the approval of the Owner.



SITE LAYOUT

Contractor will submit Site layout design drawings, data, and documents for review prior to beginning any onsite work or procurement of solar equipment. In general, contractor will define where the project will be constructed, the configuration of materials and equipment, installation of PV modules, installation of electrical systems including inverters, connection to the existing electrical infrastructure, and construction of PV mounting structures and foundations, required buildings and foundations. The design will include a vehicle access road to provide maintenance, cleaning, and public safety access that will comply with state and local county surface requirements.

EARTHWORK

The contractor will plan and execute construction of earthwork methods to control surface drainage and prevent erosion and sedimentation.

Earthwork will include, but is not limited to, the following:

- Preliminary grading, clearing and grubbing
- Trench excavation and backfill for underground utilities
- Excavation and backfill for foundations
- Excavation for roadway cut and fill
- Installation of granular fill and surfacing
- Finish grading

Contractor will provide an estimate of the types and quantities of the various materials to be encountered or required to accomplish the Work. Contractor will utilize sustainable practices where practical, such as establishing a recycling program. All materials that are not recyclable will be disposed of in an approved landfill. Contractor will clean up any spill or contamination in accordance with approved standard procedures.

CLEARING AND GRUBBING

Areas to be graded will be cleared of all brush and trees to within six (6) inches of grade. All stumps and roots will be removed. Waste from clearing will be recycled or disposed of in an offsite disposal area in accordance with all environmental regulations and as directed by the Owner.

STRIPPING

All topsoil and other organic materials will be stripped from the areas to be graded before starting earthwork. Topsoil will be placed in a stockpile for later recovery and use for landscaping the Site (if applicable).

DISPOSAL OF UNUSABLE MATERIALS

All excess excavated materials and all excavated materials unusable for fills will be disposed offsite by Contractor.

PLANT GRADING

Plant grading includes the following items:

- Shaping the natural grade as required accommodating permanent facilities and construction facilities while minimizing earthwork
- Obtaining proper cross section, longitudinal slopes, and curvature for roads



- Obtain proper area slopes to provide drainage without ponding
- Construct adequate surface drainage to discharge the twenty (20) year runoff without flooding roads and the two hundred (200) year runoff without flooding any area in the Plant
- Construct stable, erosion-resistant earthen side slopes

ROADS AND CONSTRUCTION ACCESS

GENERAL

The Contractor will submit to the Owner for review and approval all proposed designs and layouts for the roads, roadwork, walkways, parking areas, and drainage provisions for the Plant.

The Contractor will construct permanent Site roads or will improve existing roads such that they meet the design intention. The design of all pavements will conform to the requirements of the American Association of State Highway and Transportation Officials (AASHTO) and the Asphalt Institute (AI).

The horizontal and vertical alignments of all roads, vehicle parking areas and walkways will be designed to meet the requirements of anticipated future vehicular traffic, the relevant Local Authority, and Good Industry Practice. All anticipated delivery, operations, and maintenance activities of Plant equipment will be considered in determining the requirements for permanent and temporary construction access.

Permanent parking area or areas will be provided, if needed. The size and arrangement of the parking area will comply with Owner's requirements and this Technical Specification.

PAVEMENT CONSTRUCTION

The roads will be designed to sustain the maximum loads from the vehicles likely to use them during construction and throughout the life of the Plant including articulated vehicles, material handling equipment and transporters used for the removal and replacement of major pieces of equipment. All materials used in the permanent construction will be of good quality, and the total thickness of the pavement will be designed to support the construction and permanent traffic loads. The design of the thickness of various parts of the pavement will conform to the relevant Codes and Standards.

The Contractor will undertake all design and surveying required for the construction of the roads, walkways, car parks, and other roadwork. It will be the responsibility of the Contractor to ensure that the strength of the sub-grade is adequate to carry all traffic loads likely to pass over the roads during the construction and Design Life of the Project. Appropriate vertical and horizontal curves and sight lines will be used to ensure a safe road for the expected volumes of traffic during the construction period.

All pavements will consist of the following:

- Sub-base
- Road base
- Binder course
- Wearing course

The road will be constructed in advance of any significant Contractor traffic. The Contractor will re-instate the road at the end of the Works before Substantial Completion and will maintain the road during the construction period to the Owner's reasonable satisfaction.



The sub-grade for roadwork will be constructed from compacted layers to the finished formation level. The road information will be finished to grade and level as required.

The roadway formation will be kept clean, free from mud and slurry, and properly shaped and compacted by rolling to an even and uniform surface to receive pavement. Temporary or permanent roadside drains will be provided. Suitably reinforced concrete curbs will be provided at all corners to confine movement of vehicles to the pavement proper.

The wearing course will only be placed when all construction works have been completed. It will be laid to grade and camber as required.

CONSTRUCTION ACCESS

Contractor will be responsible for providing, operating, and maintaining appropriate access for equipment, services, and personnel during construction. Contractor will adhere to all applicable rules and regulations established by the state department of transportation (DOT), including road load limits. To allow traffic flow on haul routes and onsite access roads in a safe manner, Contractor will provide traffic control and protective devices in adherence of the Manual on Uniform Traffic Control Devices issued by the Federal Highway Administration. All costs associated with compliance are the responsibility of the Contractor.

ON-SITE ROADS

Contractor will provide all interior service roads as necessary. A minimum road width of 10 feet between PV array blocks must be maintained. Between rows of modules and circuit blocks, the pathways may be narrower, but must allow appropriate access for maintenance and repairs to all modules and array equipment. A minimum setback of 20 feet from the perimeter fence line such that any equipment can be used on the perimeter road. Roads will have a minimum inside radius of 17 feet. The Owner may provide written approval for smaller turning radius.

Contractor will meet the owners requirements, unless more distance is required by local authorities or instructed by state or local requirements. Road surfacing will meet local fire and emergency vehicle access requirements.

SITE ACCESS ROADS

Contractor will design and install a 20-foot wide Site access road. The Site access road will be gravel with the design based on sufficient soils and subsurface investigation by a qualified professional. The road will be designed to satisfy the loading requirements of equipment vendors and be suitable for access in all weather. The Contractor will restore any temporary roads or staging areas per the permit requirements, if applicable.

PARKING AREAS

Parking areas will be constructed with the additional requirements specified below. A minimum capacity of the car park will be provided in sufficient numbers and location to meet the operational requirements of the Plant.

The surface of the car parks will be laid with falls to the drainage system. No standing water will be permitted in the installation. Care will be taken during the construction that no materials enter the drainage system.

At the junction of the parking areas and roads due to different thickness of foundations, precautions will be taken to ensure that sub-surface drainage from the car parks does not detrimentally affect the road foundations.



ROAD MARKING & SIGNS

Signs will also be provided at strategic positions inside and outside the Plant. Directions and location of Plant areas, buildings, or structure and any other necessary signage will be provided.

STORMWATER MANAGEMENT AND SITE EROSION CONTROL

Storm water discharged to surface waters during construction and operations will not exceed the more stringent of Applicable Law or the Emissions Guarantees.

GENERAL

The Plant will be provided with a clean storm water runoff drainage system. The design of the Site drainage system will be based on the requirements from local jurisdiction.

The Site drainage system will be designed to adequately handle the peak rate of run-off resulting from the design storm. The storm water drainage system will be proportioned so that drainage channels and/or pipes run uncharged at self-cleansing/non-scouring velocities. Road ditches will be designed to ensure that the maximum width of flow in road channels does not interfere with the usage of any road.

A hydraulic analysis will be made for the storm water collection and conveyance system using established criteria as for open channel gravity sewers having uniform flow.

Stormwater drainage will be through swales and open drains. The drains generally will follow the roads within the property limits and be kept clear of all Plant equipment and buildings. Stormwater runoff will be collected by a series of swales and arterial drains. All drains will be constructed at a gradient. Ponding of stormwater is not allowed. Culverts will be provided where roads cross drainage paths. Erosion and scour protection for culvert inlets and/or outlets will be provided where needed to prevent damage.

TEMPORARY EROSION CONTROL

The Contractor will provide Temporary facilities to control erosion and runoff during earthwork operations and from graded areas until they are surfaced or seeded. Contractor will submit a location-specific erosion control plan for local jurisdiction approval prior to construction. Temporary facilities will include:

- Geotechnical silt fences
- Straw bale dikes
- Straw bale check dams in ditches
- Retention basins

All areas of temporary soil disturbance are to be graded, if necessary, and re-vegetated in a timely manner to limit erosion as required by the local jurisdiction.

SOIL EROSION AND SEDIMENTATION CONTROL

Unless otherwise specified, the Contractor will provide final grading, seeding, and other works to ensure that there is no erosion and that the erosion and sedimentation control is adequate. The Contractor will mitigate impact to the environment by adopting the following key principles to control erosion and sediment transport:

- Keep land disturbance activities to a minimum.



- Schedule the implementation of erosion and sediment controls so that they are timed to match the erosion and sediment needs created by the sequencing in each phase.
- Sequence the construction of storm drainage and sewer systems so that they are operational as soon as possible during construction.
- Divert Site runoff to keep it isolated from wetlands, watercourses, and drainage ways that flow through or near the development until the sediment in that runoff is trapped or detained.
- Utilize the existing topography to the maximum extent practical.
- Align roads on contours wherever possible and use them to divert surface water, thereby reducing slope lengths.
- Concentrate development on flattest area of the Site to avoid excessive slope cuts or fills where possible.
- Avoid steep slopes and soils with severe limitations for the intended uses. If there are no feasible alternatives to avoiding steep slopes and/or erodible soils, sound engineering practices will be employed to overcome the Site limitations. Seepage emanating from cut slopes will need provisions for internal drainage to prevent slope failure.
- Avoid flood prone areas, wetlands, beaches, dunes and other sensitive areas. When possible, keep floodplains free of fill or obstructions.
- Keep stockpiles, borrow areas, access roads and other land-disturbing activities away from critical areas that drain directly into wetlands and water bodies.
- Include early stabilization or covering of stockpiled topsoil or other erosive materials when they will not be used within thirty consecutive days.
- Locate detention basins outside of floodplains, wetlands and water courses, and adjacent to steep slopes.
- Utilize the natural drainage system whenever possible. If the natural drainage system of a Site can be preserved instead of being replaced with piped storm sewers or concrete channels, the potential for downstream damages from increased runoff can be minimized, making compliance with storm water management criteria easier.
- Minimize impervious areas and encourage infiltration where appropriate by keeping paved areas such as parking lots and roads to a minimum; increases in runoff may require control measures or drainage improvements.
- Perform runoff calculations to determine the effect of the development on the hydraulic system. Make changes where necessary to avoid downstream damage and to comply with the more stringent of Applicable Law or the Emission Guarantees.
- Perform calculations for the potential of downstream flooding or erosion when diverting one drainage system into another. The Contractor will consider collecting and detaining runoff when there is an increased potential for flooding and resultant damage to downstream facilities.

LANDSCAPING

Contractor will complete landscaping works that is required in the scope; such as retention pond seeding, drainage swale completion, sewage mound coverage, seeding, etc. The Contractor will landscape and re-vegetate the Site in accordance with all applicable laws and in consideration of the following guidelines:

- Minimize Site disturbance
- Maximize the use of native species and/or climate adapted drought tolerant species
- Maximize water conservation



- Maximize screening of visually offensive uses (utilities, equipment, etc.)
- Use natural materials for fencing to the maximum extent practicable
- Achieve maximum practical visual harmony with the surrounding environment

The Contractor will consider site specific and regional characteristics such as soil conditions, precipitation, shading, and temperature when preparing the landscape and re-vegetation plan.

The landscape and re-vegetation plan prepared will provide, but not be limited to, the following design details:

- The location of existing and proposed vegetation and landscape features;
- A list of the plant species to be used, including the size and quantity of each species.
- The approximate height of trees and shrubs (existing and proposed) to eliminate shading.
- The areas to be seeded or re-vegetated with seedlings along with the percent coverage for each plant species to be used.
- Suggested requirements for rainwater collection and/or irrigation systems.
- Compliance with local screening requirements

STRUCTURAL IMPLEMENTATION

GENERAL

Contractor will design the PV arrays' mounting systems, foundations, equipment pads, and buildings required for the Plant. The designs will be based on the requirements of applicable codes, standards, permits, and the design information provided by equipment vendors (e.g., module, inverter, transformer, switchgear, racking/tracking structures).

All structures and all parts thereof will be capable of withstanding code stress and deflection limits within prescribed settlements. The worst practicable combination of all loads including dead and live loads, wind, seismic, erection forces, secondary stresses, impact, temperature, and shrinkage effects will be considered in the design. Temporary loads during maintenance and erection will be considered. Ultimate strength design will generally be employed for reinforced concrete structures; for steelwork either load resistance factor design methods or working stress methods are acceptable. Anticipated deflections at service loading will be considered and will not result in inadequate performance or loss of normal function.

Minimum loads and loading combinations will be consistent with applicable code requirements. Except when applicable Codes and Standards provide otherwise, all loads will be considered to act in the combinations that produces the most unfavorable effect in the building, foundation, or structural member being considered. The Contractor is responsible for reviewing the provisions of the local building code, determining any unique design conditions and applying any appropriate engineering practices that may dictate live loads greater than the minimum loads listed herein. All structures will be designed for loads resulting from construction activities. Loading from construction activities, whether of short or long duration, will be considered as live load. Construction loads and combinations will be rationally combined with all other loads to address the most critical condition. Mixing of load cases/definitions and load combinations of codes of various institutions is not permitted without prior approval.



ENVIRONMENTAL LOADING

All structures at the Plant will be designed using environmental loading as specified in the American Society of Civil Engineers (ASCE) Minimum Design Loads for Buildings and Other Structures; these include seismic, wind, snow, rain, and ice. Each structure on Site will be grouped in Occupancy Category, as determined by the engineer of record, and the corresponding importance factor will be used for calculating environmental loading. Contractor will take into account a higher environmental loading for the racks on outer perimeter of the Project.

EXCAVATION, BACKFILL, AND COMPACTION

All excavations will be carried out and supported in such a manner as to prevent flooding or ponding of water, damage, or interference to structure services or stored equipment/materials. Contractor is solely responsible for all temporary work as necessary during construction. Contractor will be responsible for making all excavations in a safe manner and consistent with the requirements of the Occupational Safety and Health Administration. This includes, but is not limited to, shoring, cribbing, rock blasting, and dewatering. The Contractor will maintain records of inspection and testing of formations to ensure compliance with design assumptions and will comply with the requirements of the local authority regarding notification and inspection.

Minimum fill compaction will meet the requirements of ASTM D1557.

CORROSION PROTECTION

Corrosion protection will be applied to all structures of the Plant. The type and amount will depend on the selected materials of construction and conditions at the Site. A study of these conditions along with recommendations from the geotechnical report will be used to design the corrosion protection system.

The corrosion protection study will be performed by a qualified corrosion expert and documented with references and calculations showing that the foundations, supports, racking, fasteners, and conduit will meet a 30-year design life in aboveground and belowground conditions. If galvanized materials are used, field-applied zinc coatings will meet American Society for Testing and Materials (ASTM) A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings. This standard contains minimum requirements for the material, surface preparation, and application process.

All holes in galvanized structural members will be drilled before the galvanization is applied. If holes are required to be drilled in the field, galvanizing will be applied to the exposed steel as specified in ASTM A780. All field welds will have a field-applied galvanization as specified in ASTM A780. Only steel bolts with pre-applied corrosion inhibitors and/or stainless-steel bolts and fasteners will be allowed in the entire mounting structure.

CONCRETE AND GROUT WORK

GENERAL

Concrete work will, as a minimum, be designed, specified, and installed in accordance with applicable ACI requirements. Reinforced concrete structures and foundations will be designed in accordance with the applicable provisions of ACI 318, "Building Code Requirements for Reinforced Concrete."

The design mix will produce a workable concrete that conforms to applicable ACI requirements or those of other international standards approved by Owner. The design mix will be tested for compliance of required strength and characteristics before use in permanent works.



All grout will be flowable, non-shrink and non-metallic natural aggregate, or as required by equipment manufacturers.

EXECUTION OF WORK

In executing the work, the Contractor will conform to all applicable ACI requirements regarding:

- Design and installation of formwork
- Cutting, bending and placing of reinforcing bars
- Mixing, placing, finishing and curing of concrete

Construction joints will be located where the strength and serviceability of the structure is least impaired. Provision will be made for transfer of shear and other forces through the joints as required.

Water stops will be provided in construction joints in walls and slabs where necessary to maintain watertight integrity of the structure. Water stops will be located such that their presence does not affect the performance of shear keys if they are present in construction joints.

Minimum net thickness of concrete cover over reinforcing or embedded steel will be per ACI requirements.

MATERIALS

The minimum twenty-eight (28) day specified compressive strength of structural concrete will be a minimum of 4,000 psi (27.6 MPa). Reinforcing steel bars will be ASTM A615 Grade 60. Welded wire fabric will conform to the requirements of ASTM A185.

The concrete design mix, as well as the type and proportions of all constituent materials and cement type, will be selected to ensure adequate strength and durability for the environmental and exposure conditions. The design mix will produce a workable concrete that conforms to applicable ACI requirements or equivalent international standards approved by Owner. The design mix will be tested for compliance of required strength and characteristics before use in permanent Work. Contractor will conduct material tests and concrete break tests as appropriate during all phases of the work to ensure the quality and consistency of the concrete used. Contractor will ensure strict enforcement of all maximum permissible water-cement ratios for all concrete.

