F CLASS 2X0 SIMPLE CYCLE REUSE OF EXISTING EQUIPMENT EVALUATION

BLACK & VEATCH PROJECT NO. 406529
BLACK & VEATCH FILE NO. 41.1210

PREPARED FOR

CenterPoint Energy

SEPTEMBER 28, 2020

BLACK & VEATCH

Table of Contents

LIST OF TABLES

Executive Summary

This report summarizes the findings from the existing equipment evaluation analysis as it pertains to the addition of a 2x0 simple cycle power plant (SCPP) at the ABB station while utilizing existing equipment and systems from the current coal units.

Some of the key conclusions from this report are:

- The existing fire water supply source, and use of the existing diesel and electric fire pumps is of sufficient capacity to be reused.
- A new compressed air system will be utilized for the new SCPP.
- The existing compressed gas systems of carbon dioxide and hydrogen are oversized and compressed gas bottle racks should be utilized.
- The existing Demin storage system is in good condition and has sufficient capacity to be reused.
- The existing Demin supply system is in good condition and has sufficient capacity to be reused.
- The existing Raw/makeup water system is in good condition and can be reused.
- The existing Service water system is acceptable for reuse.
- The existing Potable water system is acceptable for reuse.
- The existing Wastewater system is acceptable for reuse.
- The existing Sanitary wastewater system is suitable for reuse.
- The existing Oily Waste System is suitable for reuse.
- RATs will continue to support existing plant auxiliary electric system.
- The existing medium voltage switchgear may be utilized for the new CTG static starting system and will continue to support existing plant auxiliary electric system.

1.0 Introduction

1.1 GENERAL FACILITY OVERVIEW

A.B. Brown Station (ABB) is a two unit, 530 megawatt (MW) coal fired electricity generating power facility, located on the northern bank of the Ohio River, 5 miles southwest of Evansville, Indiana. The station includes Unit 1 with a rated capacity of 265 MW and Unit 2 with a rated capacity of 265 MW.

CenterPoint (Company, or CNP) is reviewing the construction of a 2x0 473 MW simple cycle plant at ABB. This simple cycle configuration (project or SCPP) will utilize two combustion turbine generators.

The source of plant water for ABB is service water from the existing facility via the Ranney Collection Well for service water system users as well as fire protection. The existing demineralized (demin) water treatment system (combined with service water) will provide makeup to the CTG Inlet Evaporative Cooler.

All plant auxiliary heat loads from the plant equipment heat exchangers will be handled by new air cooled heat exchangers, one exchanger associated with each combustion turbine system.

The wastewater discharge source for ABB is the nearby Ohio River. Current design is to discharge to the existing cooling tower settling basins which outfalls to the Ohio River.

1.2 EVALUATION OBJECTIVE

The focus of the evaluation was to identify the existing ABB power station equipment and systems that could be re-utilized after the retirement of Unit 1, and of Unit 2 and a new 2x0 SCPP. The evaluation was completed in two phases; first, the Company was provided surveys to perform system/equipment condition assessments on the following systems:

- Fire Water Storage and Supply (tanks, pumps, etc…)
- Air Compressors (compressors, dryers, receivers)
- Compressed Gas Bulk Storage (H2 and CO2)
- Demineralized Water (tanks, pumps, etc…)
- Service/Raw/Makeup Water (tanks, pumps, etc…)
- Potable Water (tanks, pumps, etc…)
- Wastewater
- Oily Waste System
- Reserve Auxiliary Transformers 12/21 (RAT 12/21)
- Medium Voltage Arc-Resistant Switchgear

Second, Black & Veatch conducted assessments of the existing equipment based on the condition reports and consideration of whether the equipment meets the design requirements of the new simple cycle.

