OFFICIAL
EXHIBITS

VERIFIED SUPPLEMENTAL TESTIMONY

OF

MICHAEL L. HOLTSCLAW

ON BEHALF OF

INDIANAPOLIS POWER & LIGHT COMPANY

IURC CAUSE NOS. 44576/44602

IURC
PETITIONER'S 1-S
EXHIBIT NO.
9-21-15
DATE REPORTER

INCLUDING IPL WITNESS MLH ATTACHMENT S-1-01 THROUGH S-1-04

VERIFIED SUPPLEMENTAL TESTIMONY OF MICHAEL L. HOLTSCLAW
ON BEHALF OF
INDIANAPOLIS POWER & LIGHT COMPANY

Q1. Please state your name, employer and business address.

A1. My name is Michael L. Holtsclaw, Director, Transmission & Distribution Engineering. I am employed by Indianapolis Power & Light Company ("IPL" or "Company"), whose business address is One Monument Circle, Indianapolis, Indiana 46204.

Q2. Are you the same Michael L. Holtsclaw who previously submitted direct testimony in Cause No. 44576?

A2. Yes.

Q3. What is the purpose of your supplemental testimony in this proceeding?

A3. Together with IPL Witnesses James A. Sadtler and Craig L. Jackson, I am responding to the Issues List in the IURC's Docket Entry Dated April 9, 2015, Cause No. 44602. To provide context, my testimony first provides some basic information on the network. To facilitate an understanding of the subject matter, I identify the nomenclature used in to discuss the components of IPL's system

Q4. Are you sponsoring any Attachments in support of your testimony?

A4. Yes. I am sponsoring IPL Witness MLH Attachments S-1-01 through S-1-04, which are diagrams as identified below.

Q5. Were these attachments prepared or assembled by you or under your direction or supervision?

A5. Yes.

INTRODUCTION

Q6. Please describe the delivery systems IPL uses to serve distribution customers.

A6. IPL uses two distinctly different distribution systems to provide service to its customers. The first is called the "General Distribution System." This term refers to the distribution system used to serve the vast majority of IPL customers. The General Distribution System covers the entire service territory except for a specific area in downtown Indianapolis referred to as the "Mile Square." Within the Mile Square is located what is referred to as the "Downtown Underground Network" (or "IPL Network"). The General Distribution System is a radial system. This means primary lines extend from a substation out to a point and stop. Along the way, taps connect to the primary line and customers are connected to the taps. Refer to IPL Witness MLH Attachment S-1-01 for a diagram that depicts this arrangement.

Q7. Please describe the IPL Network and the components that comprise the network.

A7. The design of the IPL Network is different from the radial system used for the General Distribution System. The key difference is that the low voltage side of the transformers within the IPL Network are connected together, forming a grid. This grid is commonly referred to as a "Secondary Network System." A unique feature of the Secondary Network System is the loss of a single component, such as a primary feeder or a network transformer, will not result in any customer losing power. This is due to the fact that there is always an alternate source of power available to the customer from the grid. A secondary network system has been recognized for many years by the utility industry as an economical way to provide a high degree of reliability to downtown areas with a high concentration of loads. As was noted in the O'Neill Management Consulting report dated

December 19, 2011, IPL's secondary network design is typical of that used in other major cities.[1]

The components that make up the Secondary Network System include:

- Manholes: These are used as junction/splicing points for the underground cables from ducts and conduits. Workers physically enter these structures, which vary in size but are typically five feet wide by 10 feet long. Manholes are considered a confined space and require additional safety precautions to be followed for entry. IPL's manholes are relatively dry compared to a lot of other utilities. The sandy soil and low water table in downtown Indianapolis helps keep IPL's underground facilities drier than most.

- Conduit System: This is the pathway between manholes and vaults for the underground cables; it is also referred to as a duct line. These are typically four- or five-inch diameter conduits made of clay tile, fiber material, or PVC plastic. The conduits are arranged in groups of two to twelve individual conduits. The group of conduits is then encased in a concrete envelope for added physical protection.

- Transformer Vault: These structures house the underground network transformers. Typically, a vault consists of one to four compartments also referred to as bays. The size of the bay is typically 10 feet by 20 feet. Each bay generally contains one network transformer. A grating in the vault roof provides ventilation and an access door allows personnel entry into the vault. Most vaults

[1] "Independent Assessment of Indianapolis Power & Light's Downtown Underground Network", Dated December 13, 2011, O'Neill Management Consulting, page 23

contain openings between the bays that allow a worker to move from one bay to another. There is a collector bus comprised of individual copper bars to which cables connect that runs the length of the vault through each bay. The bus is supported from the ceiling of the vault by insulators. The output of the network transformer connects to this collector bus. Service cables to customers and network secondary cables between vaults also connect to the collector bus. The vault is considered a confined space and requires additional safety precautions to be followed for entry.

- Primary Network Cables: IPL's Primary Network Cables (also "Primary Cables") operate at 13,800 volts. Primary Cables are installed in the manholes and conduits from the source substation to the underground Network Transformers in the vaults. The majority of the Primary Network Cables are a paper insulated, lead jacketed cable. IPL has been installing Primary Network Cables with Ethylene Propylene Rubber ("EPR") insulation and a polyethylene jacket for the past 10 years. Both types of insulation have good thermal stability properties.

- Primary Feeder: The Primary Feeder (also "Primary Network Feeder") is the circuit that extends from the source substation 13,800 volt breaker to the each Network Transformer connected to that particular circuit. A Primary Feeder only serves Network Transformers located within a given Secondary Network Area.

- Secondary Network Cables: IPL's Secondary Network Cables (also "Secondary Cables") are operated at 120/208 volts and connect transformer vault collector buses to other transformer vault collector buses through Manholes and the

Conduit System. Customer service cables may also connect to the Secondary Cables in the Manholes through which Secondary Cables pass.

- Cable Limiter: This is a protective device similar to a fuse. It is used to isolate cables that have experienced a failure from the Secondary Network System. IPL also uses Cable Limiters on certain size service cables that connect to the Secondary Cables. These may be installed in a vault or in a Manhole. Cable Limiters are designed to protect and operate just before the insulation of the conductor is damaged by fault conditions. Cable Limiters will not reliably clear an arcing fault where the current is fluctuating rapidly from high to low.