GROUT WORK

All grout will be flowable, non-shrink conforming to ASTM C1107. Grout will not contain metallic aggregate, oxidizing catalysts, gas producing agents no more than 300 ppm chloride. Grout will attain a one (1) day minimum compressive strength of 3500 psi per ASTM C109 and a minimum compressive strength of 5000 psi at 28 days. Grout will conform to ASTM C1107 when mixed to a fluid consistency as prescribed by ASTM C827 at temperature extremes of 7°C (45°F) and 32°C (90°F) with an extended working time of 30 minutes or more.

For thickness greater than 3 inches, pea gravel or other approved filler will be added to the grout. Such filler will conform to the grout manufacturer's written requirements or recommendations.

Curing compound will conform to ASTM C309, Type 1-D with fugitive dye. The product will be compatible with and in accordance with the grout manufacturer's recommendations.

Equipment grouting will be performed in accordance with the materials and procedures specified by the equipment manufacturer.



Non-shrink grout will be furnished factory premixed so only water is added at the Site.

FOUNDATIONS

GENERAL

Contractor will design the PV arrays' mounting systems and foundations, as well as any equipment pads and buildings required for the Plant. Contractor is responsible for selection and design of foundation types. Foundations will be as required to accommodate the loadings, tolerable settlement, and soil conditions of the Site. All foundations constructed within the water table and the capillary rise zone will be suitably protected from chemically aggressive ground conditions. All concrete foundations will be reinforced with no less than ACI minimum temperature and shrinkage reinforcing.

All concrete foundations will be designed in accordance with ACI 318 or other internationally recognized standard, good industry practices, applicable building codes, and manufacturers' recommendations. The designs will comply with the information provided by the equipment/material vendors (i.e., module, inverter, transformer, switchgear, racking/tracking structures, etc.). If the structural framing or equipment manufacturers' requirements have more stringent geotechnical criteria, the most stringent criteria will be used for design.

The design of foundations for all structures and equipment will be such that differential and total settlements or other movements will not exceed acceptable limits. Settlement limits will be determined by the sensitivity of structures and equipment to settlement.

RACKING/TRACKING SUPPORT FOUNDATIONS

The racking/tracking support foundations and supports will be designed for a minimum 25-year life and will include consideration of all environmental factors and corrosion. The foundations will be designed to withstand the impacts and contact pressure from the chosen installation method. Any Contractor caused damage to corrosion protection coatings will be repaired by Contractor.

EQUIPMENT PADS

Pertinent information about the supported equipment (i.e., footprint, weight, anchorage requirement, nature of equipment, loading criteria, special recommendations by equipment manufacturers, etc.) will be considered in the design of foundations. In general, equipment will be supported on mat or spread footing type foundations; or, piling if required due to the soil conditions.

All equipment foundations will be located such that adequate personnel access is provided; a minimum of 4 feet horizontal clearance from obstructions that would otherwise limit access to the equipment on the pad will be provided on all sides of the equipment foundations. The equipment foundations will be sized sufficiently to allow for safe and adequate working space around the equipment. The slope of the grade around the inverter stations and other equipment will allow for safe and ergonomic personnel access to the equipment.

Critical equipment (i.e., inverter stations, switchgear, and substation (if applicable)) will be located outside of the Federal Emergency Management Agency (FEMA) 100-year flood plain and bolted to equipment pads.



BUILDING FOUNDATIONS

Buildings will be supported on reinforced concrete foundations and will have foundations appropriate to the ground conditions. The finished ground floor level within all buildings will be not less than 6 inches above finished grade.

TRANSFORMER FOUNDATIONS

Transformers will be founded on suitable, reinforced concrete foundations.

The ground in front of the transformers will be suitably treated to facilitate installation, maintenance and replacement of the transformers.

BUILDINGS

Buildings, storage facilities, and enclosures will be provided to the extent that is required; i.e., to provide protection from environmental loads to ensure reliability, availability, and operation of the equipment, by law, or the Interconnection Agreement.

The building architecture, architectural components, and finishing of these buildings will be appropriate for similar facilities and will comply with local culture. The Contractor will prepare the building arrangement to be reviewed and approved by the Owner before detailed design. Pre-engineered building may be used to reduce the overall cost of construction.

Buildings will conform to a common architectural concept to unify the various elements and will be suitable for the operating and climatic conditions at the Site. The design will make selective use of materials to produce a pleasing industrial concept throughout and a working environment that is safe, durable, and functional. The dimensions of all the buildings will be such as to provide adequate space for the safe installation and proper operation and maintenance of Plant and equipment. Adequate space will be provided immediately in front of, behind, and beside all buildings. Appropriate access will be made available for maintenance and operations activities including but not limited to equipment removal by fork truck or crane as required.

The design of all buildings will ensure that noise, vibration, and temperature levels are within acceptable limits.

All buildings and structures will have lightning protection, where required.

The external surface of all buildings will be protected by a system of abrasion resistant color-fast coatings. The color and pattern will be subject to Owner's selection and colors and patterns of all buildings and structures will be the same color scheme. Samples will be submitted to the Owner prior to orders being placed with the manufacturer.

STRUCTURE AND FOUNDATION STABILITY

Every structure and foundation will be designed to resist the overturning, hydrostatic uplift, and sliding effects caused by applied forces. Stability analyses will be performed by superimposing all appropriate loads for each of the conditions being investigated in accordance with standard engineering practice as governed by applicable codes and standards.



FENCING

Contractor will provide fencing for the Plant. Contractor will be responsible for security during construction and utilize temporary fencing whenever an existing fence is removed. Fencing may be required to maintain security and prevent to movement of livestock.

The Contractor will provide chain link fencing around the Site boundary and security fencing to enclose the main power generating Plant, primary construction parking and laydown, construction areas (as needed), and other areas requiring controlled access. Fencing will be a 7-foot-high chain link fence with 1-foot top guard (total 8-foot high) of three strands of nine-gage barbed wire and designed to meet NESC and IEEE standards. Fencing will have posts set in concrete no more than 2 inches above finished grade. Contractor will provide a minimum setback of 20 feet between the perimeter fence line and the PV panels and project substation. The Contractor will ensure that the perimeter fencing does not shade the PV arrays.

Locked gates at the main Plant entrances and exits will be provided. Two slide gates for vehicles with a width of 20 feet and one gate for pedestrians with a width of 4 feet will be included.

Lockable main gates, matching the construction and color of the remainder of the perimeter fencing, will be provided adjacent to all road gates.

ELECTRICAL ENGINEERING

GENERAL

The Contractor's engineering and design will be in accordance with good utility practice, and shall follow typical industry standards regarding engineering, construction and diligence for the design and construction of utility scale, grid-connected solar PV generation projects in the United States. The design shall meet the conditions of all applicable permits and laws and shall follow the standards listed herein.

SCOPE

The Contractor is wholly responsible for all design, engineering and procurement required for the construction of the PV Power Plant that meets all requirements contained herein. This includes all design drawings, calculations and specifications which will be properly certified and stamped in accordance with the requirements of the state where the project is located.

All design drawings, calculations, specifications, data and documents will be submitted to the Owner for review and comment per an agreed upon schedule.

The Contractor is responsible for providing all electrical engineering design services required to show compliance with the applicable codes and standards, and to meeting the requirements of the interconnecting utility, ISO and authority having jurisdiction. The electrical scope includes, but is not limited to, the engineering, design, procurement and construction of the following systems:



ELECTRICAL EQUIPMENT AND SYSTEMS

- Furnish Solar Modules
- AC & DC Collection Systems
- Inverters
- Combiner boxes
- Generator step-up (GSU) transformers
- Medium voltage switchgear (if applicable)
- Station auxiliary transformer
- Auxiliary power distribution system
- All power, control, instrumentation, and special cables
- 125 VDC battery system, including battery charger and DC distribution panel
- Cable installation and raceways
- Lightning protection system
- Miscellaneous electrical systems
- Substation instrument transformers
- Grounding mat and equipment grounding
- Indoor and outdoor lighting
- Emergency lighting
- Relay protection systems
- Supervisory Control and Data Acquisition (SCADA)
- Remote Terminal Unit (RTU) panels
- Communication Systems
- Generator for construction power, if applicable
- All performance testing
- Storage equipment, if applicable

ELECTRICAL STUDIES

- Load Flow / Losses
- Reactive Power
- Cable Sizing calculation
- AC auxiliary power system sizing
- DC auxiliary power system sizing
- Grounding calculation
- Insulation coordination



- Lighting/Surge protection study
- Protective relay settings
- Short Circuit Study
- Arc Flash Study
- Harmonics Study

COLLECTION SYSTEM

The Contractor will design the collection system using design philosophy typical for utility scale PV projects in the United States. The collection system shall allow the power to be collected from the individual PV modules, combined, and routed to the inverters, stepped-up in voltage and exported to the grid. All proper protection systems will be installed, including fusing, relaying and lightning protection to ensure the safe and reliable operation of the collection system. Collection system grounding shall meet all applicable codes, standards and guidelines and shall ensure the safe and reliable operation of the collection system.

DC SYSTEM

The Contractor is responsible for the engineering and design of the DC system, which includes all equipment and connections required to allow power to reach the inverters from the solar modules. The DC system should be designed to optimize energy yield, and should take into consideration typical design parameters such as voltage ratings, voltage drop, ohmic losses, etc. The Contractor will ensure all cables and equipment are sized appropriately according to the NEC and good utility practice. A cable sizing calculation will be submitted to the Owner for review. The Contractor will design all aspects of the DC system to meet applicable IEC, IEEE, NEC and authority having jurisdiction (AHJ) requirements.

Protective systems and equipment will be used through the DC systems as is dictated by good utility practice and typical design standards of utility-scale PV. At minimum, appropriately sized finger-safe fuses should be used for each DC string at the combiner boxes, and MCBs will be utilized for each inverter input. These protective systems will be sized to reduce possible damage to all components resulting from an electrical fault and will be sized to meet the applicable NEC, NESC and IEEE standards and guidelines.

The DC systems will be designed to facilitate operations, access, troubleshooting, maintenance etc., and to meet the specifications and guidelines contained in this document and all attachments.

For the DC system, all racking needs to be bonded to the inverter via equipment grounding conductor. A local grounding electrode conductor will be installed at each section of UL2703-listed racking.

Combiner box layout should be based on the maximum amperage input of the inverter's MPPT channels. All conductors will be identified via traditional color codes (i.e. red is positive, black is negative in an ungrounded system).

All DC cables must be secured and protected in a way to prevent damage and ensure operational life. Typical methods include UV resistant cable ties, cable loop clamps to modules, UV resistant cables sleeves, cable tray and conduits. Cable management plan and hardware will be described in the design documents and submitted to the Owner for approval. The cable management will ensure damage from sharp edges, water and UV light is prevented, and cables are properly protected and accessible for maintenance.



AC SYSTEM

The AC system will be engineered and designed so that all equipment and cabling (above and below ground) is sized adequately to allow power to be exported from the inverters to the grid safely and reliably. The Contractor shall ensure all cables and equipment are sized appropriately and protected as required by good utility practice and all applicable IEC, IEEE, interconnection utility, and authority have jurisdiction (AHJ) requirements.

Protective systems and equipment will be used throughout the AC systems as is dictated by good utility practice and typical design standards of utility scale PV in the United States. These protective systems will be sized to reduce possible damage to all components resulting from an electrical fault and will be designed to meet the applicable NEC, NESC, interconnection utility, ISO, NERC and IEEE standards and guidelines.

The Contractor will design the Site equipment grounding, lightning and surge protection per the applicable standards and guidelines. A comprehensive lightning and surge protection assessment will be performed and submitted to the Owner prior to the start of construction.

The Contractor is responsible for ensuring that the power delivered to the grid meets all interconnection requirements regarding reactive power and power quality.

The AC systems will be designed to facilitate operations, access, troubleshooting, maintenance etc., and to meet the specifications and guidelines contained in this document and all attachments.

PROTECTION

All equipment will be protected from damage occurring during electrical faults with fuses, breakers and protective relaying. The protection system will be designed to good utility practice and to meet all applicable codes and standards including the interconnection agreement and NERC standards. A relay studying and fuse coordination study, along with a protection one-line diagram will be submitted to the Owner for approval.

COMMUNICATION SYSTEM

The Contractor is responsible for the engineering, procurement, installation and testing of a SCADA/Communication systems that meets the requirements of the Owner, Interconnection Utility, ISO, or Offtaker using good utility design practice. These systems will allow for remote monitoring and control by the appropriate stakeholders.

The SCADA system will be composed of utility rated hardware and software designed to integrate and communicate with a wide variety of instrumentation and control systems throughout the Site, and allow for remote monitoring and control. The integration includes, but is not limit to, meteorological stations, transducers, inverter status points, and other miscellaneous alarms, sensors and controllers.

SOLAR EQUIPMENT SUPPLY

The Contractor will be responsible for procurement of all necessary equipment for the completion of an operating PV generation Plant as specified in this document. This includes, but is not limited to the items specified in this section. All equipment shall be subject to inspection by the Owner or their representative at any time during staging, installation, or testing.



The Contractor is responsible for the installation of a secured fenced area on-site for receiving and storing equipment and materials during construction. The Contractor will be responsible for maintaining the overall security of the Plant to prevent theft or damage and to securely receive and store all freight and materials.

All installed equipment will be of a quality equal or better to the equipment specified in the design and engineering plans. Utility-grade equipment will be used wherever possible, and any non-utility-grade equipment will be submitted to the Owner for approval prior to construction.

The contractor shall provide a list of all major equipment to be furnished as part of the Plant. This list shall identify both the items and quantities, and shall identify any use of SF6 or hazardous material. Data sheets and vendor drawings of the major equipment will be submitted to the Owner for approval prior to procurement.

PV PANELS

The PV modules will be Owner furnished materials. The PV modules shall meet all applicable aspects of the following standards and requirements:

- IEC 61730: Photovoltaic Module Safety Qualification
- IEC 61701: Salt Mist Corrosion Testing of Photovoltaic Modules; Severity 6
- IEC 61853: Photovoltaic Module Performance Testing and Energy Rating
- UL standard 1703 listed for the voltage specified
- Manufacturer identified as Tier 1
- Manufacturer will have a bankability report from an independent engineer
- Manufacturer will have an established track record of successful installations in the United States
- The manufacturer shall have demonstrated workmanship quality through a third-party factory audit or testing score. The results of these audits or test results will be submitted to the Owner for review.
- All modules shall have electroluminescence testing of every module for defects. Results will be made available to the Owner for review/approval.

Documentation will include flash test results and EL images before and after the tests. The testing procedure will be sent to the Owner for approval.

Flash test data for all modules will be submitted to the Owner upon procurement of the modules.

The snow load capacity of the modules must be specified to match site specific conditions.

The same module make and model will be used throughout the site, and the modules will be corrosion-resistant, resistant to damage from snow, wind, hail and windblown dust and sand. The modules shall include a grounding lug, grounding hole, or some other tested grounding attachment mechanism

COMBINER/RECOMBINER BOXES

Combiner boxes will be of utility grade construction and supplied by a reputable manufacturer.

Combiner boxes will be rated for maximum system voltage and maximum system continuous and short-circuit currents.



Terminal blocks will be rated, at minimum, for 1500V and 75°, and with a temperature rating that meets site specific requirements.

Integral fuses shall have blown fuse indicator. Finger-safe fuses will be used for protection and disconnection of each DC string.

Combiner box output shall have a means to be externally isolated.

The combiner box shall have integral surge protection on the inverter side, and the combiner/recombiner box shall have a visual trip indicator.

Combiner/Recombiner boxes will be rated NEMA 4 and will be lockable.

CABLES AND CONNECTORS

The Contractor will document cable and connector selections prior to installation for Owner approval.

PV panel interconnect connectors will be: 1) latching, polarized, and non-interchangeable with receptacles in other systems, and 2) tap branch connectors with multi-contact termination connectors. The grounding connections will be first to make and last to break and will be rated for the interrupting current.

The manufacturer of all connectors will have a proven track record of successful installations in North America.

For the DC feeders and PV panel interconnect cables the Contractor will furnish at least 2-kilovolt 90°C (wet or dry) power cable type USE-2 or RHH/RHW-2 with XLPE jacket and UL 1581, VW-1 rating (or approved equal that is capable of meeting DC collection system design current requirements. Any substitutes must be identified and submitted to the Owner for approval) All exposed cables will be UV rated, direct burial rated, and be in conformance with NEC 300.5 where applicable.

Cables will meet the requirements of PV wire as stated in NEC Article 690.

INVERTERS

The inverters will be manufactured by a reputable manufacturer who has a history of successful inverter installations in North America.

The inverter will be certified to applicable standards by an approved independent third-party inspection agency (e.g., TUV, Intertek, Underwriters Laboratory)

The inverters shall have a minimum design life of ten (10) years.

The inverter will be sized to maximize Plant output and to allow for adequate dynamic reactive compensation support to meet grid requirements. The inverters will be calibrated so that the AC output at the point of interconnection shall not exceed the limit in the generator interconnection agreement. The inverter and associated transformers and wiring will be installed to meet the requirements of the National Electric Code.