This report will consider the following new simple cycle configuration:

- 2 x 0 Simple Cycle F-Class Combustion Turbines

This full report will provide:

- Evaluation of any utilities/electrical changes required for the operation of the equipment
- Evaluate if it makes sense to use equipment in current location or relocate (for example if hydrogen is supplied via tube trailer it may make sense to put in a new location by the simple cycle to avoid underground piping congestion)
- Determine any temporary measures required
- Locate tie-ins and outline existing equipment modifications required

2.0 Existing Equipment Assessments

2.1 FIRE WATER STORAGE AND SUPPLY

Based on the existing site Fire Protection and Service Water Systems P&ID (F-1024) there are 2x100 percent fire pumps (one electric driven and one diesel driven) that are rated for 1,500 gpm @ 300 FT TDH each. The fire water pumps take suction from three existing 2000 gpm pumps located in the Ranney Well and the Raw Water Storage Tank (75,000 gallons) via a 12" nominal diameter suction header. The Raw Water Storage Tank is sized to provide 51,000 gallons of surge capacity devoted to fire water use. The existing site has a 10" underground fire water loop. This pipe is assumed to be ductile iron. For the new underground line to the simple cycle arrangement a 10" DI line or 12" HDPE DR11 pipe may be used.

The new plant's required fire water system supply flow is based on code requirements for the simple cycle combustion turbine units. Per IFC 2018 the amount of fire water required is 1,500 gpm. The current electric and diesel driven fire pumps are rated for 1,500 gpm thus these will meet the IFC requirements for the fire protection system at the new plant. There are no elevated areas for the new plant that would require booster pumps to obtain adequate pressure for hose stations so a standard pressure rating of 300 ft-H2O at the rated point is expected to be sufficient.

Per NFPA 850, the existing water source is large enough to be considered a reliable water source. The multiple Ranney Well pumps installed provide reliability such that a single failure or maintenance event will not impair the ability of the system to respond to a fire event. If a single Ranney Well pump or fire pump were to be out of service, the remaining pumps will still have sufficient capacity to supply water to the existing water users as well as the maximum fire water demand of 1,500 gpm.

Table 2-1 compares the existing Fire Water System to the new unit requirements.

Table 2-1 Existing Fire Water System

	EXISTING EQUIPMENT	REQUIREMENT FOR NEW UNITS	EXISTING SYSTEM ACCEPTABLE
Water Source	Raw Water Tank: 51,000 gal (dedicated for FW)	Raw Water Tank: 51,000 gal (dedicated for FW)	Yes, with 1 Ranny well pump out of service the pump supply exceeds the normal raw water demands plus the worst case scenario demand of the fire water system.
	Ranny Well Pumps: 3x2000 gpm @ 176 FT	Ranny Well Pumps: 3x2000 gpm @ 176 FT	
	River Water Intake Pumps: 3x3300 gpm @176 FT	River Water Intake Pumps: 3x3300 gpm @176 FT	
Pumps	1x100% Electric Driven: 1,500 gpm @ 300 FT	1x00% Electric Driven: 1,500 gpm @ 300 FT	Yes, Per IFC (2018) the simple cycle plant requires 1,500 gpm. This can be met with the existing Ranney well pumps (2000 gpm) and fire pumps (1500 gpm).
	1x100% Diesel Driven: 1,500 gpm @ 300 FT	1x100% Diesel Driven:1,500 gpm @ 300 FT	

Based on the Existing Equipment Condition Assessment report information provided by CenterPoint and given the requirements for the new system based on the calculation results, Black & Veatch can conclude the following:

- The existing fire water supply is of sufficient capacity to be reused.
- The existing 10" fire protection underground system can be reused with new 12" HDPE used for new underground headers around the new SCPP.

2.2 AIR COMPRESSORS

The existing ABB Compressed Air System includes: two station service air receivers (IA and SA), a station service air dryer (1A), two soot blowing air receivers (1A and 1B), two service air compressors (2A and 2B), one SCR soot blowing air compressor, two SBS compressors (A and B), and two soot blowing air compressors (1C and 1D). CenterPoint currently uses the two Unit 2 service air compressors to supply the Unit 1 and Unit 2 compressed air needs. The other compressors have been taken out of service. Based on the Equipment/System Condition Assessment Report the storage tanks, skids, piping, platforms, and electrical equipment are in like new condition.

Table 2-3 compares the existing compressed air equipment to the new unit requirements.