- Network Transformer: The Network Transformers are designed to be operated in a below grade environment and can be completely submersed under water. The Network Transformer brings the voltage down from the primary voltage of 13,800 volts to the secondary level of service voltages of either 120/208 volts or 277/480 volts depending on the application. Network Transformers can range in size from 500 KVA to 2,000 KVA. There are three parts to a Network Transformer. First, there is a Primary Termination Chamber where the underground Primary Cables connect to the Network Transformer. Right below that is a primary switch compartment, which contains a three position non-load break switch. Those positions are Open, Closed, and Ground. The Ground position is used for safety when personnel are working on the primary cables. The third compartment is the

main tank, which contains the core and coil assembly of the transformer. All three compartments contain insulating oil and are separate from each other.

- Network Protector: This device connects to the low voltage secondary terminals of the Network Transformer. Like the Network Transformer, the Network Protector is designed such that it can be completely submersed under water. It acts like the circuit breaker in a home except it operates on the direction of power flow rather than on the magnitude of fault current. The Network Protector is designed to open if power tries to flow from the Secondary Network System back through the transformer into the Primary Cables. This flow could occur when a Primary Cable fails and the substation circuit breaker opens to de-energize the Primary Cable. The Network Protector opens to stop reverse current flow from the vault collector bus back through the transformer and out through the Primary Cable to the fault. There are also fuses in the Network Protector that will open and isolate a fault on the secondary side of the Network Transformer to prevent a possible failure of the Network Transformer. The Network Protector is a critical component that allows a Secondary Network System to function reliably and protect the network system.

- Secondary Network Vault: IPL's Secondary Network Vaults are operated at 120/208 volts and connect through Secondary Cables that tie multiple Network Transformers together. Refer to IPL Witness MLH Attachment S-1-02 for a diagram of a typical secondary network vault layout (Figure 1) and the layout of how the secondary network vaults connect to form a secondary network (Figure

2). In Figure 2 an example of a large service would be Deering Cleaners from the March 19, 2015 event. An example of a small service would be the IDO building.

- Spot Network Transformer Vaults: These vaults operate at 277/480 volts and serve a single building. Typically, the vault collector buses are not connected to other 277/480v buses and have no backup as in the secondary network system. Refer to IPL Witness MLH Attachment S-1-03 for a diagram of a typical spot network vault layout.

- Non-Network Service: This type of service can be provided at the primary voltage level of 13,800 volts down to 120/208 volts. Service is provided by a minimum of two Primary Feeders. Loss of a Primary Feeder will result in a loss of power to the customer until either an automatic or manual switching operation occurs to transfer service to one of the remaining Primary Feeders. Customers utilizing this type of service typically provide their own voltage transformation from 13,800 volts to their utilization voltage. Refer to IPL Witness MLH Attachment S-1-04 for a diagram of a typical layout.

Q8. Please discuss how a secondary network system is configured.

A8. A secondary network system is typically sub-divided into smaller geographic service areas, referred to as Secondary Network Areas. IPL's Secondary Network System follows this configuration. The purpose of these smaller Secondary Network Areas is to manage primary feeder loadings and to reduce exposure should it be necessary to shut down a Secondary Network Area for any reason. A Secondary Network Area will be served typically with four to six primary network feeders providing service to a combination of Secondary Network Vaults and Spot Network Vaults. The Primary

Network Feeders are dedicated to a specific Secondary Network Area and do not serve any loads outside of that particular Secondary Network Area. Also, the Primary Network Feeders emanate only from one bulk power substation. Feeders from multiple bulk power substations are not mixed within a Secondary Network Area for operational reasons.

Q9. What can cause interruptions on the IPL Network?

A9. The IPL Network is reliable, interruptions to customers occur infrequently. Because of the design of IPL's Network, the failure of multiple components must occur before interruptions to customers can occur. The most common type of failure that occurs is splice failures or cable termination failures. The connection points or splice points are inherently the weakest points in any underground system. As such, these are the areas where failures are most likely to occur. These are the weak points because these connections are made in the manholes or vaults. While workers take great care to keep contamination and moisture away from the splice work being performed, they are still working underground in a harsh environment. The splicing technology has improved over time. Since the early 1990's, IPL has used heat shrink technology for most of its splices. These splices are easier to install and have greater tolerance for field conditions.

Voids (air pockets) or contaminants in the splice are common causes of splice or termination failure. Either of these will cause areas of high electrical stress in the splice and, over time, eventually lead to a failure of the splice.

Downtown Indianapolis also has an active steam heat system, which can contribute to failures on the electrical network due to excessive heat. Heat radiating from steam lines

with deteriorated insulation or steam leaking from steam pipes near electrical facilities will cause degradation of the components of the electrical network system. Excessive heat causes splice materials and cable insulation to deteriorate and eventually lose their insulating properties, resulting in an electrical failure.

Road salts and other ice melting chemicals can cause corrosion and deterioration of the electrical components as well. This can allow moisture to infiltrate the electrical components and can lead to a failure. This is discussed in further detail in response to Question 17.

Failure of customer owned equipment connected to IPL's Secondary Network System can also lead to problems and failures on IPL's components. This can be at the primary voltage level of 13,800 volts or at the secondary voltage level.

Q10. You did not include the age of the cable as one of the causes of interruptions. Why not?

A10. The insulation systems of these cables have shown they will perform well for more than 50 plus years with some lasting over 100 years. Because of the long expected service life, the cable manufacturers do not publish an expected service life value. Within the utility industry age is not considered a good proxy for equipment condition.[2]

Q11. Please describe the sequence of events for a fault event on the IPL Network.

A11. The IPL Network is designed with redundancy in order to provide continuous service to customers when a system abnormality, such as a Primary Cable failure, occurs.