The inverters selected for this project must meet the following requirements:

- UL listed to 1741



- Comply with IEEE 1547-2003, including testing to IEEE 1547.1 and IEEE C62.45. Regulatory standards compliance shall also include IEEE C62.41.2 and CSA107.1-01.1.
- Equipped with anti-islanding capability.
- The selected inverters in combination with the overall Plant design shall meet all grid code requirements regarding reactive power and power quality. The Contract shall review the MOST recent requirements (NERC, ISO, Utility, etc.) applicable to proposed project and submit documentation showing the selected inverters compliance with these guidelines, including voltage and frequency ride-through.
- The Contractor will provide notice to the Owner at least two weeks prior to factory acceptance tests. The Owner, or its representative, shall have the opportunity to witness factory acceptance tests to ensure all requirements are satisfied.
- The selected inverter will have a maximum harmonic distortion less than 3% of total harmonic distortion at rated power output. The Plant will meet all applicable requirements in IEEE 519.
- Efficiency will be greater than 97.5% (not considering medium voltage step up transformer losses)
- No-load consumption at less than 1% of nominal power and less than 0.1% in standby mode
- Comply with any applicable regulations on noise level
- Equipped with lightning protection
- Inverters located outdoors will be enclosed in lockable enclosures with a minimum rating of National Electrical Manufacturers Association (NEMA) 3R and with coatings in accordance with proper corrosion protection. Any sensitive electronic equipment will be installed in a NEMA 4 rated enclosure.
- Employ a maximum power point tracking scheme which is suitable to optimize inverter efficiency over the entire range of PV panel output for the proposed design
- Equipped with all hardware/software for data collection and control as required by the SCADA sections of this document
- Sufficient AC/DC protection and disconnect means to meet the requirements of the NEC and AHJ
- Integral protective functions for overvoltage, undervoltage, overcurrent, over-frequency and under-frequency, and will meet the low voltage ride through, ramp rate and dynamic response requirements of the interconnection.

The selected Inverter manufacturer shall:

- Be certified to OHSAS 19001, ISO 9001 and ISO 14001 standards
- Have at least 100 MW of inverter capacity installed as part of successful utility-scale PV projects in North America



TRANSFORMERS

All transformers shall comply with all applicable standards contained within IEEE C57.12 and IEC 60076 and will be rated for continuous operation at any tapping to handle the maximum output of the associated inverters.

Transformers will be oil immersed type and of a low loss design to maximize efficiency of the project. Transformers shall meet transformer efficiency standards set forth in the most recent version of the U.S. Department of Energy "Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule."

Transformers will be specified to meet the requirements of good utility practice and will be sourced from a reputable transformer manufacturer with proven success in North America. Transformer specification, vendor drawings and procurement order will be submitted to the Owner for approval.

The transformer shall include standard accessories including, at minimum, liquid level and pressure vacuum gauges, dial type thermometer with SPDT alarm contacts, pressure relief valve and a drain valve with sampler.

The transformer will be supplied with a fused disconnect switch on the transformer high-voltage side to isolate the transformer in case of an internal fault. The switch/transformer configuration will be designed for loop feed.

The Owner reserves the right to attend factory witness testing of transformer and will be informed when this testing is scheduled. The service life of the transformer will be at least 25 years.

SWITCHGEAR

The switchgear will be designed, manufactured, and tested in accordance with the latest IEC, ANSI, and NEMA standards. The MV and LV switchgear will be of a design that has passed testing for arc-flash resistance according to Standard IEEE C.37.20.7, or will be provided with arc-flash mitigation if required. The switchgear will be adequately rated for the parameters of the Project.

The design of the equipment will be such as to prevent accidental contact with live metal and to avoid the spread of fire or damage from short circuits or other cause. Cubicle type equipment shall include barriers to segregate the equipment for each circuit and main and subsidiary bus bar compartments. Suitable handling equipment will be provided where necessary for the operation and maintenance of the switchgear and breakers.

Circuit breakers utilized in the MV switchgear will be SF6 or vacuum type. A SF6 type circuit breaker shall conform to all requirements in IEC 60376.

All circuit breakers of the same voltage will be fully interchangeable. The operating mechanism will be of the trip free design with an anti-pumping scheme and operation counter.

In general, the switchgear design and components shall meet the requirements of the interconnecting utility and the interconnection agreement and follow good utility practice.

The switchgear specification and vendor drawings will be submitted to the owner for approval prior to procurement. The switchgear will be outdoor rated, NEMA 4. It will be lockable and shall have current and voltage protection, instrument transformers and associated relays included.



MODULE SUPPORT STRUCTURE

FIXED TILT RACKING STRUCTURE

Contractor will be responsible for the fixed tilt racking system (if applicable), including the racking structure and all module mounting hardware. The racking vendor or a third party may supply the supports. Contractor shall specify the rack's azimuth and tilt angle on the engineering drawings.

Contractor shall design the racking system with a 20-year design lifetime. This includes the racking structures, support attachments, module mounting brackets, fastening hardware, and supports (if applicable). Vendors under consideration for the fixed tilt racking system shall have installed a minimum of 50 MW capacity in utility-scale projects.

SINGLE AXIS TRACKING STRUCTURE

Single axis tracking systems (if applicable) shall include the racking structure, mounting hardware, drive motor(s), and controller system. Any equipment required for the safe operation and wind stow (if applicable) will be included in the bid. The trackers shall automatically track the path of the sun each day. All control equipment enclosures will be rated NEMA 4.

The tracking system will be designed using the environmental loads and the Occupancy Category outlined in contract documents. The torque tubes, support attachments, module mounting brackets, all fastening hardware, and supports (if applicable) shall have a 20-year design lifetime. PV modules will be mounted in landscape orientation. PV modules may be mounted in portrait orientation only if backtracking is employed in the tracker controls.

Single axis trackers feature a "stow" option that operates during high wind conditions, the "stow" feature changes the angle of the tracker's tilt to decrease the wind loads on the racking, supports, and foundations. A backup energy source (i.e., backup emergency battery storage system) will be installed at the Plant if a "stow" is required to meet wind loads in the event of a grid interruption. This is to ensure that the tracker can move into the stow position.

Contractor shall design the PV arrays' mounting systems and foundations. The design shall be based upon standard industry practice, including the requirements of applicable codes, standards, and permits, as well as the information and specifications provided by the module, inverter, transformer, switchgear, racking, and all other vendors.

Single axis tracking vendors under consideration shall have installed a minimum of 50 MW of capacity in utility-scale projects.

METEOROLOGICAL STATION

Contractor will provide at least two (2) Meteorological Stations to provide adequate meteorological data to evaluate Plant performance. For sites with greater than 50MWp, a minimum of three (3) Meteorological stations are required. The Meteorological Station shall include at a minimum, the ability to measure:

- Reference cell temperature
- Reference cell irradiance at plane of array



- Ambient air temperature having an accuracy of $\pm 0.2^{\circ}\text{C}$ or better – two temperature stations are required for Plants with a single Meteorological Station
- Wind speed having an accuracy of ± 1.5 percent or better
- Wind direction having an accuracy of $\pm 5^{\circ}$ or better
- Global horizontal irradiation (GHI) – two pyranometers are required for GHI measurement
- In-plane of array (POA) irradiation – one pyranometer is required for POA irradiation measurement
- Rain measurement
- Back of module temperature having an accuracy of $\pm 0.5^{\circ}\text{C}$ or better, attached to modules in such a way as to reflect temperatures representative of the average of the array and adhered to middle of back of module using conductive epoxy and/or Kapton tape to avoid the creation of a hot spot

The irradiance meters shall have an accuracy of better than ± 2 percent.

The station shall have capability of recording and storing environmental conditions without AC power for a minimum of 1 day.

Installation, calibration, maintenance and operation of the meteorological station shall conform to standard industry practices. NIST calibration certificates will be provided for meteorological instruments listed above. The reference cells or modules will be calibrated by the National Renewable Energy Laboratory (NREL) or an Owner-approved equivalent.

SCADA

The Contractor will furnish and install an Owner-approved monitoring hardware and software package from a reputable vendor. The monitoring system shall provide energy generation data, historical data, solar insolation attributes, and meteorological data. In addition, it must provide all the necessary status and alarm monitoring and Site control points.

The SCADA system will utilize microprocessor based process controllers to monitor and control Plant areas and auxiliaries (inverters, relays, meteorological stations etc.). A suitable data network will be designed (typically TCP/IP on fiber optic network) to allow centralized monitoring and control at operator and engineering workstations.

The monitoring system will be designed to instantly alert the operations manager of alarm status.

The system will be designed so that metering complies with the standards in IEC 61724.

The metering scheme will be designed to read bi-directional energy flow at the point of interconnection, and will be capable of metering both the maximum (daytime) and minimum (standby) power flows.

All metering, status, alarm, analog and control points will be made available for remote control and monitoring to the Owner, Utility, ISO and Offtaker as required. The Contractor shall propose a method for accomplishing this which will be submitted for approval by the Owner. Typical industry security measures will be taken to ensure there is no unauthorized access to the system. This includes firewalls and routers as dictated by good utility practice.



Points to be monitored and made available shall include at minimum the following:

- Meteorological parameters
- Inverter Shelter environmental conditions
- Inverter Shelter HVAC/climate control status
- Inverter Shelter door position switch
- Inverter performance points: To include real time AC and DC electrical characteristics, including power, energy generated, inverter status and diagnostics, and all data available from inverter system (including every inverter fused input monitoring).
- Met Station PV module surface temperature (quantity of 2 sensors per PV module, and 2 such monitored PV modules per weather station)
- PV String current, all
- Inverter Transformer oil temperature
- Inverter Transformer pressure/vacuum
- Inverter Transformer oil level
- Medium & High Voltage Circuit Breakers Status
- Medium & High Voltage Circuit Breakers Loss of DC Voltage Loss of AC Control Power
- Medium & High Voltage Circuit Breakers Low SF6
- Medium & High Voltage Circuit Breakers General Fault
- Control Room Interior Temp
- Control Room Door Status
- Control Room HVAC Status
- Revenue Meter Voltage, VARS, MVARs, MWh, Amps, Frequency

A final points list will be submitted to the owner for approval.

METERS

A bi-directional revenue grade meter will be installed to measure the total Plant output at a point specified in generator interconnection agreement (POI). The revenue grade meter will be American National Standards Institute C12.20 0.2% Class UL listed, ISO9001 certified. The instrument transformers utilized by this meter will be metering class accuracy.

The meter shall have a local visible display and interface, and shall also provide data to the SCADA system for remote monitoring.

This revenue meter shall match the one specified by the interconnection utility which shall act as the billing meter. Contractor shall coordinate with the interconnection utility for the installation of same.



AUXILIARY EQUIPMENT AND ACCESORIES

The battery system will be sized: to provide DC power to trip, close, and recharge the switchyard 8 hours after a loss of power; recharge within 12 hours; and supply sufficient power to the SCADA and communications systems for 12 hours minimum. The battery sizing will be compliant with IEEE 484 and the battery sizing calculation will be provided by Contractor to Owner. If the PV trackers have “stow” functionality, back-up will be provided to allow them to return to the stow position in the case of power loss.

The contractor will design permanent lighting installations, comprehensive emergency lighting systems, and road lighting systems per typical industry practice. The lighting installation will be designed to last the operational life of the Plant; providing recommended minimum levels of illumination in accordance with BS EN 12464. Illumination will be provided in such a manner as to ensure evenness and to avoid glare.

To facilitate operations and maintenance, the contractor will install power socket outlets at convenient areas throughout the Plant. Socket outlets shall comply with IEC 60309 and will be installed to give adequate coverage of all buildings and areas of the solar PV installation.

SIGNAGE, IDENTIFICATION, NUMBERING, AND LABELING REQUIREMENTS

Contractor will include within its scope of supply a Plant-universal designation numbering system utilizing the Owner’s based system. The designations will be included on all drawings, schedules, descriptions, and other documents as well as on all nameplates, tags, and on equipment and components itself (wherever applicable). Except for cable and wire identification, the identification designation will be engraved or stamped on stainless steel nameplates. Each piece of equipment and associated apparatus will be provided with signage (tag plates) indicating tag number and description. All major equipment – including inverters, combiner boxes, transformers, etc. – will be provided with the data plates, indicating the name of the vendor, type, model number, serial number, year of fabrication, main characteristics, and all further information necessary for a complete identification of the equipment.

Instruction plates, nameplates and labels will be provided for all items of the Plant giving particulars about rating, duty, size, model number, serial number and full information for identification and operation. The Contractor shall pay attention to the name tags, nameplates and labels during painting operations to ensure that such identifiers are not painted over. Labels will be of sufficient size to carry a full description of the Plant item and its complete identifier.

Tags will be fitted by stainless steel self-tapping screws, stainless steel banding such that they are not readily lost or broken during routine operations and maintenance.

Cable markers which indicate the presence of underground electrical facilities will be installed at all road crossing locations.

Arc flash labels will be placed prior to energization of equipment.

Any labels damaged or defaced during installation of Plant will be replaced by the Contractor prior to Substantial Completion.

All Plant signage must meet current industry standards and shall have a life span of 20 years.



INSTALLATION

DC SYSTEM WIRING

- Any cable or connector that will be exposed to sunlight is required to be UV resistant and outdoor rated.
- For series string connections between solar modules, the factory supplied quick connectors will be utilized.
- Series string circuits will be combined in parallel and ran as a single circuit back to a combiner box. A minimum of 12 AWG cable will be used to connect these series string circuits and the cable shall utilize quick connect ends.
- The DC cabling running between the modules and the combiner box will be buried in conduit, at least 24" below grade in a clean fill material. For cables that are direct buried, a detectable marker tape will be placed 12" below grade over the entire length of the conductor run. Backfill will be compacted to 95% modified proctor density.
- The DC cabling from the combiner boxes to the inverters will be buried conduit at least 18" below grade in a clean fill material free of aggregate. If the cable is run underground, a detectable marker tape will be placed 12" below grade over the entire length of the cable run. Trench bedding will be adequate to prevent damage to the cable from any oversized material.
- For transitions between above and below grade, DC cabling will be protected from damage by utilizing mechanical protection (e.g. conduit).

AC SYSTEM WIRING (600 V AND BELOW)

- All conductors and cable accessories will be UL/IEC listed.
- All exposed cables and connectors will be outdoor rated and UV resistant.
- All conductors will be stranded copper or aluminum. Any connectors used with aluminum conductors must be compression type and suitable for use with aluminum cable.
- Oxide inhibit will be used when terminating aluminum conductors.
- AC conductors shall not be spliced.

MEDIUM VOLTAGE AC SYSTEM WIRING: INVERTER TRANSFORMER TO INTERCONNECTION FACILITIES

- Medium voltage AC conductors will be aluminum with copper concentric neutrals. Selected cable must be rated for the intended use and meet applicable IEEE, NEC and ICEA standards.
- The Contractor shall select one of the installation methods listed below for each cable:



- Direct bury rated, single conductor with jacket: Conductors are placed in a single trench and separated per NEC table 310-82. Trench shall have a bed of clean fill material free from aggregate.
- Direct bury rated, single conductor with jacket: Conductors are placed in a single trench in a triplex arrangement as per NEC table 310-82. Trench shall have a bed of clean fill material free from aggregate.
- Three conductor cables, with an interlocked metallic armor and with an overall jacket, suitable for direct burial.
- All conductors will be buried at a minimum depth of 36" below grade unless otherwise specified in the contract documents. All cables will have a marker tap placed 12" below grade over the entire length of the cable run.
- The Contractor will install a bare copper equipment grounding conductor with each feeder with a calculation supporting its size.
- The Contractor will size the conductors so that no single conductor has more than a 2% voltage drop across it at full generation.
- For medium voltage terminations the contractor will install cold shrink terminations, rated for outdoor use and live front applications. The terminations will be of IEEE-386 class for non-load break, dead front applications.
- For transitioning into and out of the transformers, conduits sleeve will be provided.
- For transitions between above and below grade, AC cabling will be protected from damage by utilizing mechanical protection (e.g. conduit).

SECURITY SYSTEM WIRING

The contractor will install all security system components in accordance with the manufacturer's specifications, and all applicable codes. The contractor is responsible for all interconnections, additions and adjustments required to commission and complete an operable and satisfactory system.

The Contractor will install security system wiring in dedicated conduit throughout. All low-voltage wiring outside enclosures will be plenum rated where required by code.

The Contractor will identify each conductor by its wire code as shown on the construction drawings.

GROUNDING

- Grounding system installation will be compliant IEEE 80, 81, 142, 665 837, and 1050 as well as the NEC and NESC.
- Ground conductors will be stranded copper.



- PV Modules, mounting equipment, combiner/recombiner boxes and inverters will be grounded per NEC requirements.
- All below grade connections will be compressed or exothermic and UL listed for direct burial applications.
- The Contractor will present calculations to show that the proposed system complies with applicable IEEE standards and is safe in terms of touch, step, and transferred potential.
- Ground rods will be placed at all junction boxes
- Surge arrestors will be installed on the DC side of the system (e.g. DC side of inverter, array junction box, etc.)
- All module racking needs to be bonded to the inverter via equipment grounding conductor. A local grounding electrode conductor will be installed at each section of UL2703-listed racking.

EQUIPMENT ENCLOSURES

Electrical equipment enclosures (junction boxes, control cabinets, etc.) will be in accordance with NEMA Standards and will be suitable for the location conditions. All enclosures will be provided with provisions for pad locking. Base design will be:

- Indoor: NEMA 1
- Outdoor: NEMA 4

TESTING

The purpose of the performance testing is to ensure that the solar installation is operating as intended and meets the system requirements. All testing will be in accordance to the Interconnection Agreement. The Contractor shall conduct a capacity test and performance ratio test. The Owner must authorize all tests in advance and the Owner must be notified at least 5 business days in advance of testing to be able to witness the tests if desired.