Table 2-2 Existing Compressed Air Equipment

	EXISTING COMPRESSED AIR EQUIPMENT	REQUIREMENT FOR NEW UNITS	EXISTING SYSTEM ACCEPTABLE
Station Service Air Receivers	IA Rec: 3,000 gallons	IA Rec: 1,060 gallons	Yes
	SA Rec: 3,000 gallons	SA Rec: 1,060 gallons	Yes
Station Service Air Dryer	1A: 3,500 scfm	A: 500 scfm	Yes
Soot Blowing Air Receivers	1A: 5,000 gallons	NA	NA
	1B: 5,000 gallons	NA	NA
2A Service Air compressor			The existing Compressors are oversized and would cycle to often and would also require the operation of the Unit 2 CCW system. Using new smaller compressors would be more efficient and the new CCCW system would be utilized for cooling.
2B Service Air Compressor			The existing Compressors are oversized and would cycle to often and would also require the operation of the Unit 2 CCW system. Using new smaller compressors would be more efficient and the new CCCW system would be utilized for cooling.
1 SCR sootblowing compressor/service air	2,310 scfm @ 125 psig	NA	NA
A SBS Compressor	3,000 scfm @ 130 psig	500 scfm @ 125 psig	NA
B SBS compressor	3,000 scfm @ 130 psig	500 scfm @ 125 psig	NA
1C Sootblowing compressor	NA	NA	Due to current 1C Sootblowing Compressor condition this compressor would not be reused.

1D Sootblowing compressor	NA	NA	Due to current 1C Sootblowing Compressor condition this compressor would not be reused.

Based on the Existing Equipment Condition Assessment report information provided by CenterPoint and given the requirements for the new system based on the calculation results, Black & Veatch can conclude the following:

- The existing 2A and 2B service air compressors are in good condition to be used but there are some drawbacks to the reuse.
- The existing service air compressors would require the existing Unit 2 closed cycle cooling water system to remain in operation. This is an issue when Unit 2 is retired.
- The reuse of the existing 2A and 2B service air compressors would require a new compressed air line from the compressor discharge piping to the new plant. This piping would be a considerable run which would include underground piping.
- The existing 2A and 2B service air compressors would be significantly oversized for use when Unit 2 is offline and the new simple cycle is online. This would result in the compressors cycling on and off frequently and increase the amount of maintenance required. Also, due to the compressors being significantly oversized, the power consumption would be greater than a correctly sized air compressor.
- Discussions with plant personnel indicated a new dedicated compressed air system should be considered for the new simple cycle.

For the purposes of this study Black & Veatch has concluded that new compressors (2x100%), dryers (2x100%), wet receivers (2x100%), and dry receivers (1x100% for each CTG unit) should be supplied in the 2x0 Simple Cycle scope.

2.3 COMPRESSED GAS BULK STORAGE (H2 AND CO2)

The existing compressed gas bulk storage system contains a 30 ton Carbon dioxide generation system which includes a rental tank, vaporizer and compressor. The system also includes a hydrogen supply trailer that is also rented. Based on the Equipment/System Condition Assessment Report the storage tanks, skids and electrical equipment is in fair condition. Mechanical piping, valves and structural surfaces are in good condition.

Table 2-4 compares the existing compressed gas equipment to the new unit requirements.

Table 2-3 Existing Compressed Gas Bulk Storage

	EXISTING EQUIPMENT	REQUIREMENT FOR NEW UNIT	EXISTING SYSTEM ACCEPTABLE
Hydrogen System	3,440 gallons (460 cubic feet)	Pressure and Volume to be determined from CTG supplier data	N/A - Utilize Bottle Rack
	2400 psig (max service)		

Carbon Dioxide System	30 Tons	Pressure and Volume to be determined from CTG supplier data	N/A - Utilize Bottle Rack
	MAWP: 350 psig		

Based on the Existing Equipment Condition Assessment report information provided by CenterPoint and given the requirements for the new system based on the calculation results, Black & Veatch can conclude the following:

- The existing equipment is oversized and not located in close proximity to be reused. Compressed gas bottle racks will be included in the estimate and design.
- This facilitates future changes to a bulk storage system if desired by CenterPoint.

For the purposes of this study Black & Veatch has concluded that the existing compressed gas systems of carbon dioxide and hydrogen are oversized and compressed gas bottle racks located at the new combustion turbines should be utilized.

2.4 DEMINERALIZED WATER

The existing Demineralized Water system includes three demineralized water storage tanks (1 for Unit 1 and 2 for Unit 2), three condensate makeup pumps (1 for Unit 1 and 2 for Unit 2), and the water treatment system. Based on the Equipment/System Condition Assessment Report the equipment, piping, and controls are in good condition.