[2] Paper presented at 2001 EUCI Conference on T&D Aging Infrastructure by Dan O'Neill, Navigant Consulting http://docslide.us/documents/age-is-a-poor-proxy-why-relying-on-age-based-replacement-is-imprudent-presented-by-dan-oneill-to-the-euci-aging-td-infrastructure-workshop-february-21.html

When a Primary Cable failure occurs, the protective relays at the source substation detect a problem and signal the substation circuit breaker at the beginning of the Primary Cable circuit to open. For underground network feeders the circuit breaker opens typically within 0.1 seconds and stays open. The Network Protectors on the transformers connected to the faulting Primary Cable circuit will immediately open on reverse power flow from the secondary network back toward the primary network. This isolates the faulted feeder from the rest of the network system and results in no customer outages. The System Operators in the Transmission Operations Control Center are signaled through the Energy Control System that the circuit breaker opened. They dispatch the appropriate personnel to respond.

When a Secondary Network Cable failure occurs, fault current will flow toward the fault from both directions. The fault current will melt the cable in two at the short circuit point thus clearing the fault. Most Secondary Cable faults are isolated without incident. Infrequently, Secondary Cable faults can result in a fire or an over-pressurization event.

An over-pressurization event can occur when the levels of carbon monoxide and other combustible gases build up in the manhole above their lower explosive limit. The combustible gases can include natural gas, methane gas from the sewers, and other gases created from the smoldering or burning of the cable insulation. The most prominent gas generated from burning cable insulation is carbon monoxide which has a lower explosive limit of 13.8 percent. If there is an ignition source such as arcing at the short circuit point, the combustible gases in the manhole can be ignited. The pressure in the Manhole will build rapidly and can dislodge one or more Manhole covers.

Q12. Please discuss how IPL interfaces to Customer-Owned Equipment on the IPL Network.

A12. IPL owns and maintains the Primary and Secondary Network Cables, vault, Network Transformers and other associated equipment, including the metering equipment. The customer is required to extend their secondary service cables to an IPL Manhole or vault. The demarcation point between IPL and the customer is the point where the customer's cables connect to the IPL Secondary Network System. The details on service requirements for customers are provided in IPL's Electric Service and Meter Manual (a.k.a., "The Gold Book").[3] This book provides details about IPL's requirements for service, the customer's responsibilities, and how the metering equipment will be installed. IPL requires an inspection certification from the City of Indianapolis Electrical Inspector before a service will be connected and energized.

ISSUE 1 -NETWORK SAFETY

Q13. Please discuss the safety of IPL's network, focusing on the downtown network.

A13. Safety is our first value at IPL and we take safety very seriously. Indianapolis has a well-designed, safe and reliable Downtown Underground Network. As indicated in the Independent Assessment of Indianapolis Power & Light's Downtown Underground Network by O'Neill Management Consulting in December 2011 ("O'Neill Report"), the electrical network in downtown Indianapolis is well designed and regularly maintained.[4] In response to the O'Neill Report, IPL accepted and has completed all the

[3] This publication is available at http://apps.iplpower.com/goldbook/Goldbook.html

[4] "Independent Assessment of Indianapolis Power & Light's Downtown Underground Network", Dated December 13, 2011, O'Neill Management Consulting, page 5

recommendations in the O'Neill Report and this has made an even greater favorable impact on the safe performance of the Indianapolis Downtown Underground Network.

IPL strives to enhance our practices, procedures and protection equipment to help keep our employees, contractors, customers and the general public safe. The completed recommendations of the O'Neill Report referenced above have enhanced the rigor and consistency of manhole and vault inspections with both electronic tablet inspections with business rules and infrared technology. Through May 31, 2015, over 500 Manhole covers have been replaced, out of the 1,214 planned, with Swiveloc covers that allow the pressure to be relieved during an over-pressurization event while keeping the Manhole latched to the ground. IPL is in the process of replacing 137 480 volt Network Protectors for both employee arc flash protection and for public safety. IPL has replaced all the mineral oil in the primary termination chambers with FR-3 fluid with a flashpoint high enough to eliminate or limit combustion. Lastly, we have enhanced our emergency response and post event analysis to ensure a rapid response to events and to maximize our lessons learned from any event to help improve our procedures.

As IPL senior leaders have discussed in the Commission's public meetings, IPL is diligently working to eliminate downtown network failures and to mitigate the impact when failures occur. However, we cannot guarantee a failure will not occur regardless of the amount of money IPL or any other utility operating a downtown underground network would spend. IPL is confident the steps we have taken in response to the Independent Assessment of Indianapolis Power & Light's Downtown Underground Network have prevented events that would have otherwise occurred. IPL's actions have mitigated the impact of others and will continue to mitigate future network failures.

Actions like retro-filling the primary termination chambers with FR-3 fluid have mitigated the impact when failures have occurred as indicated in the March 16, 2015 Root Cause Analysis ("RCA"). We continue to develop our Asset Management System to help find ways to make the IPL Network safer and more reliable.

Q14. In order to properly frame the network safety discussion, please describe what would constitute an unreasonable level of safety on the downtown network. Please discuss what would constitute an unreasonable risk of safety to the public.

A14. There is no definitive answer or "bright line test" for what is a reasonable or unreasonable level of safety. Based on my 36 years of operating experience, I believe IPL is ahead of the utility curve for network operation and safety. That does not mean utilities behind IPL on the curve provide an unreasonable level of safety. Certainly, an example of an unreasonable level of safety on the IPL Network would be where an attempt to cure or eliminate a known risk creates unanticipated risks. Changes to the network equipment, practices and procedures require careful evaluation in order to avoid unintended adverse consequences. The implementation plan should monitor results and make adjustments as necessary. While I believe the IPL Network is safe, I also believe that "standing still" is inappropriate. That's why IPL installs new equipment, adopts new technology and procedures and engages experts on the subject. Our objective is to work to improve reliability of the Indianapolis Downtown Underground Network and minimize the risk of event occurrence and the impact of failures.

Q15. Please discuss the failure evaluation, including any root cause analyses performed, for the March 16, 2015, and March 19, 2015, events, and what mitigation measures those events suggest IPL should consider in order to improve network safety.

A15. IPL Witness Sadtler presents the root cause analyses for the March 16 and 19, 2015 events and otherwise responds to this request.

Q16. Please present the necessary data to determine whether or not there were any ongoing, persistent network conditions that may have contributed to the occurrence of the ongoing series of network events since 2005. That data should include at a minimum the following information:

1. **System design.—cabling, conduits, vaults, insulation, design standards, best practices;**
2. **Age of network system components;**
3. **Inspection practices—trainings recordkeeping, prioritization of observation results, and speed of remediation.**

A16. I discuss part one above in response to Questions 7 and 8. IPL Witness Sadtler addresses parts two and three of this request.