Contractor shall develop a procedure that includes at a minimum, a listing of test instrumentation, calibration procedures, test duration, type of data collected and collection frequency, test data collection procedures, and test reporting to complete the required tests. Contractor shall provide preliminary test results to the Owner five days after conclusion of each test and provide Final Test Report 10 business days once all tests have concluded. The test report shall consist of the following:

- Any agreed upon deviations to the test procedures
- Instrument calibration sheets/certificates
- Test data (manual and from the data acquisition system)
- Corrected test data
- Field notes
- Calculations
- Post-test uncertainty analysis



- Conclusions

ACCEPTANCE TESTS

The Contractor shall prepare a testing plan and perform tests to verify system functionality of the following equipment:

- DC Cable
- LV Cable
- MV Cable
- Ground Loop
- Pad-mount Transformers
- Fiber loops and Communication
- PV Strings (i.e. module string, string circuits, and string combiner box)
- Inverters
- MV switchgear and relays
- Meteorological Stations
- Ground Grid
- SCADA

Testing plan, procedures, and documentation of results will be submitted to the Owner for approval.

PERFORMANCE RATIO TEST

The purpose to the Performance Ratio test is to prove the Plant can continuously produce the energy in line with the contracted Performance Ratio. All incidents shall be recorded in 15-minute increments when the Plant is in operation. Unsatisfactory results will be recorded as well. The PR will be measured at the AC utility meter and will be weather corrected. The test will be conducted over a period of at least five consecutive days and meet the minimum requirements below:

- At least five days with irradiance measured on the plane of the array greater than 600 W/m² for 3 contiguous hours.
- Data will be excluded when the Plant is not fully available. The test period will be extended to obtain a full set of data for an equivalent of five days with 100% availability.

Acceptance of the test will be achieved if the Plant meets the minimum PR for the corresponding month the test was conducted in.

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Grid-Connected System: Simulation parameters

Project : **IEA_IN_South Bend**

Geographical Site **IEA_IN_S Bend_CPR32** Country **United States**

Situation Latitude 41.75° N Longitude -86.15° W
 Time defined as Legal Time Time zone UT-5 Altitude 243 m
 Albedo 0.20

Meteo data: **IEA_IN_S Bend_CPR32** NREL NSRD : TMY3 - TMY

Simulation variant : **IEA_IN_S Bend_472s_27m_Jinko395_5TMEIC840_FT45g**

Simulation date 11/12/18 13h48

Simulation parameters System type **Unlimited sheds**

Collector Plane Orientation Tilt 25° Azimuth 0°

Sheds configuration Nb. of sheds 50 Unlimited sheds
 Sheds spacing 8.75 m Collector width 3.94 m
 Inactive band Top 0.02 m Bottom 0.02 m
 Shading limit angle Limit profile angle 18.0° Ground cov. Ratio (GCR) 45.0 %
 Shadings electrical effect Cell size 15.6 cm Strings in width 2

Models used Transposition Perez Diffuse Imported

Horizon Free Horizon

Near Shadings Mutual shadings of sheds Electrical effect

PV Array Characteristics

PV module Si-mono Model **JKM395M-72L-V**
 Custom parameters definition Manufacturer Jinkosolar
 Number of PV modules In series 27 modules In parallel 472 strings
 Total number of PV modules Nb. modules 12744 Unit Nom. Power 395 Wp
 Array global power Nominal (STC) **5034 kWp** At operating cond. 4573 kWp (50°C)
 Array operating characteristics (50°C) U mpp 994 V I mpp 4603 A
 Total area Module area **25271 m²** Cell area 23123 m²

Inverter Model **Solar Ware 840 - PVU-L0840ER(PRERELEASE)**
 Custom parameters definition Manufacturer TMEIC
 Characteristics Operating Voltage 915-1300 V Unit Nom. Power 840 kWac
 Inverter pack Nb. of inverters 5 units Total Power 4200 kWac
 Pnom ratio 1.20

PV Array loss factors

Array Soiling Losses Loss Fraction 1.0 %
 Thermal Loss factor Uc (const) 29.0 W/m²K Uv (wind) 0.0 W/m²K / m/s
 Wiring Ohmic Loss Global array res. 2.9 mOhm Loss Fraction 1.2 % at STC
 LID - Light Induced Degradation Loss Fraction 2.0 %
 Module Quality Loss Loss Fraction -0.4 %
 Module Mismatch Losses Loss Fraction 0.6 % at MPP
 Strings Mismatch loss Loss Fraction 0.10 %
 Incidence effect (IAM): User defined IAM profile

0°	25°	50°	65°	70°	75°	80°	85°	90°
1.000	1.000	0.992	0.955	0.916	0.852	0.719	0.428	0.000

User's needs : Unlimited load (grid)

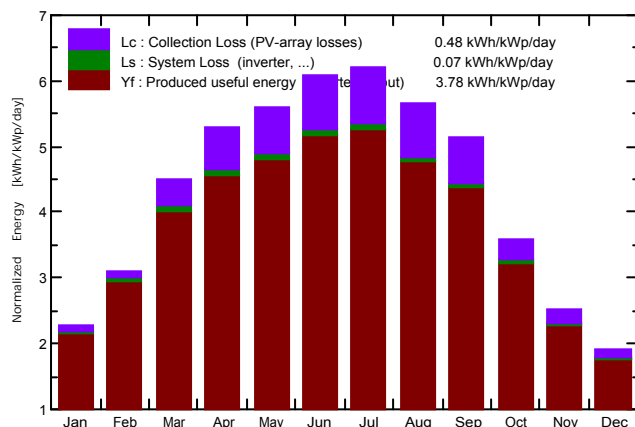
Grid-Connected System: Main results

Project : IEA_IN_South Bend
Simulation variant : IEA_IN_S Bend_472s_27m_Jinko395_5TMEIC840_FT45g

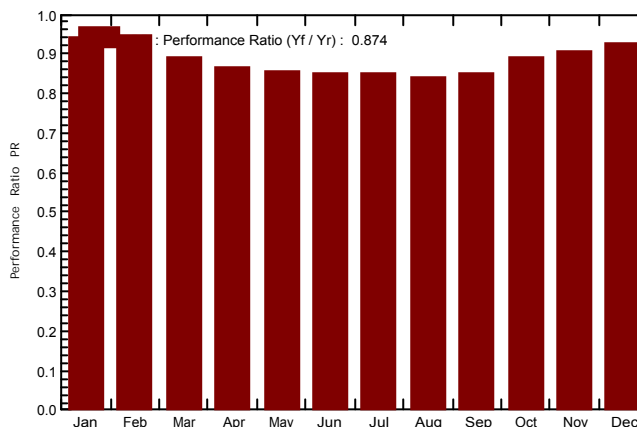
Main system parameters		System type	Unlimited sheds	
PV Field Orientation	Sheds disposition, tilt	25°	azimuth	0°
PV modules	Model	JKM395M-72L-V	Pnom	395 Wp
PV Array	Nb. of modules	12744	Pnom total	5034 kWp
Inverter	Solar Ware 840 - PVU-L0840ER(PRERELEASE)		Pnom	840 kW ac
Inverter pack	Nb. of units	5.0	Pnom total	4200 kW ac
User's needs	Unlimited load (grid)			

Main simulation results
 System Production **Produced Energy 6952 MWh/year** Specific prod. 1381 kWh/kWp/year
 Performance Ratio PR **87.36 %**

Normalized productions (per installed kWp): Nominal power 5034 kWp



Performance Ratio PR



IEA_IN_S Bend_472s_27m_Jinko395_5TMEIC840_FT45g

Balances and main results

	GlobHor	DiffHor	T Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m ²	kWh/m ²	°C	kWh/m ²	kWh/m ²	MWh	MWh	
January	51.2	33.30	-3.77	71.2	66.8	343.5	336.9	0.940
February	67.6	41.50	-3.47	87.3	82.4	424.4	416.9	0.948
March	114.4	49.64	6.37	139.6	132.9	638.5	626.9	0.892
April	144.4	62.04	11.82	158.6	150.6	702.4	690.1	0.865
May	170.6	75.64	14.98	173.7	164.4	762.9	749.7	0.857
June	183.5	80.88	21.22	182.6	173.0	794.4	780.8	0.849
July	191.0	82.80	21.70	192.1	181.9	835.4	821.7	0.850
August	164.0	70.93	23.20	175.2	166.2	755.8	743.4	0.843
September	130.8	53.58	20.09	154.0	146.5	672.0	661.1	0.853
October	85.9	39.27	11.60	111.7	106.4	511.6	502.4	0.893
November	52.4	26.35	6.41	75.6	71.6	352.0	345.1	0.907
December	41.6	27.68	-3.39	59.3	55.3	283.2	277.3	0.929
Year	1397.4	643.62	10.63	1580.9	1498.0	7076.1	6952.3	0.874

Legends: GlobHor Horizontal global irradiation GlobEff Effective Global, corr. for IAM and shadings
 DiffHor Horizontal diffuse irradiation EArray Effective energy at the output of the array
 T Amb Ambient Temperature E_Grid Energy injected into grid
 GlobInc Global incident in coll. plane PR Performance Ratio

Grid-Connected System: Loss diagram

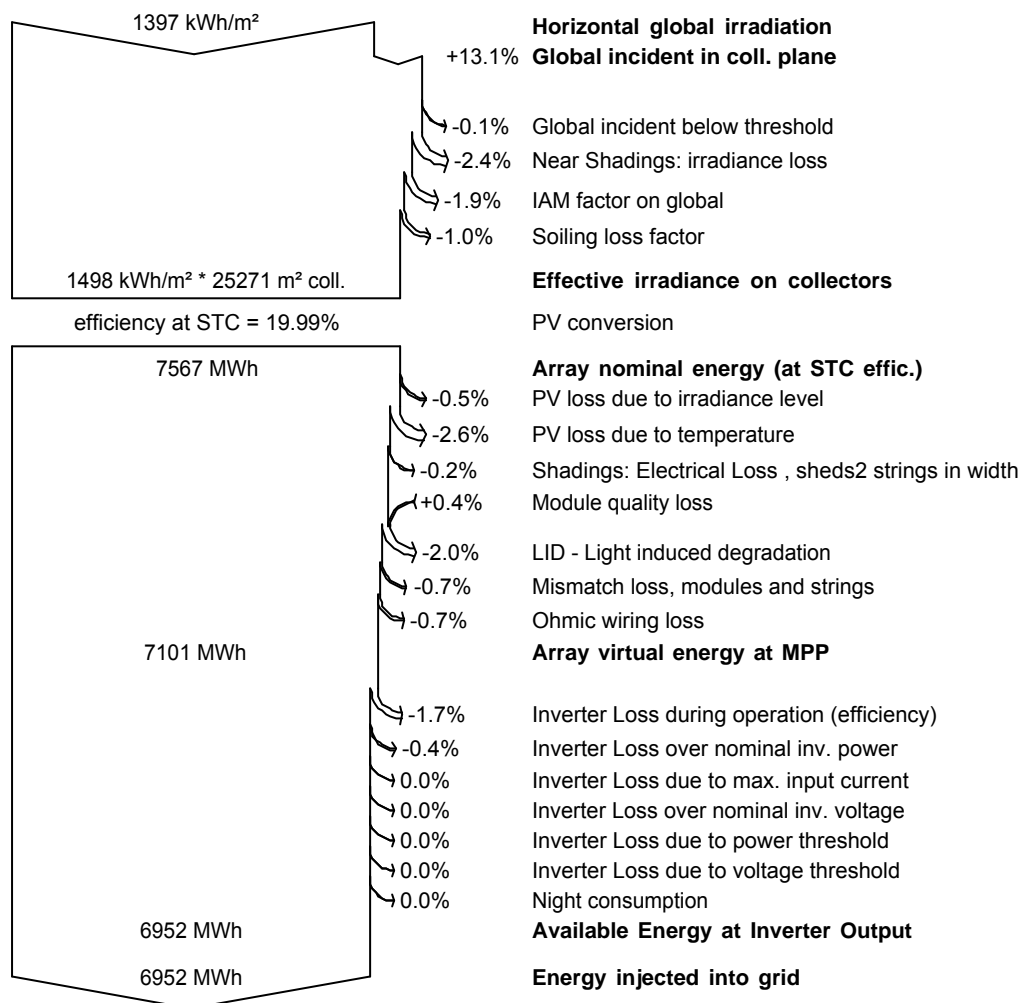
Project : IEA_IN_South Bend

Simulation variant : IEA_IN_S Bend_472s_27m_Jinko395_5TMEIC840_FT45g

Main system parameters

	System type	Unlimited sheds	
PV Field Orientation	Sheds disposition, tilt	25°	azimuth 0°
PV modules	Model	JKM395M-72L-V	Pnom 395 Wp
PV Array	Nb. of modules	12744	Pnom total 5034 kWp
Inverter	Solar Ware 840 - PVU-L0840ER(PRERELEASE)		Pnom 840 kW ac
Inverter pack	Nb. of units	5.0	Pnom total 4200 kW ac
User's needs	Unlimited load (grid)		

Loss diagram over the whole year



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Grid-Connected System: Simulation parameters

Project : IEA_IN_South Bend

Geographical Site IEA_IN_S Bend_CPR32 Country **United States**

Situation Latitude 41.75° N Longitude -86.15° W
Time defined as Legal Time Time zone UT-5 Altitude 243 m
Albedo 0.20

Meteo data: IEA_IN_S Bend_CPR32 NREL NSRD : TMY3 - TMY

Simulation variant : IEA_IN_S Bend_504s25m_Jinko395_5TMEIC840_33GCR

Simulation date 11/12/18 17h53

Simulation parameters System type **Tracking system, with backtracking**

Tracking plane, tilted Axis Axis Tilt 0° Axis Azimuth 0°
Rotation Limitations Minimum Phi -52° Maximum Phi 52°

Backtracking strategy Nb. of trackers 150 Identical arrays
Tracker Spacing 5.93 m Collector width 1.92 m
Backtracking limit angle Phi limits +/- 70.8° Ground cov. Ratio (GCR) 32.4 %

Models used Transposition Perez Diffuse Imported

Horizon Free Horizon

Near Shadings According to strings Electrical effect 100 %

PV Array Characteristics

PV module Si-mono Model **JKM395M-72L-V**
Custom parameters definition Manufacturer Jinkosolar
Number of PV modules In series 25 modules In parallel 504 strings
Total number of PV modules Nb. modules 12600 Unit Nom. Power 395 Wp
Array global power Nominal (STC) **4977 kWp** At operating cond. 4521 kWp (50°C)
Array operating characteristics (50°C) U mpp 920 V I mpp 4915 A
Total area Module area **24985 m²** Cell area 22861 m²

Inverter Model **Solar Ware 840 - PVU-L0840ER(PRERELEASE)**
Custom parameters definition Manufacturer TMEIC
Characteristics Operating Voltage 915-1300 V Unit Nom. Power 840 kWac
Inverter pack Nb. of inverters 5 units Total Power 4200 kWac
Pnom ratio 1.19

PV Array loss factors

Array Soiling Losses Loss Fraction 1.0 %

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%

Thermal Loss factor Uc (const) 29.0 W/m²K Uv (wind) 0.0 W/m²K / m/s

Wiring Ohmic Loss Global array res. 2.5 mOhm Loss Fraction 1.2 % at STC

LID - Light Induced Degradation Loss Fraction 2.0 %

Module Quality Loss Loss Fraction -0.4 %

Module Mismatch Losses Loss Fraction 0.6 % at MPP

Incidence effect (IAM): User defined IAM profile

0°	50°	55°	65°	70°	75°	80°	85°	90°
1.000	0.992	0.985	0.955	0.916	0.852	0.719	0.428	0.000

Grid-Connected System: Simulation parameters

User's needs : Unlimited load (grid)