Table 2-8 compares the existing Demineralized Water equipment to the new unit requirements.

Table 2-4 Existing Demineralized Treatment Equipment

	EXISTING DEMINERALIZED WATER EQUIPMENT	REQUIREMENT FOR NEW UNITS	EXISTING SYSTEM ACCEPTABLE
Demineralized Water Storage Tank Capacity	U1: 100,000 gallons U2 East: 100,000 gallons U2 West: 100,000 gallons Total Storage: 300,000 gallons	Current tank(s) capacity provides 34 hours of storage volume total (~11 hours per tank).	Yes.
Demineralized Water Transfer Pump Capacity	U1: 100 gpm (1 x 100%) U2: 100 gpm (1 x 100%)	147gpm maximum with: Units 5&6 Evap Cooling CT3 Water Injection	Yes.
Demineralized Water Transfer Pump Discharge	U1/U2: 120 ft TDH		
Cycle Makeup Treatment System Capacity	Large RO/EDI - 100 gpm Product Small RO/EDI - 53 gpm Product	Not Applicable for Simple Cycle	Yes

Based on the Existing Equipment Condition Assessment report information provided by CenterPoint and given the requirements for the new system based on the calculation results, Black & Veatch can conclude the following:

- The existing Demin water treatment system is in good condition and has sufficient capacity for the new SCPP.

2.5 SERVICE/RAW/MAKEUP WATER

Based on the Equipment/System Condition Assessment Report the equipment and controls are like new while the mechanical and electrical systems are in good or fair condition. The Ranney well pumps are used to fill the Raw Water Tank, while the Service Water pumps withdraw water from the Raw Water Tank for service water usage.

Table 2-9 compares the existing Raw Water and Service Water equipment to the new unit requirements.

Table 2-5 Existing Service and Raw Water Equipment

	EXISTING RAW WATER SYSTEM EQUIPMENT	REQUIREMENT FOR NEW UNITS	EXISTING SYSTEM ACCEPTABLE
Raw Water Tank	Tank: 75,000 gal (51,000 gal firewater reserve)	Current tanks will have 1.5 hours of storage at normal makeup water flow rate	Yes
	Ranny Well Pumps: 3x2000 gpm @ 176 FT	1,500 gpm (Firewater) + ~213 gpm (Makeup)	Yes
Service Water	Pumps: 3x500 gpm @345 FT	~300 gpm (peak case)	Yes
	Piping: HDPE well to pump		Yes
Raw Water Supply Piping	24" Steel	NA	Yes

* Equipment sized for capacity of the new 2x0 simple cycle plant.

Based on the Existing Equipment Condition Assessment report information provided by CenterPoint and given the requirements for the new system based on the calculation results, Black & Veatch can conclude the following:

- The existing equipment is in good condition to be reused. The current equipment location is also acceptable.

2.6 POTABLE WATER

Based on the Equipment/System Condition Assessment Report the equipment and controls are like new while the mechanical and electrical systems are in good or fair condition.

Table 2-11 the existing Potable Water equipment to the new unit requirements.

Table 2-6 Existing Potable Water Equipment

	EXISTING POTABLE WATER SYSTEM EQUIPMENT	REQUIREMENT FOR NEW UNIT	EXISTING SYSTEM ACCEPTABLE
Potable Water	Tank: 18,611 gallons		Yes
	Pumps: 2x300 gpm	~10 average potable water use. 20 gpm shower usage	Yes
	Piping: HDPE well to pump		Yes

Based on the Existing Equipment Condition Assessment report information provided by CenterPoint and given the requirements for the new system based on the calculation results, Black & Veatch can conclude the following:

- The existing equipment is in good condition to be reused. The current equipment location is also acceptable.

2.7 WASTEWATER

ABB currently utilizes three lined settling basins for cooling tower blowdown solids settling. Surface loading rates for sedimentation basins where coagulation for turbidity removal is required are typically 0.5 to 1 gallons per minute per square foot. Table 3-4 below compares the surface loading rates of the existing operating plant to the discharge flow to determine if the existing settling ponds are sufficient.

Table 2-12 compares the existing Wastewater equipment to the new unit requirements.