Q17. Please discuss what externalities, if any, may have contributed to the cause/effect of the series of IPL network events. These externalities may include, but are not necessarily be limited to, the following items:

1. **Effect of other underground facilities on IPL's system (i.e. steam heat, cooling system, drinking water system, natural gas system, fiber optics, and telecommunications);**
2. **Effect of other environmental factors (i.e., road salt and other ice melting chemicals, other chemicals, debris including mud, airflow, water, ongoing downtown construction projects, customer-owned equipment failures, etc.).**

A17. As has been discussed in prior presentations to the Commission, IPL along with a number of other utilities share the limited right-of-way space in downtown Indianapolis. The utilities work together and coordinate the placement of each utility's underground facilities to minimize impact on each other's facilities. Heat has the most detrimental effect on underground utilities. Over the years, IPL has attempted to maintain as much

separation between its electric facilities and the steam lines as possible, but this separation cannot always be achieved. IPL and Citizens Energy Group, current operator of the downtown steam system, have a very good working relationship. When a situation is discovered where elevated temperatures are found in an IPL electric manhole, Citizens Energy is immediately contacted and they respond to address and rectify the situation. IPL has found instances where IPL electric cables exhibited signs of damage from prolonged exposure to elevated temperatures. To address this concern, in 2012 Citizens Energy began sharing the results of their annual thermal imaging scans of their system. This thermal imaging survey shows areas where there are elevated temperatures associated with a steam line. IPL uses this information to see if we have underground cables in the vicinity and investigate for possible cable damage.

The runoff of road salt and melting snow can, if there is cracking or breaks in the insulation of the cable jacket due to corrosion or other damage, pass through the compromised insulation and directly contact its energized conductor giving rise to a path for an electrical flashover and cause the cable to fail. The utility industry has seen an increase in underground cable failures in the days and weeks after a snow storm where city street departments have spread road salt to clear the streets of ice. IPL has experienced some cable failures shortly after a snow event but given IPL's low number of cable failures, IPL has not found a strong correlation between cable failures and road salt. However, Con Edison in New York which operates a much larger secondary network system, has determined from their analysis that there is a direct correlation between tons of road salt used and cable failures. IPL's predominate use of solid manhole covers helps to keep the road salt mixture out of the manholes and reduces the potential impact versus

the use of a grated cover which would allow much more of the road salt mixture to enter the Manhole.

Downtown construction activity has at times resulted in damage to IPL's underground facilities. Third party dig-ins is a constant risk the Company faces. While state law requires contractors to call for underground utilities to be located before they start excavating, incidents still occur. During the years that Circle Center Mall was being constructed there were dig-ins and during the recent Cultural Trail construction there were dig-ins. IPL monitors downtown construction activities on a daily basis watching for construction activities that might be near IPL underground facilities and has conversations with the contractors and other utilities to make sure they know the location of IPL's facilities.

Q18. Please discuss any efforts IPL should expedite to ensure public safety. To the extent those efforts could have been implemented before March 2015, please explain why IPL had not previously taken those efforts.

A18. IPL is expediting the replacement of Swiveloc locking manhole covers to replace all 1,214 covers by the end of 2015. The reason IPL had not accelerated the locking replacement covers previously is because there had been insufficient time to experience and identify any operational or maintenance issues with using the locking replacement covers, especially the latching mechanism.

Q19. Did IPL identify any issues with the locking manhole covers?

A19. Yes. Early in 2014, IPL contacted Swiveloc (the locking manhole cover manufacturer) regarding difficulty entering manholes due to corrosion associated with the locking

mechanism. Swiveloc responded to our concerns and began testing a new locking mechanism in late 2014. Swiveloc provided IPL a new Manhole cover with a new latching mechanism for IPL to test in early 2015. Based upon that successful pilot test in early 2015, IPL was comfortable making the decision to accelerate the replacement of the remaining approximately 800 covers by the end of 2015.

Q20. Please discuss IPL's network redundancies, and evaluate how successful those redundancies have been to prevent service outages after the occurrences of network events.

A20. The design of IPL's Network has proven to be very reliable. Customers served from IPL's Network rarely see sustained power outages and they do not see momentary outages that customers on the General Distribution System see from time to time. As was shown in the responses to Questions 7 and 8 above, multiple redundancies have been designed into IPL's Network beginning at the substation and continuing on through the secondary vault. As a result of those redundancies, Primary Cable faults and Secondary Cable faults rarely result in outages to customers on IPL's Network. The Network SAIFI[5] for most years is 0. The August 13, 2014 event on South Meridian Street did result in some customer outage and made the 2014 Network SAIFI 0.00001 compared to the year-end system SAIFI of 0.96 for the overall system (transmission, General Distribution and IPL Network). The 2015 Network SAIFI year to date is 0.002 as a result of the March 19, 2015 event on North Street. Prior to 2014, SAIFI had been 0.0 since 2008. For customers on IPL's Network to experience an extended outage, requires the failure of multiple primary feeders in the same Secondary Network Area resulting in

[5] System Average Interruption Frequency Index (SAIFI) measures ratio of total customers interrupted to the total number of system customers.

the loss of Spot Network Vault or that requires the shutdown of a Secondary Network Area.

Q21. Please discuss how many times in the past 10 years IPL has shut down a secondary network resulting in an extended outage to customers on IPL's Network.

A21. Over the past 10 years, IPL has shut down a Secondary Network Area only three times. Once in 2005 for a secondary fire, in 2007 at the direction of the Fire Department for electrical wires sparking in customer owned equipment, and in 2015 for the secondary fire on March 19th. IPL takes shutting a Secondary Network Area down very seriously, but the Company will take this action to protect the public and to prevent further damage to IPL's electrical facilities if the situation warrants. When a Secondary Network Area is shut down, service to approximately a quarter of downtown Indianapolis is interrupted.

ISSUE 2-NETWORK MAINTENANCE

Q22. Are you familiar with IPL's responses to the recent informal investigations and the associated consultant report recommendations?

A22. Yes. I participated in the public meetings and investigation of the incidents reviewed during these meetings. I am familiar with the documents which the Commission took administrative notice of by docket entry dated March 20, 2015.