Grid-Connected System: Near shading definition

Project : IEA_IN_South Bend

Simulation variant : IEA_IN_S Bend_504s25m_Jinko395_5TMEIC840_33GCR

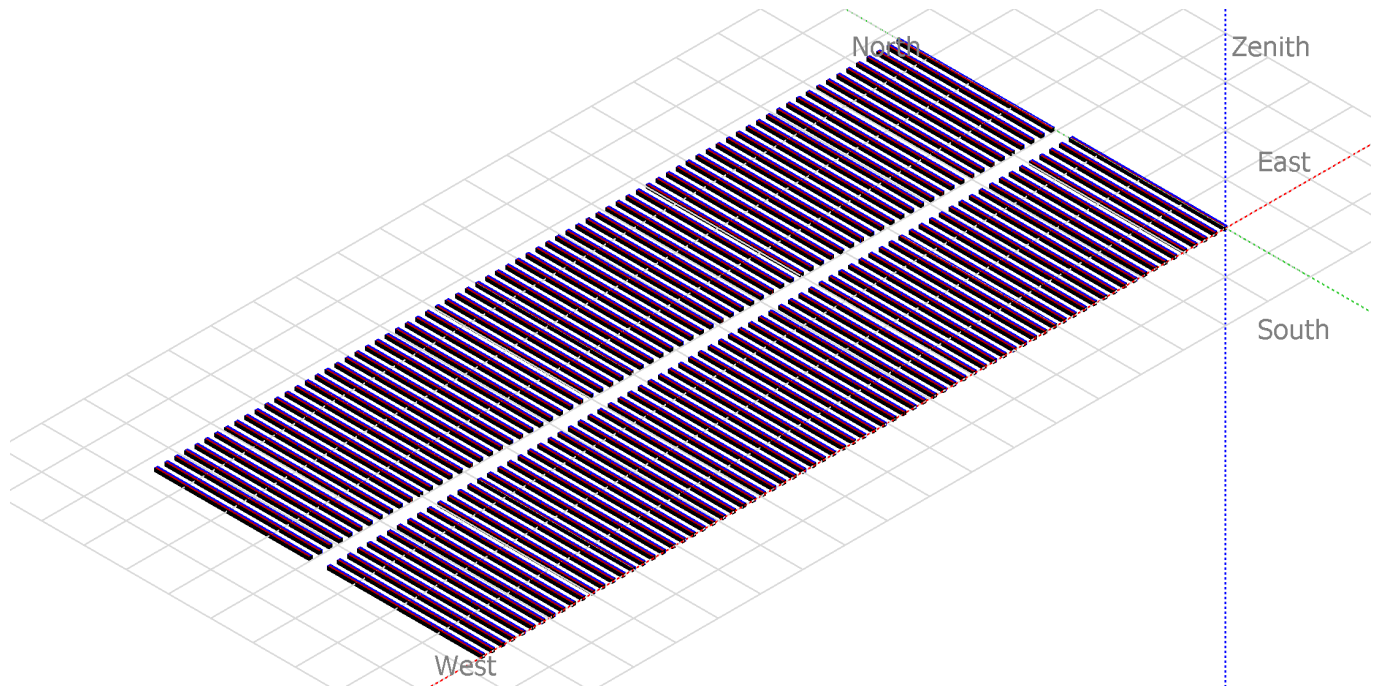
Main system parameters

System type **Tracking system, with backtracking**

Near Shadings

	According to strings	Electrical effect	100 %
PV Field Orientation	tracking, tilted axis, Axis Tilt 0°	Axis Azimuth	0°
PV modules	Model JKM395M-72L-V	Pnom	395 Wp
PV Array	Nb. of modules 12600	Pnom total	4977 kWp
Inverter	Solar Ware 840 - PVU-L0840ER(PRE-RELEASE)	Pnom	840 kW ac
Inverter pack	Nb. of units 5.0	Pnom total	4200 kW ac
User's needs	Unlimited load (grid)		

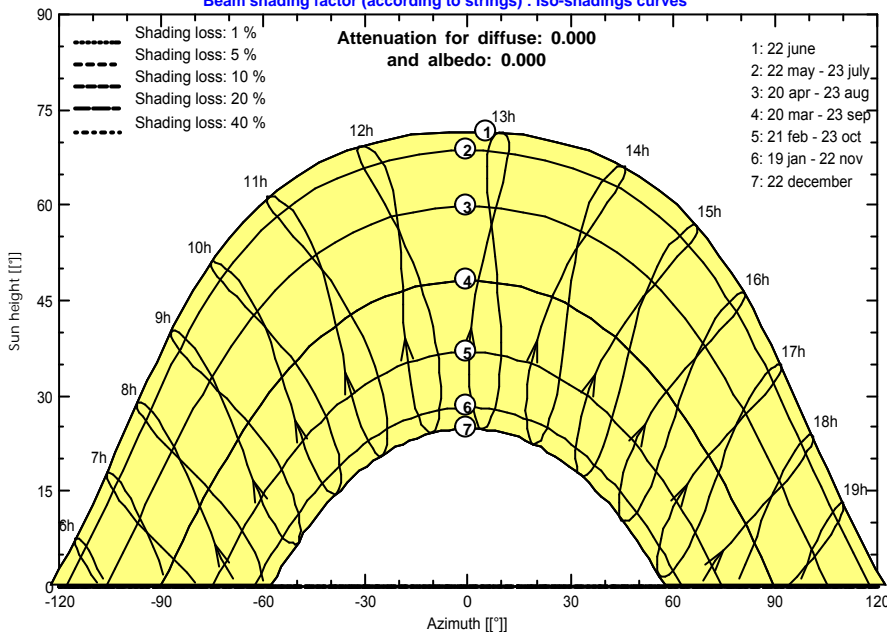
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

IEA_IN_South Bend

Beam shading factor (according to strings) : Iso-shadings curves



Grid-Connected System: Main results

Project : IEA_IN_South Bend

Simulation variant : IEA_IN_S Bend_504s25m_Jinko395_5TMEIC840_33GCR

Main system parameters

System type **Tracking system, with backtracking**

Near Shadings

According to strings

Electrical effect 100 %

PV Field Orientation

tracking, tilted axis, Axis Tilt 0°

Axis Azimuth 0°

PV modules

Model JKM395M-72L-V

Pnom 395 Wp

PV Array

Nb. of modules 12600

Pnom total **4977 kWp**

Inverter

Solar Ware 840 - PVU-L0840ER(PRERELEASE) Pnom 840 kW ac

Inverter pack

Nb. of units 5.0

Pnom total **4200 kW ac**

User's needs

Unlimited load (grid)

Main simulation results

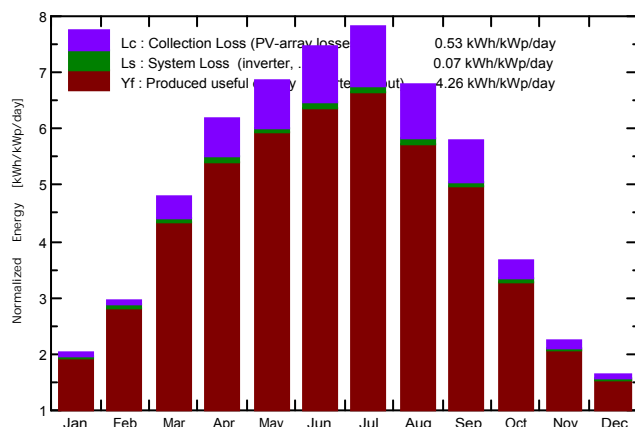
System Production

Produced Energy 7746 MWh/year

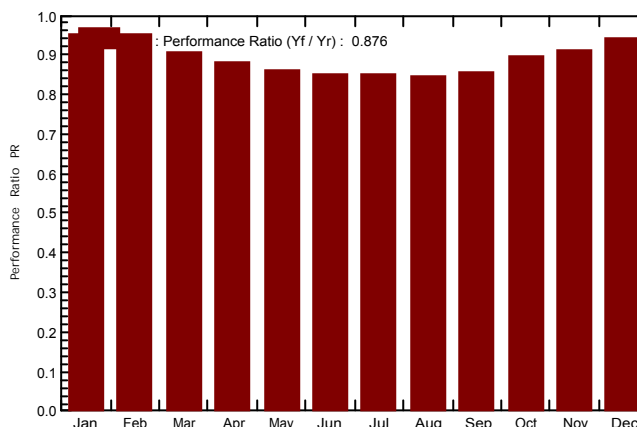
Specific prod. 1556 kWh/kWp/year

Performance Ratio PR 87.64 %

Normalized productions (per installed kWp): Nominal power 4977 kWp



Performance Ratio PR



IEA_IN_S Bend_504s25m_Jinko395_5TMEIC840_33GCR

Balances and main results

	GlobHor kWh/m ²	DiffHor kWh/m ²	T Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray MWh	E_Grid MWh	PR
January	51.2	33.30	-3.77	63.4	59.1	306	300	0.951
February	67.6	41.50	-3.47	83.4	78.0	401	394	0.950
March	114.4	49.64	6.37	148.7	141.0	682	671	0.906
April	144.4	62.04	11.82	184.9	175.7	822	809	0.879
May	170.6	75.64	14.98	212.4	201.9	928	913	0.864
June	183.5	80.88	21.22	223.9	212.9	964	949	0.852
July	191.0	82.80	21.70	241.5	229.6	1040	1025	0.853
August	164.0	70.93	23.20	210.1	199.7	897	884	0.846
September	130.8	53.58	20.09	174.2	165.6	754	743	0.857
October	85.9	39.27	11.60	114.1	108.0	517	508	0.895
November	52.4	26.35	6.41	67.7	63.5	314	308	0.914
December	41.6	27.68	-3.39	51.3	47.6	246	241	0.942
Year	1397.4	643.62	10.63	1775.7	1682.6	7870	7746	0.876

Legends: GlobHor Horizontal global irradiation
 DiffHor Horizontal diffuse irradiation
 T Amb Ambient Temperature
 GlobInc Global incident in coll. plane
 GlobEff Effective Global, corr. for IAM and shadings
 EArray Effective energy at the output of the array
 E_Grid Energy injected into grid
 PR Performance Ratio

Grid-Connected System: Loss diagram

Project : IEA_IN_South Bend

Simulation variant : IEA_IN_S Bend_504s25m_Jinko395_5TMEIC840_33GCR

Main system parameters

System type **Tracking system, with backtracking**

Near Shadings

According to strings

Electrical effect 100 %

PV Field Orientation

tracking, tilted axis, Axis Tilt 0°

Axis Azimuth 0°

PV modules

Model JKM395M-72L-V

Pnom 395 Wp

PV Array

Nb. of modules 12600

Pnom total **4977 kWp**

Inverter

Solar Ware 840 - PVU-L0840ER(PRE-RELEASE)

Pnom 840 kW ac

Inverter pack

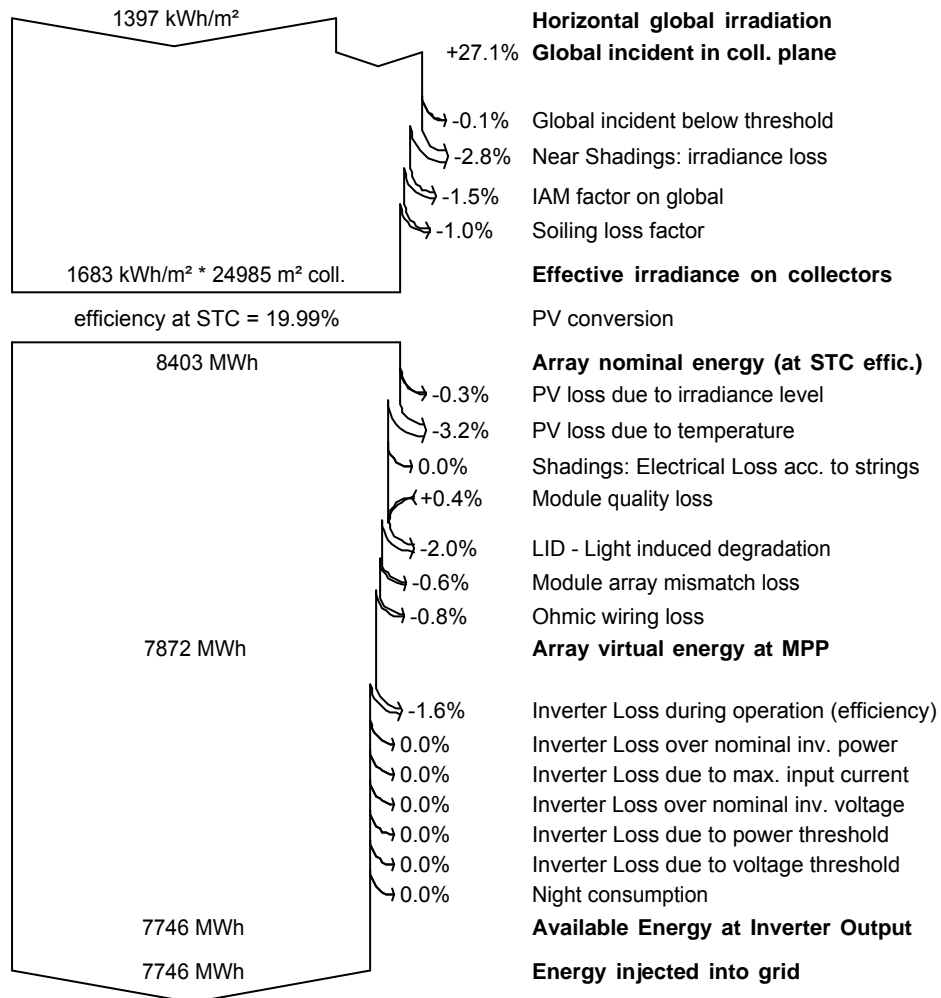
Nb. of units 5.0

Pnom total **4200 kW ac**

User's needs

Unlimited load (grid)

Loss diagram over the whole year



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Grid-Connected System: Simulation parameters

Project : **IEA_IN_South Bend**

Geographical Site **IEA_IN_S Bend_CPR32** Country **United States**

Situation Latitude 41.75° N Longitude -86.15° W
 Time defined as Legal Time Time zone UT-5 Altitude 243 m
 Albedo 0.20

Meteo data: **IEA_IN_S Bend_CPR32** NREL NSRD : TMY3 - TMY

Simulation variant : **IEA_IN_S Bend_1626s_6m_FS430_5TMEIC840_FT45g**

Simulation date 11/12/18 13h53

Simulation parameters System type **Unlimited sheds**

Collector Plane Orientation Tilt 25° Azimuth 0°

Sheds configuration Nb. of sheds 50 Unlimited sheds
 Sheds spacing 8.97 m Collector width 4.04 m
 Inactive band Top 0.02 m Bottom 0.02 m
 Shading limit angle Limit profile angle 17.9° Ground cov. Ratio (GCR) 45.0 %

Models used Transposition Perez Diffuse Imported

Horizon Free Horizon

Near Shadings Mutual shadings of sheds

PV Array Characteristics

PV module CdTe Model **FS-6430 Dec2017**

Original PVsyst database Manufacturer First Solar

Number of PV modules In series 6 modules In parallel 1626 strings

Total number of PV modules Nb. modules 9756 Unit Nom. Power 430 Wp

Array global power Nominal (STC) **4195 kWp** At operating cond. 3857 kWp (50°C)

Array operating characteristics (50°C) U mpp 995 V I mpp 3878 A

Total area Module area **24147 m²** Cell area 22124 m²

Inverter Model **Solar Ware 840 - PVU-L0840ER(PRERELEASE)**

Custom parameters definition Manufacturer TMEIC

Characteristics Operating Voltage 915-1300 V Unit Nom. Power 840 kWac

Inverter pack Nb. of inverters 5 units Total Power 4200 kWac
 Pnom ratio 1.00

PV Array loss factors

Array Soiling Losses Loss Fraction 1.0 %

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
6.9%	6.0%	5.0%	3.8%	2.0%	1.2%	0.0%	0.1%	1.5%	3.2%	4.9%	6.7%

Thermal Loss factor Uc (const) 30.7 W/m²K Uv (wind) 0.0 W/m²K / m/s

Wiring Ohmic Loss Global array res. 3.4 mOhm Loss Fraction 1.2 % at STC

Module Quality Loss Loss Fraction -2.1 %

Module Mismatch Losses Loss Fraction 1.0 % at MPP

Strings Mismatch loss Loss Fraction 0.10 %

Incidence effect (IAM): User defined IAM profile

0°	30°	50°	60°	65°	70°	75°	80°	90°
1.000	1.000	0.990	0.960	0.940	0.890	0.820	0.690	0.000

User's needs : Unlimited load (grid)

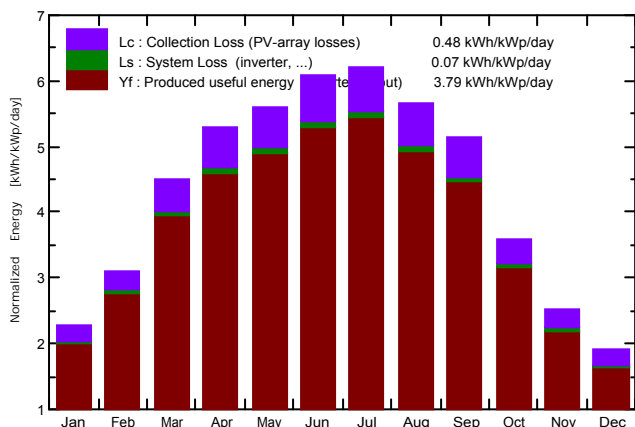
Grid-Connected System: Main results

Project : IEA_IN_South Bend
Simulation variant : IEA_IN_S Bend_1626s_6m_FS430_5TMEIC840_FT45g

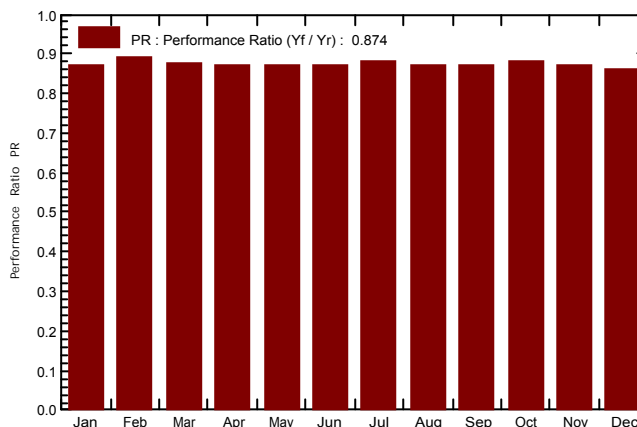
Main system parameters		System type	Unlimited sheds	
PV Field Orientation	Sheds disposition, tilt	25°	azimuth	0°
PV modules	Model	FS-6430 Dec2017	Pnom	430 Wp
PV Array	Nb. of modules	9756	Pnom total	4195 kWp
Inverter	Solar Ware 840 - PVU-L0840ER(PRERELEASE)		Pnom	840 kW ac
Inverter pack	Nb. of units	5.0	Pnom total	4200 kW ac
User's needs	Unlimited load (grid)			