Table 2-7 Existing Waste Water Equipment

	EXISTING EQUIPMENT	REQUIREMENT FOR NEW UNITS*	EXISTING SYSTEM ACCEPTABLE
Cooling Tower Settling Basin #1 Cooling Tower Settling Basin #2 Cooling Tower Settling Basin #3	511,000 gallons / 9,500 ft2 768,000 gallons / 15,870 ft2 1,178,000 gallons / 24,300 ft2	F- Class = 13 gpm	Yes - Surface loading rate <0.1gpm/ft2
Polymer Storage Tank Capacity	U1: 1,500 gallons U2: 1,500 gallons	<1,500 gals	Yes
Polymer Pump capacity	U1: 0.5 gph (1 x 100%) U2: 0.5 gph (1 x 100%)	<0.5 gph	Yes
* Equipment sized for capacity of the new 2x0 combined cycle plant. Polymer feed requirements will be negligible and as needed based on flow.			

All surface loading rates, including the existing operating facility, are well below recommended limits for adequate sedimentation. It is reasonable to assume the existing settling basins would provide the same solids settling capability to meet discharge limitation requirements based on surface loading rates shown above. Also important to note that the same circulating water chemical conditioning program will be utilized for circulating water treatment. No changes to the settling basins or cooling tower/circulating water treatment program are necessary.

Based on the Existing Equipment Condition Assessment report information provided by CenterPoint and given the requirements for the new system based on the calculation results, Black & Veatch can conclude the following:

- The existing settling basins are in good condition to be reused. The current equipment location is also acceptable.
- The existing capacity and resulting surface loading rates are adequate to meet the demands of the new SCPP alternatives.
- The system will need to be utilized for the new SCPP during startup/commissioning efforts.

2.8 SANITARY WASTEWATER SYSTEM

Based on the Equipment/System Condition Assessment Report the equipment and controls are like new while the mechanical and electrical systems are in good or fair condition.

Table 2-13 compares the existing Sanitary Wastewater equipment to the new unit requirements.

Table 2-8 Existing Sanitary Treatment Equipment

	EXISTING SANITARY WASTEWATER SYSTEM EQUIPMENT	REQUIREMENT FOR NEW UNIT*	EXISTING SYSTEM ACCEPTABLE
Sanitary Wastewater System Capacity	4,000 gallons/day	2 to 3 gpm average sanitary use	Yes

* Equipment sized for capacity of the new 2x0 combined cycle plant.

Based on the Existing Equipment Condition Assessment report information provided by CenterPoint and given the requirements for the new system based on the calculation results, Black & Veatch can conclude the following:

- The existing equipment is in good condition to be reused.
- The current equipment location is acceptable.

2.9 OILY WASTE SYSTEM

The existing Oily Waste system includes gravity drain pipe from Units 1 and 2, oily waste surge basin, oily waste skimmer, oil/water separator, stilling basin, and oil storage tank. Based on the Equipment/System Condition Assessment Report all components are in new/like new condition. Based on the Condition Assessment Report, the equipment is around 14 years old and had a recent overhaul in January of 2017 where the east pump was replaced. The oil/water separator fill was also replaced in the fall of 2016.

Table 2-14 compares the existing Oily Waste equipment to the new unit requirements. The existing Oily Waste System will provide adequate flow and storage. The new Oily Waste gravity pipe will be tied in to the existing Oily Waste gravity pipe system at an existing manhole location upstream from the existing oil/water separator. This will allow utilization of the existing gravity pipe system and alleviate new underground pipe congestion.

Table 2-9 Existing Oily Waste Equipment

COMPONENT	EXISTING EQUIPMENT CAPACITY	REQUIRED CAPACITY FOR NEW UNIT	EXISTING SYSTEM ACCEPTABLE
Surge Basin	13,500 gal normal 27,000 gal emergency	Normal operation acceptable. 5,000 gal fire water + 15,000 gal oil spill for a total emergency volume of 20,000 gal	Yes
OWS Pump Oil Skimmer Pump	500 gpm 35 gpm	500 gpm No impact	Yes
Oil Storage Tank	2,000 gal normal 3,060 gal emergency	Tank capacity is acceptable for normal operation. In an emergency event the tank and surge basin will be used together for oil storage. The tank will have to be pumped out multiple times.	Yes

Based on the Existing Equipment Condition Assessment report information provided by CenterPoint and given the expected requirements for the new system, Black & Veatch can conclude the following:

- The existing equipment is in good condition to be reused. The current equipment location is also acceptable.
- The existing capacity of the surge basin, oil/water separator pump, oil skimmer pump, and oil storage tank are adequate to the meet the demands of the new SCPP.
- The system will need to be utilized for the new SCPP during startup/commissioning efforts as well as first fire.