Q23. Please discuss IPL's responses to the recent informal IURC investigations and the associated consultant report recommendations.

A23. IPL has cooperated fully with the Commission's investigations. In 2011, after O'Neill Management Consulting was selected by the Commission to conduct an independent

assessment of IPL's Network, IPL met with Dan O'Neill and Charlie Fijnvandraat on site at IPL and conducted numerous conference calls over a four month period to provide them with all requested information. On December 13, 2011, O'Neill filed its Report. The Report (at 5) stated: "The electrical network in downtown Indianapolis is well designed and regularly maintained. Notwithstanding a higher incidence of recent events, detailed in our report below, the risk to the citizens of, and visitors to, Indianapolis has historically been low; lower, in fact, than in many other major cities' downtown areas that are served by similar underground facilities." We were pleased to see the O'Neill Report confirm that the Downtown Underground Network is sound and safe.

That said, we were also pleased to receive the feedback in the Report. In January 2012, IPL filed its response to the O'Neill Report. IPL committed to implement all ten of the O'Neill recommendations. The Company also agreed to file annual status reports until all of the recommendations and the additional commitments that Company made were complete. As requested by the Commission, during implementation of the O'Neill recommendations starting in 2012, the Company continued to have discussions with O'Neill Management Consulting and provided them with all requested information on the implementation progress. These recommendations are now complete.

In October 2014, O'Neill submitted an independent review of the Company's RCA for the 26 S. Meridian Street Network Event on August 13, 2014. This report stated: "Overall, we find the report and the process employed to be generally consistent with industry practice of root cause analysis ("RCA") for comparable events." The Company reviewed the additional feedback and in December 2014 submitted an Action Plan which

committed to implement all the recommendations in the RCA report. Implementation of the Action Plan is underway.

Q24. Please discuss how IPL's past responses to network events and infrastructure maintenance have improved IPL's process to prevent similar types of network events today.

A24. IPL's past responses to network events and infrastructure has been good as shown by the reliability of the Network. That said we have and continue our proactive efforts to improve. One way we do this is through the deployment of technology. As technology has improved, IPL has worked to incorporate that technology into our systems to allow us to improve our operations. One significant advancement that IPL made recently is the installation of the downtown network Supervisory Control and Data Acquisition ("SCADA") system in 2012 and 2013. I discuss this system in more detail in Question 30. As stated therein, this system places IPL ahead of most utilities that operate a Secondary Network System. Moreover, IPL was able to reduce the cost of this improvement by taking the initiative to apply for and receive a Department of Energy Smart Energy Project grant.

As explained in the RCA for the March 16, 2015 event presented by IPL Witness Sadtler, the addition of FR-3 transformer insulation/cooling fluid is one network safety improvements that had been made by IPL that came into use and was successful in mitigating a primary termination chamber insulating oil fire. The on-going deployment of the locking Manhole covers and the replacement of all the 480/277 Volt Network Protectors further enhances the infrastructure. As Network Transformers are replaced,

the new design eliminates the use of a primary termination chamber through the use of a bolted termination fitting.

IPL has reduced the mean time between inspection cycles for the vaults and Manholes which comprise the Downtown Underground Network. The inspection process refinements, work management and asset management tools we have invested in allow us to better utilize technology to maintain and understand the needs of the Downtown Network.

Q25. Please discuss any efforts IPL should expedite to maintain its network. To the extent those efforts could have been implemented before March 2015, please explain why IPL had not previously taken those efforts.

A25. IPL is in the process of replacing 137 of the 480 volt Network Protectors for purposes of both safety and reliability. This replacement effort will be completed by the end of 2018. As of May 31, 2015, IPL has 19 of the 137 completed. The reason this work has not already been completed is due to the need to analyze the appropriate equipment and procedures to meet the National Fire Protection Association standards (adoption pending by the State of Indiana as part of the Indiana Electrical Code) for arc flash requirements without requiring extensive customer outage. We could have met the standard by always taking an outage when performing routine and emergency 480 volt underground vault work, but that would require shutting off service to major downtown high rise buildings to perform that work. Waiting for manufacturers to develop a 480 volt network protector that operates fast enough to limit arc flash energy and for IPL to ensure the safety performance were the reasons we did not accelerate the replacement of the 480 volt Network Protectors.

Q26. Please analyze what effect IPL's asset management program/practices, if any, may have had in assisting IPL predict or prevent potential network failures and other related problems.

A26. Generally, IPL uses a combination of leading and lagging indicators to evaluate the probability of a network asset failing. The asset management philosophy has helped build the formal processes to store consistent and quality data for potential failure analysis. This data along with available industry data and the best practices are being documented with asset life cycle plans. These plans take a holistic look at the asset class life cycle and are expected to address items such as:

- Description of the assets
- Asset performance
- Asset conditions and health (health and criticality)
- Operating and maintenance strategies
- Expenditures and refurbishment/replacement strategies
- Information systems
- Innovations and best practices

ISSUE 3-NETWORK INVESTMENT

Q27. Please discuss how IPL's shareholders influence the ongoing investment in, and operation and maintenance of, its network facilities.

A27. IPL Witness Jackson responds to this request.

Q28. Please discuss how network performance, maintenance, and safety are reasonably correlated to sufficient ongoing investment.

A28. IPL reviews network performance, maintenance, and safety on an on-going basis by monitoring leading (inspection and monitoring) and lagging (failure history) indicators. Opportunities to improve performance are continuously investigated and reviewed by subject matter experts. IPL also actively participates in industry forums that share best practices. Projects and investment opportunities are analyzed throughout the year.

Q29. Please support the past level of investment in its network (focusing on 2000 through June 2013), as well as the expectation of going- forward investment.

A29. The chart below shows IPL's capital investment in the downtown network for the years 2000 through June of 2013.

Capital Investment in Downtown Network By Year	
2000	$ 2,298,445
2001	$ 798,012
2002	$ 1,010,730
2003	$ 1,024,313
2004	$ 1,869,913
2005	$ 3,218,865
2006	$ 2,260,853
2007	$ 2,618,414
2008	$ 4,593,963
2009	$ 3,997,232
2010	$ 6,071,673
2011	$ 8,337,816
2012	$ 4,982,785
YTD June 2013	$ 5,984,523

As illustrated in the chart, IPL has increased investment in the Downtown Underground Network. New facilities have been installed for customer growth. Public improvement projects associated with the Cultural Trail and Georgia Street have resulted in new electrical equipment and structures. As part of IPL's Department of Energy Smart

Energy Project, over $4.4 million was invested, installing a downtown network SCADA system.