Main simulation results
 System Production **Produced Energy 5798 MWh/year** Specific prod. 1382 kWh/kWp/year
 Performance Ratio PR **87.43 %**

Normalized productions (per installed kWp): Nominal power 4195 kWp



Performance Ratio PR



IEA_IN_S Bend_1626s_6m_FS430_5TMEIC840_FT45g

Balances and main results

	GlobHor kWh/m ²	DiffHor kWh/m ²	T Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray MWh	E_Grid MWh	PR
January	51.2	33.30	-3.77	71.2	62.6	266.0	260.5	0.872
February	67.6	41.50	-3.47	87.3	77.9	333.6	327.4	0.894
March	114.4	49.64	6.37	139.6	127.2	523.6	514.0	0.878
April	144.4	62.04	11.82	158.6	145.9	588.7	578.3	0.869
May	170.6	75.64	14.98	173.7	162.2	646.6	635.5	0.872
June	183.5	80.88	21.22	182.6	172.1	677.4	665.8	0.869
July	191.0	82.80	21.70	192.1	183.1	720.8	709.0	0.880
August	164.0	70.93	23.20	175.2	167.2	652.0	641.3	0.873
September	130.8	53.58	20.09	154.0	145.3	571.5	562.2	0.870
October	85.9	39.27	11.60	111.7	103.7	421.4	413.5	0.882
November	52.4	26.35	6.41	75.6	68.6	282.9	276.9	0.874
December	41.6	27.68	-3.39	59.3	51.9	218.9	213.8	0.859
Year	1397.4	643.62	10.63	1580.9	1467.6	5903.4	5798.2	0.874

Legends: GlobHor Horizontal global irradiation
 DiffHor Horizontal diffuse irradiation
 T Amb Ambient Temperature
 GlobInc Global incident in coll. plane
 GlobEff Effective Global, corr. for IAM and shadings
 EArray Effective energy at the output of the array
 E_Grid Energy injected into grid
 PR Performance Ratio

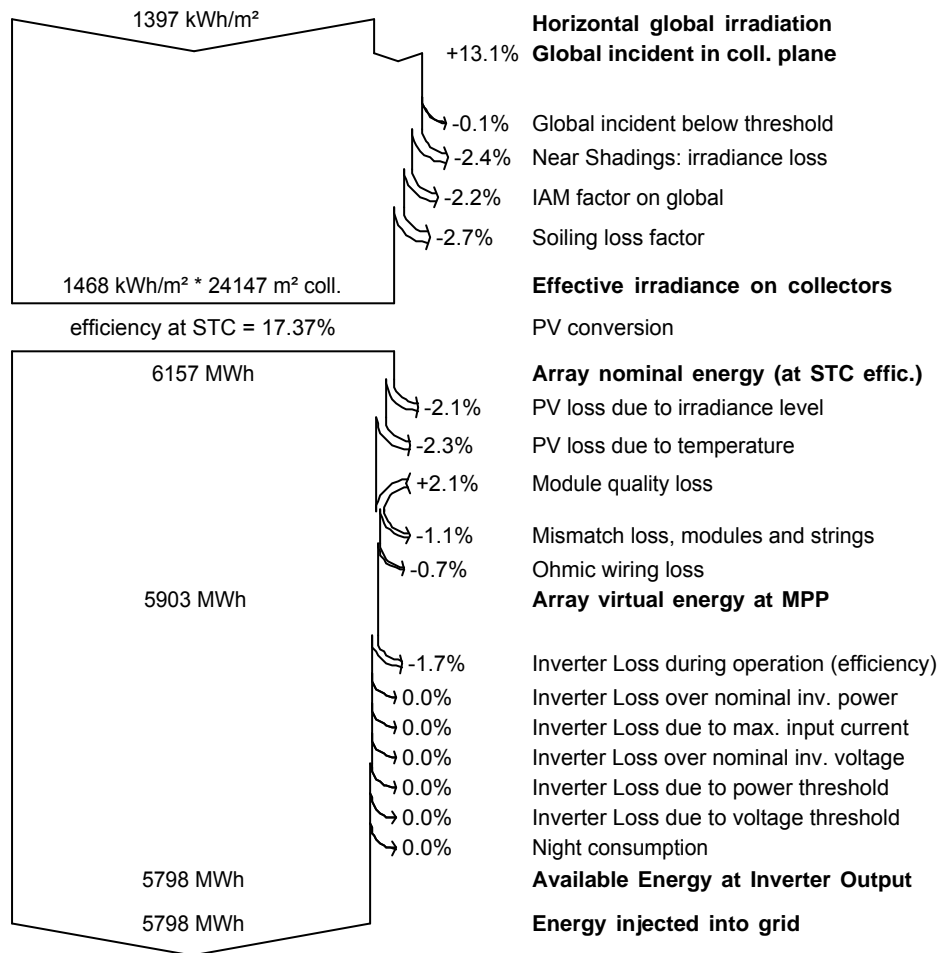
Grid-Connected System: Loss diagram

Project : IEA_IN_South Bend

Simulation variant : IEA_IN_S Bend_1626s_6m_FS430_5TMEIC840_FT45g

Main system parameters		System type	Unlimited sheds		
PV Field Orientation		Sheds disposition, tilt	25°	azimuth	0°
PV modules		Model	FS-6430 Dec2017	Pnom	430 Wp
PV Array		Nb. of modules	9756	Pnom total	4195 kWp
Inverter		Solar Ware 840 - PVU-L0840ER(PRERELEASE)		Pnom	840 kW ac
Inverter pack		Nb. of units	5.0	Pnom total	4200 kW ac
User's needs		Unlimited load (grid)			

Loss diagram over the whole year



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Grid-Connected System: Simulation parameters

Project : IEA_IN_South Bend

Geographical Site IEA_IN_S Bend_CPR32 Country **United States**

Situation Latitude 41.75° N Longitude -86.15° W
 Time defined as Legal Time Time zone UT-5 Altitude 243 m
 Albedo 0.20

Meteo data: IEA_IN_S Bend_CPR32 NREL NSRD : TMY3 - TMY

Simulation variant : IEA_IN_S Bend_1638s_6m_FS430_5TMEIC840_SAT33g

Simulation date 10/12/18 16h06

Simulation parameters System type **Tracking system**

Tracking plane, tilted Axis Axis Tilt 0° Axis Azimuth 0°
 Rotation Limitations Minimum Phi -52° Maximum Phi 52°

Trackers configuration Nb. of trackers 150 Identical arrays
 Tracker Spacing 6.08 m Collector width 1.96 m
 Shading limit angles Phi limits +/- 70.9° Ground cov. Ratio (GCR) 32.2 %

Models used Transposition Perez Diffuse Imported

Horizon Free Horizon

Near Shadings Linear shadings

PV Array Characteristics

PV module CdTe Model **FS-6430 Dec2017**
 Original PVsyst database Manufacturer First Solar
 Number of PV modules In series 6 modules In parallel 1638 strings
 Total number of PV modules Nb. modules 9828 Unit Nom. Power 430 Wp
 Array global power Nominal (STC) **4226 kWp** At operating cond. 3885 kWp (50°C)
 Array operating characteristics (50°C) U mpp 995 V I mpp 3906 A
 Total area Module area **24325 m²** Cell area 22288 m²

Inverter Model **Solar Ware 840 - PVU-L0840ER(PRERELEASE)**
 Custom parameters definition Manufacturer TMEIC
 Characteristics Operating Voltage 915-1300 V Unit Nom. Power 840 kWac
 Inverter pack Nb. of inverters 5 units Total Power 4200 kWac
 Pnom ratio 1.01

PV Array loss factors

Array Soiling Losses Loss Fraction 1.0 %

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
6.9%	6.0%	5.0%	3.8%	2.0%	1.2%	0.0%	0.1%	1.5%	3.2%	4.9%	6.7%

Thermal Loss factor Uc (const) 30.7 W/m²K Uv (wind) 0.0 W/m²K / m/s

Wiring Ohmic Loss Global array res. 3.4 mOhm Loss Fraction 1.2 % at STC

Module Quality Loss Loss Fraction -2.1 %

Module Mismatch Losses Loss Fraction 1.0 % at MPP

Strings Mismatch loss Loss Fraction 0.10 %

Incidence effect (IAM): User defined IAM profile

0°	30°	50°	60°	65°	70°	75°	80°	90°
1.000	1.000	0.990	0.960	0.940	0.890	0.820	0.690	0.000

Grid-Connected System: Simulation parameters

User's needs : Unlimited load (grid)

Grid-Connected System: Near shading definition

Project : IEA_IN_South Bend

Simulation variant : IEA_IN_S Bend_1638s_6m_FS430_5TMEIC840_SAT33g

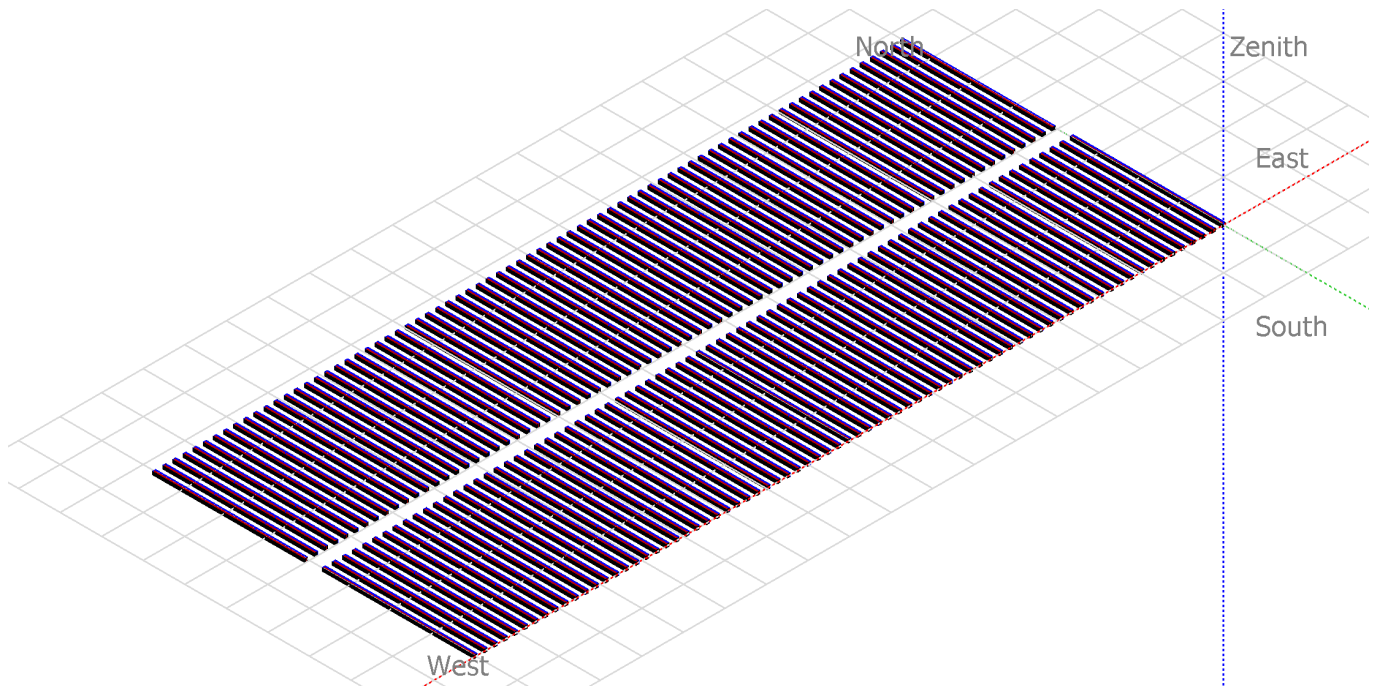
Main system parameters

System type **Tracking system**

Near Shadings

PV Field Orientation	tracking, tilted axis, Axis Tilt	0°	Axis Azimuth	0°
PV modules	Model	FS-6430 Dec2017	Pnom	430 Wp
PV Array	Nb. of modules	9828	Pnom total	4226 kWp
Inverter	Solar Ware 840 - PVU-L0840ER(PRE-RELEASE)		Pnom	840 kW ac
Inverter pack	Nb. of units	5.0	Pnom total	4200 kW ac
User's needs	Unlimited load (grid)			

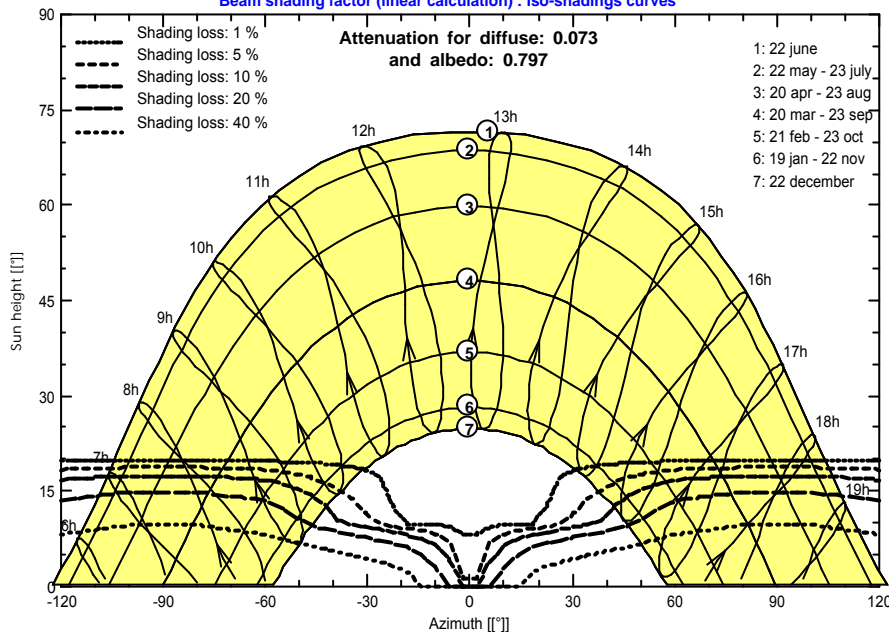
Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

IEA_IN_South Bend

Beam shading factor (linear calculation) : Iso-shadings curves



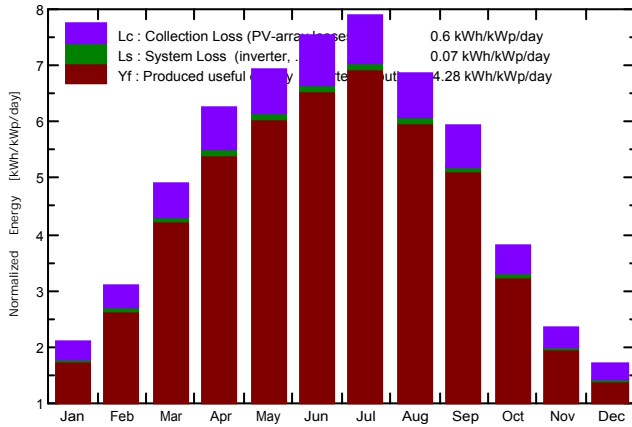
Grid-Connected System: Main results

Project : IEA_IN_South Bend
Simulation variant : IEA_IN_S Bend_1638s_6m_FS430_5TMEIC840_SAT33g

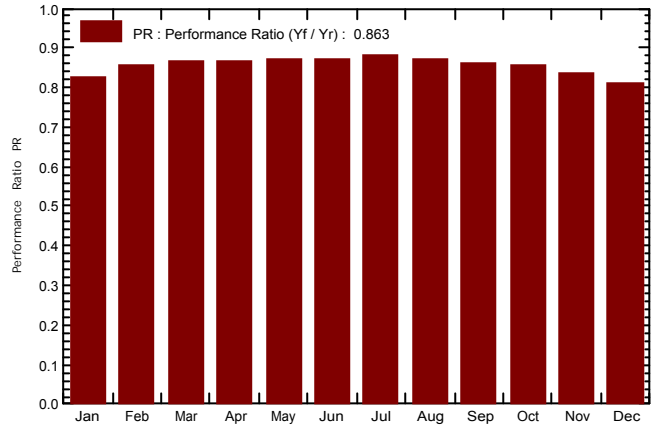
Main system parameters		System type	Tracking system
Near Shadings		Linear shadings	
PV Field Orientation	tracking, tilted axis, Axis Tilt	0°	Axis Azimuth 0°
PV modules	Model	FS-6430 Dec2017	Pnom 430 Wp
PV Array	Nb. of modules	9828	Pnom total 4226 kWp
Inverter	Solar Ware 840 - PVU-L0840ER(PRERELEASE)		Pnom 840 kW ac
Inverter pack	Nb. of units	5.0	Pnom total 4200 kW ac
User's needs	Unlimited load (grid)		

Main simulation results
System Production **Produced Energy** **6597 MWh/year** Specific prod. 1561 kWh/kWp/year
Performance Ratio PR 86.33 %