2.10 RESERVE AUXILIARY TRANSFORMERS 12/21 (RAT 12/21)

The existing reserve auxiliary transformers, RAT12/21, are three winding, 138 kV (H) – 13.8/4.16 kV (X/Y), 30/40/50 MVA (H) – 15/20/25 MVA (X&Y). The transformers were placed in service January, 2004. Based on the Equipment/System Condition Assessment Report the equipment is in like new condition. In October 2016 the transformers underwent LTC inspection and maintenance repairs, Oil processing and electrical testing. All electrical tests were within limits with the exception of RAT 21. These transformers exhibited elevated Phase C exciting currents which may have been due to residual magnetization.

The RATs will continue to support existing plant auxiliary electric system in their present configuration, without modification.

2.11 MEDIUM VOLTAGE ARC-RESISTANT SWITCHGEAR

The existing medium voltage, arc-resistant switchgear is rated 4.15 kV, 3000A, 50 kAIC. There are two lineups of the gear, one connected to an existing Unit Auxiliary Transformer (UAT) and the 4.16 kV winding of RAT 12, the other connected to an existing UAT and the 4.16 kV winding of RAT 21. There exists a Beckwith M-4272 fast transfer scheme controlling both main circuit breakers of each switchgear lineup. The medium voltage switchgear will continue to support existing plant auxiliary electric system in the present configuration, without modification.

The 13.8 kV winding of RAT 12 and RAT 21 feed an existing medium voltage 13.8 kV, 2000A switchgear lineup which presently feeds the Unit #1 & #2 ID fans being removed from service . At the option of Turnkey Contractor, the new CTG static starting transformers may be fed from the existing 13.8kV switchgear.

3.0 Conclusions

This report has shown the following:

- The Fire Water Storage and Supply and existing fire water pumps are of sufficient capacity to be reused.
- A new compressed air system should be installed for the new SCPP. This includes new air compressors (2x100%), air dryers (2x100%), a wet receiver (1x100%), and a dry receiver (1x100%).
- Compressed Gas Bulk Storage existing equipment is oversized and not located in close proximity to be reused. New compressed gas bottle racks will be included in the estimate and design. This facilitates future changes to a bulk storage system if desired by Vectren.
- Demineralized Water storage is in good condition and has sufficient capacity to be reused for the new SCPP.
- The existing Demin water treatment system is in good condition and has sufficient capacity for the new SCPP.
- Service/Raw/Makeup Water (tanks, pumps, etc…) The existing equipment is in good condition to be reused. The current equipment location is also acceptable, however, above grade and below grade piping and valves at the pump intake structure are in poor condition. The existing system and will be reused for the new SCPP with regular inspections for additional degradation and maintained as required.
- Potable Water existing equipment is in good condition to be reused. The current equipment location is also acceptable.
- Wastewater existing settling basins are in good condition to be reused. The current equipment location is also acceptable.
  - The existing capacity and resulting surface loading rates are adequate to the meet the demands of the new SCPP alternatives.
  - The system will need to be utilized for the new SCPP during startup/commissioning efforts.
- Sanitary Wastewater existing equipment is in good condition to be reused. The current equipment location is also acceptable.
- The existing Oily Waste equipment is in good condition to be reused. The current equipment location is also acceptable.
  - The existing capacity of the surge basin, oil/water separator pump, oil skimmer pump, and oil storage tank are adequate to the meet the demands of the new SCPP alternatives.
  - The system will need to be utilized for the new SCPP during startup/commissioning efforts as well as first fire.
- Reserve Auxiliary Transformers 12/21 (RAT 12/21) will continue to support existing plant auxiliary electric system.

- Medium Voltage Arc-Resistant Switchgear may be used to feed the new CTG static starting transformers, at option of Turnkey Contractor, and will continue to support existing plant auxiliary electric system.