In addition to customer, public improvement, and system technology projects, IPL uses a condition-based approach to pro-actively replace infrastructure. In addition to normal condition based equipment replacements, since the beginning of 2013, IPL has also pro-actively replaced over 33,800 feet of less reliable Cross-linked Polyethylene ("XLPE") primary feeder cable. Presently, there is also a project underway to replace 137 - 480V Network Protectors at an estimated total investment of $15 million to be completed in 2018. The chart below shows the budgeted dollars for the Downtown Underground Network from 2015 through 2019.

Capital Budget in Downtown Network By Year	
2015	$ 9,236,000
2016	$ 9,236,000
2017	$ 10,873,000
2018	$ 11,006,000
2019	$ 6,089,000

Q30. Please discuss what forms of grid modernization technology, if any, could have afforded IPL the ability to prevent or mitigate the cause and effects of network events.

A30. In 2012 IPL began implementing multiple strategies to help mitigate the effects of network events and those efforts are on-going. One of the key strategies was the implementation of IPL's network SCADA system in 2013. Based on my experience and knowledge of other systems, IPL is ahead of many utilities that operate a Secondary Network System because of the Network SCADA. The network SCADA system provides real-time information at the vault level, something not previously available.

This system allows the Transmission Operations Control Center ("TOCC") to monitor and control the low voltage network protector for all of the transformers feeding the downtown low voltage network. Field personnel also have real time access to this data. This data alarms the TOCC office for abnormal conditions such as currents, voltages, power flows, and relay temperatures. This information provides IPL system operators with much more information to make operational decisions and allow pro-active responses to some abnormal conditions. While network SCADA cannot prevent a network event from occurring, it can help to assess the situation and mitigate the event by reducing the length of time the event might last.

Installation of the new 480 volt Network Protectors will provide IPL's workers with increased safety for arc flash mitigation while performing work in the vault. As was discussed in Question 25, IPL is replacing all 137 of the 480 volt Network Protectors to comply with new safety standards, but the project also addresses concerns raised after the August 19, 2014 network event with some of the 480 volt Network Protectors.

It is important to note it is not possible to eliminate all network events. However, IPL continuously reviews the latest technology improvements available to minimize the possibility of network occurrences. As an example, IPL is now purchasing Network Transformers with 600A bolted terminations to eliminate the Network Transformer's primary oil-field termination chamber as a result of the recommendations in the 2012 O'Neill Report. Existing termination chambers have been retro-filled with flame retardant Envirotemp FR3 fluid. This FR3 increases the flash point and improves safety. Since its introduction, there has been no reported fire-related failure with transformers filled with FR3 fluid.

IPL completed implementation of a downtown network SCADA system in 2013.

Additionally, IPL is in the process of completing the installation of a manhole cover restraint system, Swiveloc, on all manhole covers that have network facilities in the downtown area.

IPL is developing plans to replace the electromechanical relays on over 30 substation network primary feeder breakers with microprocessor relays on the by the end of 2016 as a commitment from the March 16, 2015 Massachusetts Avenue RCA report. These relays will have the capability to monitor all phase currents and single phase volt-ampere reactive ("VAR") power values. This VAR monitoring will allow the TOCC office to see abnormal reactive power flows that may give an indication of a network secondary fault or other abnormal conditions.

Q31. Please discuss IPL's current managerial, financial, and technical benchmarking program and practices pertaining to the provision of safe and reliable service to customers.

A31. In his direct testimony, IPL Witness Sadtler (Q/A 14-19) addresses IPL use of SAIFI, SAIDI, CAIDI and IEEE benchmarking. IPL also uses key performance indicators ("KPI") to monitor and evaluate the success of an organization or of a particular activity in which it engages. IPL has also worked to strengthen the rigors of the Power Delivery asset management business framework. Power Delivery's Asset Management Group has responsibility for maintenance, inspection, and capital investment, which includes asset replacement programs for the downtown network system. The asset management process is a more systematic approach that uses performance indicators calculated on a monthly basis and are reviewed to monitor the progress and performance of the T&D infrastructure, including

the downtown network system. We are confident this enhanced asset management process provides benefits to IPL and its customers ensuring continued high reliability provided in an efficient and effective manner. The following list includes key performance indicators ("KPI") provided to IPL senior management for monitoring operations on a monthly basis.

Safety KPIs:

- OSHA Recordable Incident Rate
- Lost Work Day Rate
- Accident Severity Rate
- Preventable Vehicle Accident Rate
- Safety Walks
- Near Miss Reports
- Safety Meeting Attendance

Customer Service KPIs:

- Annual JD Power Survey – Percentile
- Average Speed of Answer (ASA)
- First Call Resolution
- Days Sales Outstanding Time to Answer (80 seconds +)
- Total Monthly IURC Inquiries

Transmission & Distribution KPIs:

- SAIDI
- CAIDI
- SAIFI

Power Supply KPIs:

- Commercial Availability (CA) – began monitoring in 2013
- Equivalent Availability Factor (EAF)
- Equivalent Forced Outage Factor (EFOF)
- Capacity Factor
- Net Heat Rate

- Non-Fuel Costs ($/KW capacity)

Financial KPIs

- Pre-tax earnings contribution
- Net Income
- Contributed Free Cash Flow
- Dividends
- Capital Expenditures

Asset Management KPI's

- Monthly Communication Availability for Network SCADA
- Manholes and Vault Inspections
- Network Transformers and Network Protector Inspections
- Trending of Inspection Findings

Q32. Please summarize your testimony.

A32. In closing, IPL's Network is safe and reliable. The design of the system is consistent with the design of secondary network systems of other utilities around the country. This was pointed out by O'Neill Management Consulting in the opening paragraphs of their 2011 Report. The concentration of businesses and more recently an increase in residential projects downtown has changed the service usage and needs in this area. While the redundancy in IPL's Secondary Network system already provides significant reliability, the Company has and will continue to maintain and upgrade the Network to maintain a safe and reliable system.