Normalized productions (per installed kWp): Nominal power 4226 kWp



Performance Ratio PR



IEA_IN_S Bend_1638s_6m_FS430_5TMEIC840_SAT33g

Balances and main results

	GlobHor kWh/m ²	DiffHor kWh/m ²	T Amb °C	GlobInc kWh/m ²	GlobEff kWh/m ²	EArray MWh	E_Grid MWh	PR
January	51.2	33.30	-3.77	65.9	55.3	235.5	230.5	0.827
February	67.6	41.50	-3.47	86.6	74.1	319.8	314.1	0.858
March	114.4	49.64	6.37	152.1	135.3	565.6	555.7	0.865
April	144.4	62.04	11.82	187.6	170.8	697.2	685.6	0.865
May	170.6	75.64	14.98	214.4	199.7	803.1	789.9	0.872
June	183.5	80.88	21.22	225.3	212.0	841.0	827.4	0.869
July	191.0	82.80	21.70	243.9	231.8	921.3	907.1	0.880
August	164.0	70.93	23.20	212.5	201.3	793.4	781.2	0.870
September	130.8	53.58	20.09	178.1	165.0	657.7	647.5	0.860
October	85.9	39.27	11.60	117.7	105.3	433.6	425.8	0.856
November	52.4	26.35	6.41	70.4	60.9	254.1	248.6	0.835
December	41.6	27.68	-3.39	53.8	44.8	188.7	184.1	0.810
Year	1397.4	643.62	10.63	1808.4	1656.2	6710.9	6597.5	0.863

Legends: GlobHor Horizontal global irradiation GlobEff Effective Global, corr. for IAM and shadings
 DiffHor Horizontal diffuse irradiation EArray Effective energy at the output of the array
 T Amb Ambient Temperature E_Grid Energy injected into grid
 GlobInc Global incident in coll. plane PR Performance Ratio

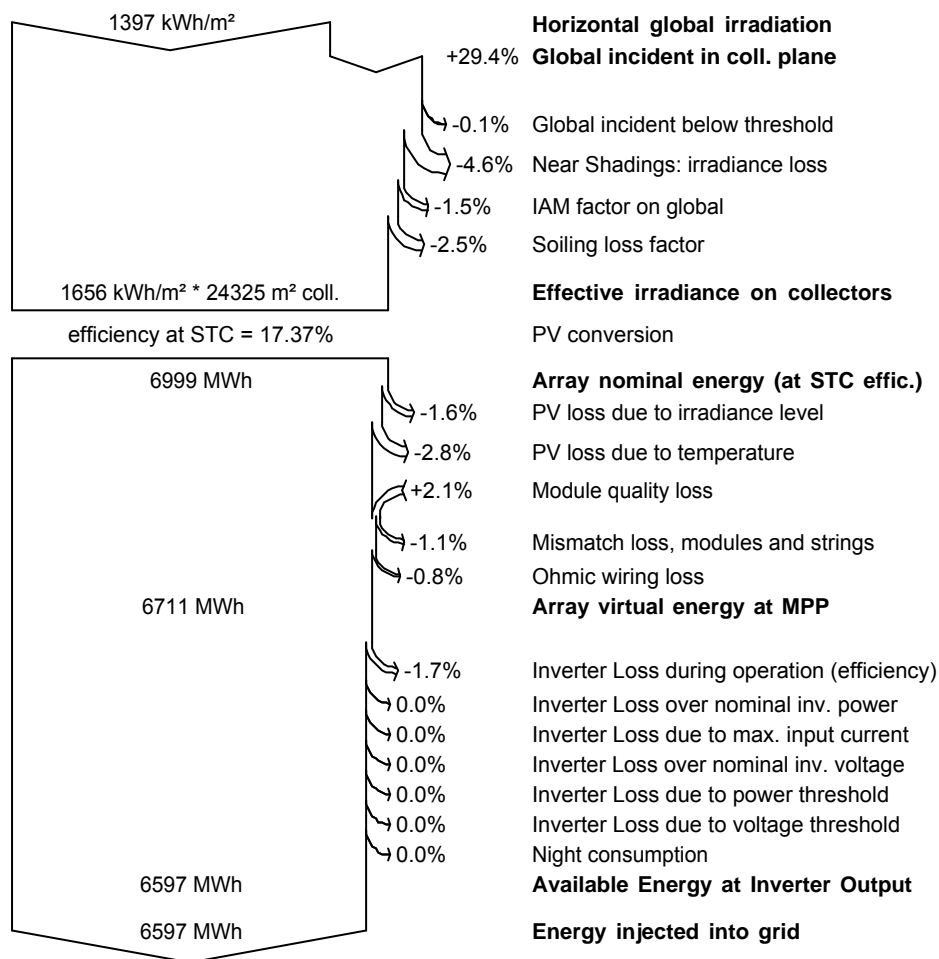
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Grid-Connected System: Loss diagram

Project : IEA_IN_South Bend
Simulation variant : IEA_IN_S Bend_1638s_6m_FS430_5TMEIC840_SAT33g

Main system parameters	System type	Tracking system	
Near Shadings	Linear shadings		
PV Field Orientation	tracking, tilted axis, Axis Tilt	0°	Axis Azimuth 0°
PV modules	Model	FS-6430 Dec2017	Pnom 430 Wp
PV Array	Nb. of modules	9828	Pnom total 4226 kWp
Inverter	Solar Ware 840 - PVU-L0840ER(PRERELEASE)		Pnom 840 kW ac
Inverter pack	Nb. of units	5.0	Pnom total 4200 kW ac
User's needs	Unlimited load (grid)		

Loss diagram over the whole year



PUBLIC VERSION



PROJECT NUMBER

PROJECT NAME

IE Engineer

Notes:

For:

18.01712

IEA_IN_South Bend Solar

TBD

Clean Power Research-Unit size of 4200 kWAC

Project Characteristics	
Date of Estimate	12/11/18
Source of Estimate	Ulteig Engineering
Estimator	ANDREW.MELVIN
Latitude	41.73 °
Longitude	-86.10 °
Module	Jinko JKM 395M-72HL-V
Module Wattage	395 W
Inverter	TMEIC Solar Ware 840 - PV-PCS
Inverter Capacity	840 kW
DC/AC (@Inv)	1.20
DC/AC (@POI)	1.26
Net Inverter Quantity	26
Total Strings	2360
Installed DC Capacity (kWdc)	25,169 kW
Installed AC Capacity (kWac)	21,840 kW
POI Limitation	20,000 kW
Structure Type	Fixed Tilt
Tilt Angle	25.00 °
Azimuth Angle	0.00 °
Ground Coverage Ratio	45.0%
Tracker Range of Motion	n/a
First Year Net Energy	32,166.3 MWh/yr
Specific Yield	1,278. kWh/kWp
DC Net Capacity Factor	14.59%
AC Net Capacity Factor - Inv Rating	17.49%
AC Net Capacity Factor - POI Rating	18.36%
Modeled Degradation	0.50%/Year
System Availability Loss	1%

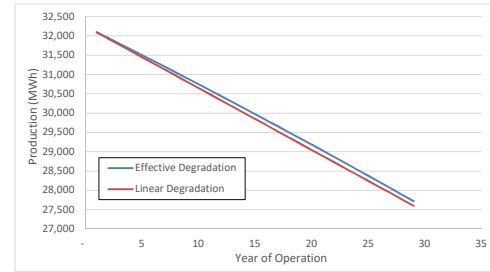
PUBLIC VERSION

Soiling Loss	
	0
January Soiling	1.0%
February Soiling	1.0%
March Soiling	1.0%
April Soiling	1.0%
May Soiling	1.0%
June Soiling	1.0%
July Soiling	1.0%
August Soiling	1.0%
September Soiling	1.0%
October Soiling	1.0%
November Soiling	1.0%
December Soiling	1.0%
Snow Loss	
January Snow	23.5%
February Snow	16.5%
March Snow	7.6%
April Snow	2.8%
May Snow	0.4%
June Snow	0.0%
July Snow	0.0%
August Snow	0.0%
September Snow	0.0%
October Snow	1.3%
November Snow	4.7%
December Snow	17.8%

PUBLIC VERSION

While module power degrades at a constant rate, there are often losses associated with clipping or the available dc power being higher than the inverters can output. Because of this, production often does not degrade linearly. This is referred to as Effective degradation and is shown in the table and graph below.

Year	Annual Production	% Inverter Clipping	% POI Clipping	Effective Degredation	Annual Prod_Linear	Degradation (%)
1	32,094	0.4%	0.3%	0.00%	32,094	0.00%
2	31,949	0.3%	0.3%	-0.45%	31,934	-0.50%
3	31,803	0.3%	0.3%	-0.46%	31,773	-0.50%
4	31,656	0.3%	0.2%	-0.46%	31,613	-0.50%
5	31,508	0.2%	0.2%	-0.46%	31,452	-0.50%
6	31,359	0.2%	0.2%	-0.47%	31,292	-0.50%
7	31,207	0.2%	0.2%	-0.47%	31,132	-0.50%
8	31,056	0.2%	0.2%	-0.47%	30,971	-0.50%
9	30,904	0.1%	0.2%	-0.47%	30,811	-0.50%
10	30,751	0.1%	0.2%	-0.48%	30,650	-0.50%
11	30,597	0.1%	0.1%	-0.48%	30,490	-0.50%
12	30,442	0.1%	0.1%	-0.48%	30,329	-0.50%
13	30,286	0.1%	0.1%	-0.49%	30,169	-0.50%
14	30,131	0.0%	0.1%	-0.48%	30,008	-0.50%
15	29,975	0.0%	0.1%	-0.49%	29,848	-0.50%
16	29,818	0.0%	0.1%	-0.49%	29,687	-0.50%
17	29,661	0.0%	0.1%	-0.49%	29,527	-0.50%
18	29,503	0.0%	0.1%	-0.49%	29,366	-0.50%
19	29,344	0.0%	0.1%	-0.49%	29,206	-0.50%
20	29,185	0.0%	0.0%	-0.49%	29,045	-0.50%
21	29,025	0.0%	0.0%	-0.50%	28,885	-0.50%
22	28,863	0.0%	0.0%	-0.50%	28,724	-0.50%
23	28,701	0.0%	0.0%	-0.50%	28,564	-0.50%
24	28,539	0.0%	0.0%	-0.51%	28,404	-0.50%
25	28,376	0.0%	0.0%	-0.51%	28,243	-0.50%
26	28,213	0.0%	0.0%	-0.51%	28,083	-0.50%
27	28,049	0.0%	0.0%	-0.51%	27,922	-0.50%
28	27,885	0.0%	0.0%	-0.51%	27,762	-0.50%
29	27,721	0.0%	0.0%	-0.51%	27,601	-0.50%
30	27,556	0.0%	0.0%	-0.51%	27,441	-0.50%
31	27,391	0.0%	0.0%	-0.52%	27,280	-0.50%
32	27,226	0.0%	0.0%	-0.51%	27,120	-0.50%
33	27,062	0.0%	0.0%	-0.51%	26,959	-0.50%
34	26,898	0.0%	0.0%	-0.51%	26,799	-0.50%
35	26,733	0.0%	0.0%	-0.51%	26,638	-0.50%



PUBLIC VERSION

Ambient Temperature	11	°C
Global Horizontal Irradiation	1,397	kWh/m²
Increase in GHI on the tilted plane	13.1%	%
Far Shadings/Horizon	0.0%	%
Near Shadings: Irradiance Loss	-2.4%	%
IAM Losses	-1.9%	%
Array Soiling Loss	-1.0%	%
Effective Irradiance on collectors	1,498	kWh/m²
Efficiency at STC	20.36%	%
Collector Area	123,626	m ²
Array nominal energy (STC effic)	37,833	MWh
PV Loss Due to Irradiance	-0.5%	%
PV Loss Due to Temperature	-2.6%	%
Module Quality Loss	0.4%	%
LID - Light Induced Degradation	2.0%	%
Module array mismatch loss	-0.7%	%
DC Ohmic wiring loss	-0.7%	%
Array virtual energy at MPP	35,381	MWh
Inverter Loss During Operation	-1.7%	%
Inver Loss over nominal inv. Power	-0.4%	%
Inverter Loss due to voltage threshold	0.0%	%
Available Energy at Inverter Output	34,770	MWh
Nighttime Inverter Losses	6	MWh
AC ohmic loss to Xfmr/POC	0.0%	%
ISU/Net transformer loss	-1.6%	%
ISU to GSU/POC AC ohmic loss	-0.3%	%
GSU transformer loss	0.0%	%
GenTie AC ohmic loss	0.0%	%
Station Load Loss	-0.2%	%
POI Clipping	-0.3%	%
Snow Loss	-4.2%	%
Net Excluding Availability	32,491	MWh
Installed Capacity	25,169	kWp DC
Yield Factor Excluding Availability	1,291	kWh/kWp
Availability	-1.0%	%
Net With Availability	32,166	MWh

PUBLIC VERSION



PROJECT NUMBER

PROJECT NAME

IE Engineer

Notes:

For:

18.01712

IEA_IN_South Bend Solar

TBD

Clean Power Research-Unit size of 4200 kWAC

Project Characteristics	
Date of Estimate	12/11/18
Source of Estimate	Ulteig Engineering
Estimator	ANDREW.MELVIN
Latitude	41.73 °
Longitude	-86.10 °
Module	Jinko JKM 395M-72HL-V
Module Wattage	395 W
Inverter	TMEIC Solar Ware 840 - PV-PCS
Inverter Capacity	840 kW
DC/AC (@Inv)	1.19
DC/AC (@POI)	1.24
Net Inverter Quantity	26
Total Strings	2520
Installed DC Capacity (kWdc)	24,885 kW
Installed AC Capacity (kWac)	21,840 kW
POI Limitation	20,000 kW
Structure Type	Single Axis Tracker
Tilt Angle	n/a
Azimuth Angle	0.00 °
Ground Coverage Ratio	33.0%
Tracker Range of Motion	+/-52
First Year Net Energy	36,178.9 MWh/yr
Specific Yield	1,453.8 kWh/kWp
DC Net Capacity Factor	16.60%
AC Net Capacity Factor - Inv Rating	19.67%
AC Net Capacity Factor - POI Rating	20.65%
Modeled Degradation	0.50%/Year
System Availability Loss	1%

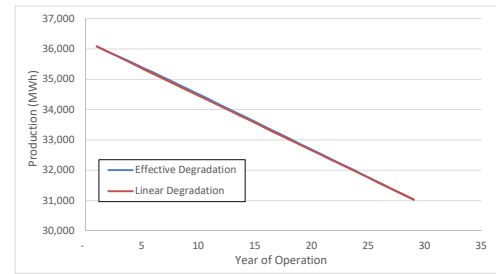
PUBLIC VERSION

Soiling Loss	
	0
January Soiling	1.0%
February Soiling	1.0%
March Soiling	1.0%
April Soiling	1.0%
May Soiling	1.0%
June Soiling	1.0%
July Soiling	1.0%
August Soiling	1.0%
September Soiling	1.0%
October Soiling	1.0%
November Soiling	1.0%
December Soiling	1.0%
Snow Loss	
January Snow	25.6%
February Snow	16.8%
March Snow	6.8%
April Snow	2.3%
May Snow	0.3%
June Snow	0.0%
July Snow	0.0%
August Snow	0.0%
September Snow	0.0%
October Snow	1.1%
November Snow	4.3%
December Snow	17.2%

PUBLIC VERSION

While module power degrades at a constant rate, there are often losses associated with clipping or the available dc power being higher than the inverters can output. Because of this, production often does not degrade linearly. This is referred to as Effective degradation and is shown in the table and graph below.