Q33. Does that conclude your prefiled supplemental testimony?

A33. Yes.

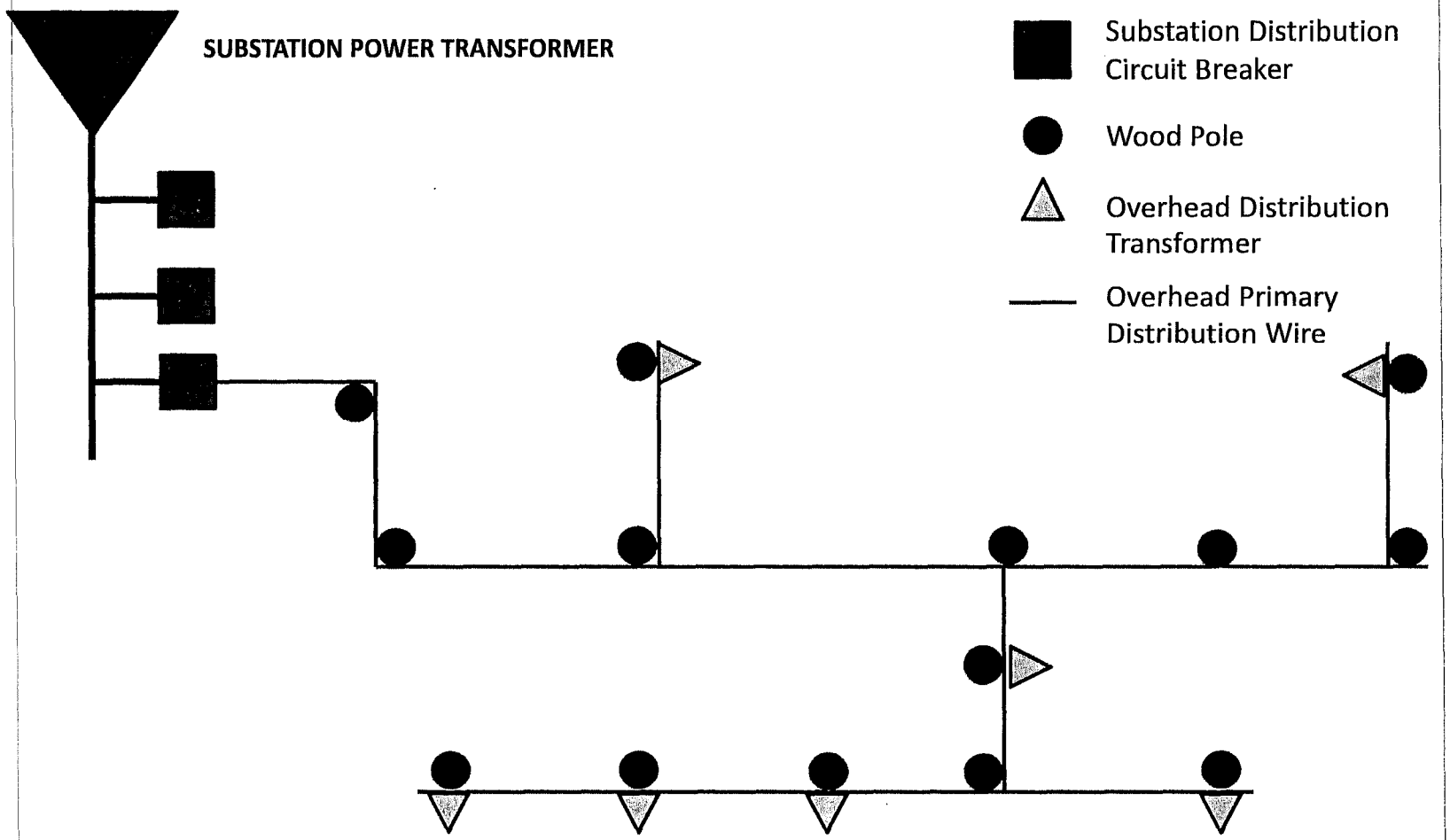
VERIFICATION

I, Michael L. Holtsclaw, Director, Transmission & Distribution Engineering for Indianapolis Power & Light Company, affirm under penalties of perjury that the foregoing representations are true and correct to the best of my knowledge, information and belief.