Year	Annual Production	% Inverter Clipping	% POI Clipping	Effective Degredation	Annual Prod_Linear	Degradation (%)
1	36,084	0.0%	0.1%	0.00%	36,084	0.00%
2	35,916	0.0%	0.1%	-0.47%	35,904	-0.50%
3	35,745	0.0%	0.1%	-0.47%	35,723	-0.50%
4	35,572	0.0%	0.1%	-0.48%	35,543	-0.50%
5	35,398	0.0%	0.1%	-0.48%	35,362	-0.50%
6	35,222	0.0%	0.0%	-0.49%	35,182	-0.50%
7	35,044	0.0%	0.0%	-0.49%	35,002	-0.50%
8	34,867	0.0%	0.0%	-0.49%	34,821	-0.50%
9	34,687	0.0%	0.0%	-0.50%	34,641	-0.50%
10	34,506	0.0%	0.0%	-0.50%	34,460	-0.50%
11	34,325	0.0%	0.0%	-0.50%	34,280	-0.50%
12	34,144	0.0%	0.0%	-0.50%	34,099	-0.50%
13	33,962	0.0%	0.0%	-0.50%	33,919	-0.50%
14	33,780	0.0%	0.0%	-0.51%	33,739	-0.50%
15	33,598	0.0%	0.0%	-0.50%	33,558	-0.50%
16	33,415	0.0%	0.0%	-0.51%	33,378	-0.50%
17	33,232	0.0%	0.0%	-0.51%	33,197	-0.50%
18	33,049	0.0%	0.0%	-0.51%	33,017	-0.50%
19	32,867	0.0%	0.0%	-0.51%	32,837	-0.50%
20	32,682	0.0%	0.0%	-0.51%	32,656	-0.50%
21	32,499	0.0%	0.0%	-0.51%	32,476	-0.50%
22	32,317	0.0%	0.0%	-0.51%	32,295	-0.50%
23	32,134	0.0%	0.0%	-0.51%	32,115	-0.50%
24	31,951	0.0%	0.0%	-0.51%	31,934	-0.50%
25	31,767	0.0%	0.0%	-0.51%	31,754	-0.50%
26	31,584	0.0%	0.0%	-0.51%	31,574	-0.50%
27	31,400	0.0%	0.0%	-0.51%	31,393	-0.50%
28	31,216	0.0%	0.0%	-0.51%	31,213	-0.50%
29	31,033	0.0%	0.0%	-0.51%	31,032	-0.50%
30	30,849	0.0%	0.0%	-0.51%	30,852	-0.50%
31	30,667	0.0%	0.0%	-0.51%	30,671	-0.50%
32	30,484	0.0%	0.0%	-0.51%	30,491	-0.50%
33	30,301	0.0%	0.0%	-0.51%	30,311	-0.50%
34	30,117	0.0%	0.0%	-0.51%	30,130	-0.50%
35	29,934	0.0%	0.0%	-0.51%	29,950	-0.50%



PUBLIC VERSION

Ambient Temperature	11	°C
Global Horizontal Irradiation	1,397	kWh/m²
Increase in GHI on the tilted plane	27.1%	%
Far Shadings/Horizon	0.0%	%
Near Shadings: Irradiance Loss	-2.8%	%
IAM Losses	-1.5%	%
Array Soiling Loss	-1.0%	%
Effective Irradiance on collectors	1,683	kWh/m²
Efficiency at STC	20.36%	%
Collector Area	122,229	m ²
Array nominal energy (STC effic)	42,015	MWh
PV Loss Due to Irradiance	-0.3%	%
PV Loss Due to Temperature	-3.2%	%
Module Quality Loss	0.4%	%
LID - Light Induced Degradation	2.0%	%
Module array mismatch loss	-0.6%	%
DC Ohmic wiring loss	-0.8%	%
Array virtual energy at MPP	39,351	MWh
Inverter Loss During Operation	-1.6%	%
Inver Loss over nominal inv. Power	0.0%	%
Inverter Loss due to voltage threshold	0.0%	%
Available Energy at Inverter Output	38,737	MWh
Nighttime Inverter Losses	6	MWh
AC ohmic loss to Xfmr/POC	0.0%	%
ISU/Net transformer loss	-1.6%	%
ISU to GSU/POC AC ohmic loss	-0.3%	%
GSU transformer loss	0.0%	%
GenTie AC ohmic loss	0.0%	%
Station Load Loss	-0.2%	%
POI Clipping	-0.1%	%
Snow Loss	-3.5%	%
Net Excluding Availability	36,544	MWh
Installed Capacity	24,885	kWp DC
Yield Factor Excluding Availability	1,469	kWh/kWp
Availability	-1.0%	%
Net With Availability	36,179	MWh

PUBLIC VERSION



PROJECT NUMBER

PROJECT NAME

IE Engineer

Notes:

For:

18.01712

IEA_IN_South Bend Solar

TBD

Clean Power Research-Unit size of 4200 kWAC

Project Characteristics	
Date of Estimate	12/11/18
Source of Estimate	Ulteig Engineering
Estimator	ANDREW.MELVIN
Latitude	41.73 °
Longitude	-86.10 °
Module	First Solar FS-6430
Module Wattage	430 W
Inverter	TMEIC Solar Ware 840 - PV-PCS
Inverter Capacity	840 kW
DC/AC (@Inv)	1.00
DC/AC (@POI)	1.26
Net Inverter Quantity	26
Total Strings	9756
Installed DC Capacity (kWdc)	25,170 kW
Installed AC Capacity (kWac)	21,840 kW
POI Limitation	20,000 kW
Structure Type	Fixed Tilt
Tilt Angle	25.00 °
Azimuth Angle	0.00 °
Ground Coverage Ratio	45.0%
Tracker Range of Motion	n/a
First Year Net Energy	31,960.3 MWh/yr
Specific Yield	1,269.8 kWh/kWp
DC Net Capacity Factor	14.49%
AC Net Capacity Factor - Inv Rating	14.48%
AC Net Capacity Factor - POI Rating	18.24%
Modeled Degradation	0.50%/Year
System Availability Loss	1%

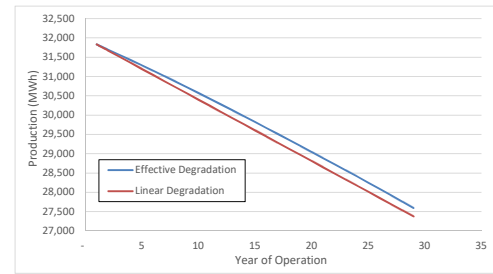
PUBLIC VERSION

Soiling Loss	
	0
January Soiling	6.9%
February Soiling	6.0%
March Soiling	5.0%
April Soiling	3.8%
May Soiling	2.0%
June Soiling	1.2%
July Soiling	0.0%
August Soiling	0.1%
September Soiling	1.5%
October Soiling	3.2%
November Soiling	4.9%
December Soiling	6.7%
Snow Loss	
January Snow	23.5%
February Snow	16.5%
March Snow	7.6%
April Snow	2.8%
May Snow	0.4%
June Snow	0.0%
July Snow	0.0%
August Snow	0.0%
September Snow	0.0%
October Snow	1.3%
November Snow	4.7%
December Snow	17.8%

PUBLIC VERSION

While module power degrades at a constant rate, there are often losses associated with clipping or the available dc power being higher than the inverters can output. Because of this, production often does not degrade linearly. This is referred to as Effective degradation and is shown in the table and graph below.

Year	Annual Production	% Inverter Clipping	% POI Clipping	Effective Degredation	Annual Prod_Linear	Degradation (%)
1	31,833	0.0%	1.2%	0.00%	31,833	0.00%
2	31,699	0.0%	1.1%	-0.42%	31,674	-0.50%
3	31,564	0.0%	1.0%	-0.42%	31,515	-0.50%
4	31,428	0.0%	0.9%	-0.43%	31,356	-0.50%
5	31,289	0.0%	0.8%	-0.44%	31,196	-0.50%
6	31,149	0.0%	0.8%	-0.44%	31,037	-0.50%
7	31,007	0.0%	0.7%	-0.45%	30,878	-0.50%
8	30,864	0.0%	0.6%	-0.45%	30,719	-0.50%
9	30,718	0.0%	0.6%	-0.46%	30,560	-0.50%
10	30,572	0.0%	0.5%	-0.46%	30,401	-0.50%
11	30,425	0.0%	0.4%	-0.46%	30,242	-0.50%
12	30,276	0.0%	0.4%	-0.47%	30,082	-0.50%
13	30,126	0.0%	0.4%	-0.47%	29,923	-0.50%
14	29,974	0.0%	0.3%	-0.48%	29,764	-0.50%
15	29,822	0.0%	0.3%	-0.48%	29,605	-0.50%
16	29,667	0.0%	0.2%	-0.49%	29,446	-0.50%
17	29,513	0.0%	0.2%	-0.48%	29,287	-0.50%
18	29,359	0.0%	0.2%	-0.49%	29,127	-0.50%
19	29,203	0.0%	0.1%	-0.49%	28,968	-0.50%
20	29,046	0.0%	0.1%	-0.49%	28,809	-0.50%
21	28,889	0.0%	0.1%	-0.50%	28,650	-0.50%
22	28,730	0.0%	0.1%	-0.50%	28,491	-0.50%
23	28,571	0.0%	0.1%	-0.50%	28,332	-0.50%
24	28,411	0.0%	0.0%	-0.50%	28,172	-0.50%
25	28,250	0.0%	0.0%	-0.51%	28,013	-0.50%
26	28,088	0.0%	0.0%	-0.51%	27,854	-0.50%
27	27,924	0.0%	0.0%	-0.51%	27,695	-0.50%
28	27,760	0.0%	0.0%	-0.52%	27,536	-0.50%
29	27,595	0.0%	0.0%	-0.52%	27,377	-0.50%
30	27,429	0.0%	0.0%	-0.52%	27,217	-0.50%
31	27,265	0.0%	0.0%	-0.52%	27,058	-0.50%
32	27,100	0.0%	0.0%	-0.52%	26,899	-0.50%
33	26,935	0.0%	0.0%	-0.52%	26,740	-0.50%
34	26,770	0.0%	0.0%	-0.52%	26,581	-0.50%
35	26,604	0.0%	0.0%	-0.52%	26,422	-0.50%



PUBLIC VERSION

Ambient Temperature	11	°C
Global Horizontal Irradiation	1,397	kWh/m²
Increase in GHI on the tilted plane	13.1%	%
Far Shadings/Horizon	0.0%	%
Near Shadings: Irradiance Loss	-2.4%	%
IAM Losses	-2.2%	%
Array Soiling Loss	-2.7%	%
Effective Irradiance on collectors	1,468	kWh/m²
Efficiency at STC	17.44%	%
Collector Area	144,358	m ²
Array nominal energy (STC effic)	36,941	MWh
PV Loss Due to Irradiance	-2.1%	%
PV Loss Due to Temperature	-2.3%	%
Module Quality Loss	2.1%	%
LID - Light Induced Degradation	0.0%	%
Module array mismatch loss	-1.1%	%
DC Ohmic wiring loss	-0.7%	%
Array virtual energy at MPP	35,420	MWh
Inverter Loss During Operation	-1.7%	%
Inver Loss over nominal inv. Power	0.0%	%
Inverter Loss due to voltage threshold	0.0%	%
Available Energy at Inverter Output	34,799	MWh
Nighttime Inverter Losses	7	MWh
AC ohmic loss to Xfmr/POC	0.0%	%
ISU/Net transformer loss	-1.8%	%
ISU to GSU/POC AC ohmic loss	-0.3%	%
GSU transformer loss	0.0%	%
GenTie AC ohmic loss	0.0%	%
Station Load Loss	-0.2%	%
POI Clipping	-1.1%	%
Snow Loss	-4.0%	%
Net Excluding Availability	32,283	MWh
Installed Capacity	25,170	kWp DC
Yield Factor Excluding Availability	1,283	kWh/kWp
Availability	-1.0%	%
Net With Availability	31,960	MWh

PUBLIC VERSION



PROJECT NUMBER

PROJECT NAME

IE Engineer

Notes:

For:

18.01712

IEA_IN_South Bend Solar

TBD

Clean Power Research-Unit size of 4200 kWAC

Project Characteristics	
Date of Estimate	12/11/18
Source of Estimate	Ulteig Engineering
Estimator	ANDREW.MELVIN
Latitude	41.73 °
Longitude	-86.10 °
Module	First Solar FS-6430
Module Wattage	430 W
Inverter	TMEIC Solar Ware 840 - PV-PCS
Inverter Capacity	840 kW
DC/AC (@Inv)	1.01
DC/AC (@POI)	1.27
Net Inverter Quantity	26
Total Strings	9828
Installed DC Capacity (kWdc)	25,356 kW
Installed AC Capacity (kWac)	21,840 kW
POI Limitation	20,000 kW
Structure Type	Single Axis Tracker
Tilt Angle	n/a
Azimuth Angle	0.00 °
Ground Coverage Ratio	33.0%
Tracker Range of Motion	+/-52
First Year Net Energy	36,787.7 MWh/yr
Specific Yield	1,450.8 kWh/kWp
DC Net Capacity Factor	16.56%
AC Net Capacity Factor - Inv Rating	16.66%
AC Net Capacity Factor - POI Rating	21.00%
Modeled Degradation	0.50%/Year
System Availability Loss	1%

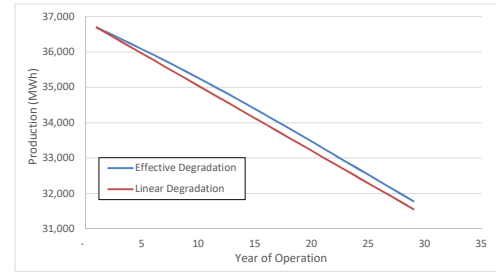
PUBLIC VERSION

Soiling Loss	
	0
January Soiling	6.9%
February Soiling	6.0%
March Soiling	5.0%
April Soiling	3.8%
May Soiling	2.0%
June Soiling	1.2%
July Soiling	0.0%
August Soiling	0.1%
September Soiling	1.5%
October Soiling	3.2%
November Soiling	4.9%
December Soiling	6.7%
Snow Loss	
January Snow	25.6%
February Snow	16.8%
March Snow	6.8%
April Snow	2.3%
May Snow	0.3%
June Snow	0.0%
July Snow	0.0%
August Snow	0.0%
September Snow	0.0%
October Snow	1.1%
November Snow	4.3%
December Snow	17.2%

PUBLIC VERSION

While module power degrades at a constant rate, there are often losses associated with clipping or the available dc power being higher than the inverters can output. Because of this, production often does not degrade linearly. This is referred to as Effective degradation and is shown in the table and graph below.

Year	Annual Production	% Inverter Clipping	% POI Clipping	Effective Degredation	Annual Prod_Linear	Degradation (%)
1	36,695	0.0%	0.9%	0.00%	36,695	0.00%
2	36,545	0.0%	0.8%	-0.41%	36,511	-0.50%
3	36,392	0.0%	0.7%	-0.42%	36,328	-0.50%
4	36,237	0.0%	0.6%	-0.42%	36,145	-0.50%
5	36,081	0.0%	0.6%	-0.43%	35,961	-0.50%
6	35,923	0.0%	0.5%	-0.43%	35,778	-0.50%
7	35,762	0.0%	0.4%	-0.44%	35,594	-0.50%
8	35,597	0.0%	0.4%	-0.45%	35,411	-0.50%
9	35,432	0.0%	0.3%	-0.45%	35,227	-0.50%
10	35,264	0.0%	0.2%	-0.46%	35,044	-0.50%
11	35,093	0.0%	0.2%	-0.46%	34,860	-0.50%
12	34,921	0.0%	0.2%	-0.47%	34,677	-0.50%
13	34,746	0.0%	0.1%	-0.47%	34,493	-0.50%
14	34,569	0.0%	0.1%	-0.48%	34,310	-0.50%
15	34,390	0.0%	0.1%	-0.49%	34,126	-0.50%
16	34,209	0.0%	0.0%	-0.49%	33,943	-0.50%
17	34,026	0.0%	0.0%	-0.50%	33,759	-0.50%
18	33,842	0.0%	0.0%	-0.50%	33,576	-0.50%
19	33,656	0.0%	0.0%	-0.51%	33,392	-0.50%
20	33,471	0.0%	0.0%	-0.51%	33,209	-0.50%
21	33,283	0.0%	0.0%	-0.51%	33,025	-0.50%
22	33,095	0.0%	0.0%	-0.51%	32,842	-0.50%
23	32,907	0.0%	0.0%	-0.51%	32,658	-0.50%
24	32,719	0.0%	0.0%	-0.51%	32,475	-0.50%
25	32,532	0.0%	0.0%	-0.51%	32,292	-0.50%
26	32,344	0.0%	0.0%	-0.51%	32,108	-0.50%
27	32,155	0.0%	0.0%	-0.51%	31,925	-0.50%
28	31,967	0.0%	0.0%	-0.51%	31,741	-0.50%
29	31,779	0.0%	0.0%	-0.51%	31,558	-0.50%
30	31,591	0.0%	0.0%	-0.51%	31,374	-0.50%
31	31,402	0.0%	0.0%	-0.51%	31,191	-0.50%
32	31,214	0.0%	0.0%	-0.51%	31,007	-0.50%
33	31,025	0.0%	0.0%	-0.51%	30,824	-0.50%
34	30,837	0.0%	0.0%	-0.51%	30,640	-0.50%
35	30,647	0.0%	0.0%	-0.52%	30,457	-0.50%



PUBLIC VERSION

Ambient Temperature	11	°C
Global Horizontal Irradiation	1,397	kWh/m²
Increase in GHI on the tilted plane	29.4%	%
Far Shadings/Horizon	0.0%	%
Near Shadings: Irradiance Loss	-4.6%	%
IAM Losses	-1.5%	%
Array Soiling Loss	-2.5%	%
Effective Irradiance on collectors	1,657	kWh/m²
Efficiency at STC	17.44%	%
Collector Area	145,424	m ²
Array nominal energy (STC effic)	42,018	MWh
PV Loss Due to Irradiance	-1.6%	%
PV Loss Due to Temperature	-2.8%	%
Module Quality Loss	2.1%	%
LID - Light Induced Degradation	0.0%	%
Module array mismatch loss	-1.1%	%
DC Ohmic wiring loss	-0.8%	%
Array virtual energy at MPP	40,287	MWh
Inverter Loss During Operation	-1.7%	%
Inver Loss over nominal inv. Power	0.0%	%
Inverter Loss due to voltage threshold	0.0%	%
Available Energy at Inverter Output	39,617	MWh
Nighttime Inverter Losses	7	MWh
AC ohmic loss to Xfmr/POC	0.0%	%
ISU/Net transformer loss	-1.6%	%
ISU to GSU/POC AC ohmic loss	-0.3%	%
GSU transformer loss	0.0%	%
GenTie AC ohmic loss	0.0%	%
Station Load Loss	-0.2%	%
POI Clipping	-0.9%	%
Snow Loss	-3.3%	%
Net Excluding Availability	37,159	MWh
Installed Capacity	25,356	kWp DC
Yield Factor Excluding Availability	1,465	kWh/kWp
Availability	-1.0%	%
Net With Availability	36,788	MWh