Michael L Holtsclaw

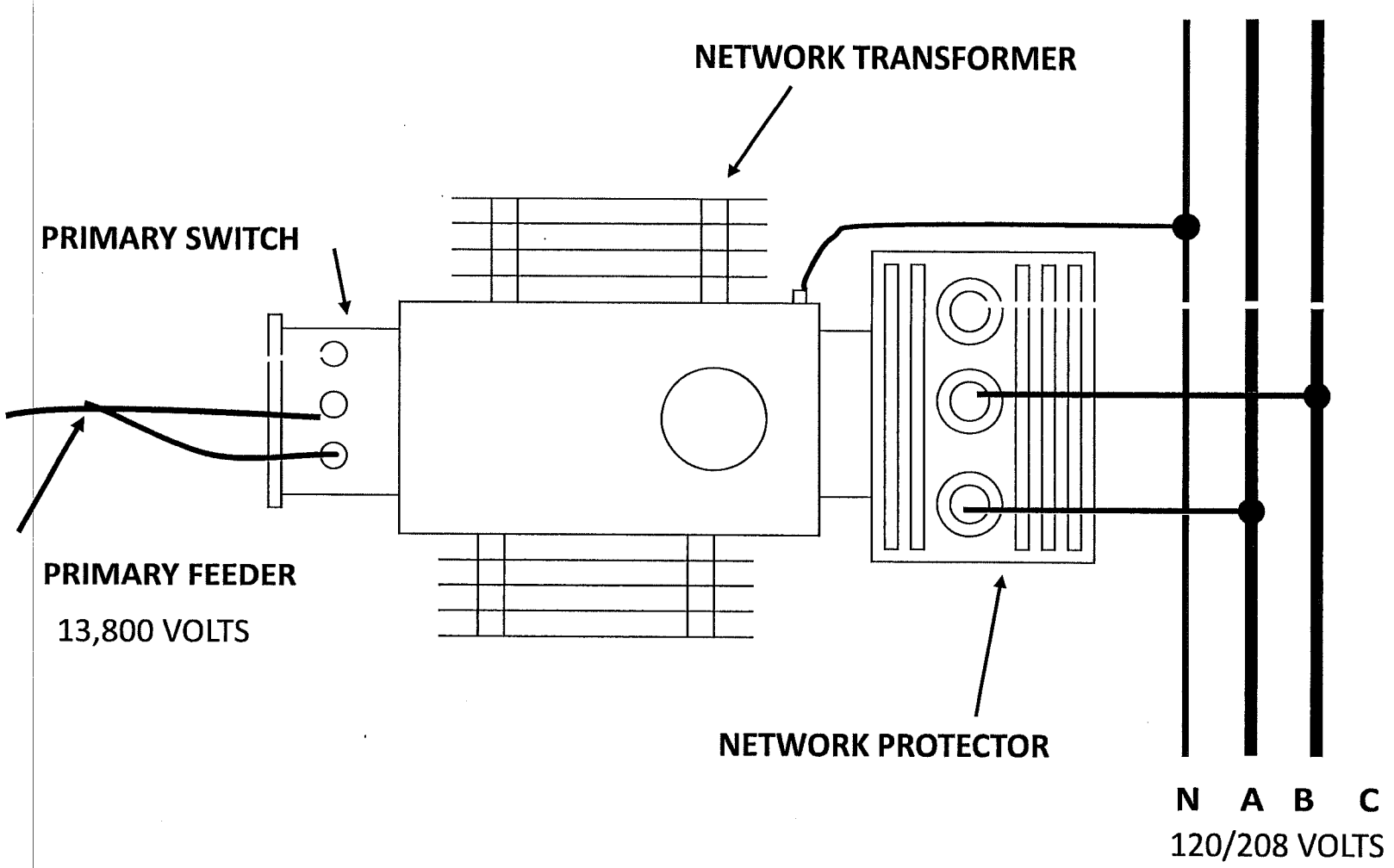
Michael L. Holtsclaw

Dated: June 1, 2015



TYPICAL RADIAL OVERHEAD DISTRIBUTION FEEDER LAYOUT

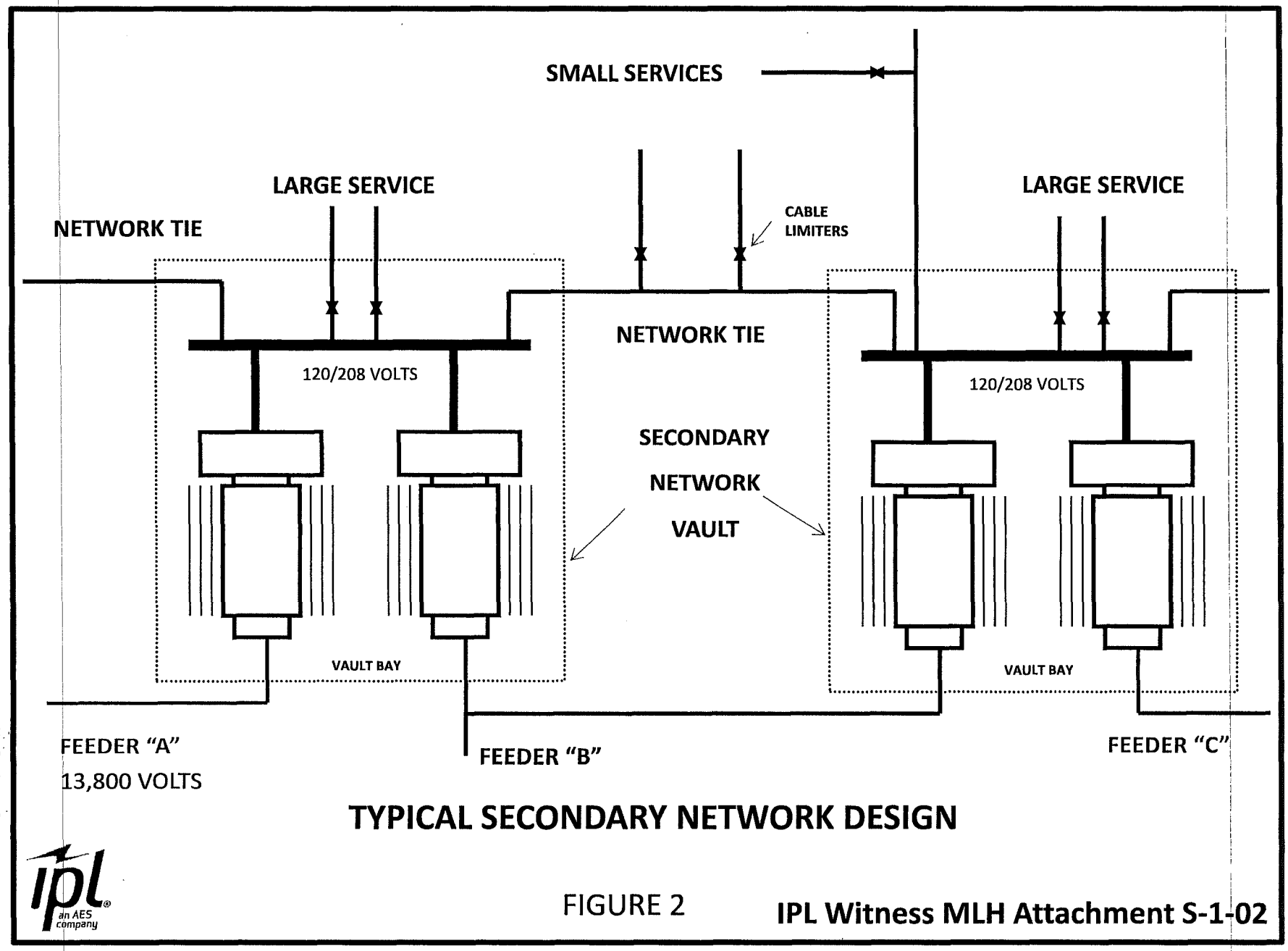
IPL Witness MLH Attachment S-1-01



TYPICAL SECONDARY NETWORK VAULT LAYOUT

FIGURE 1

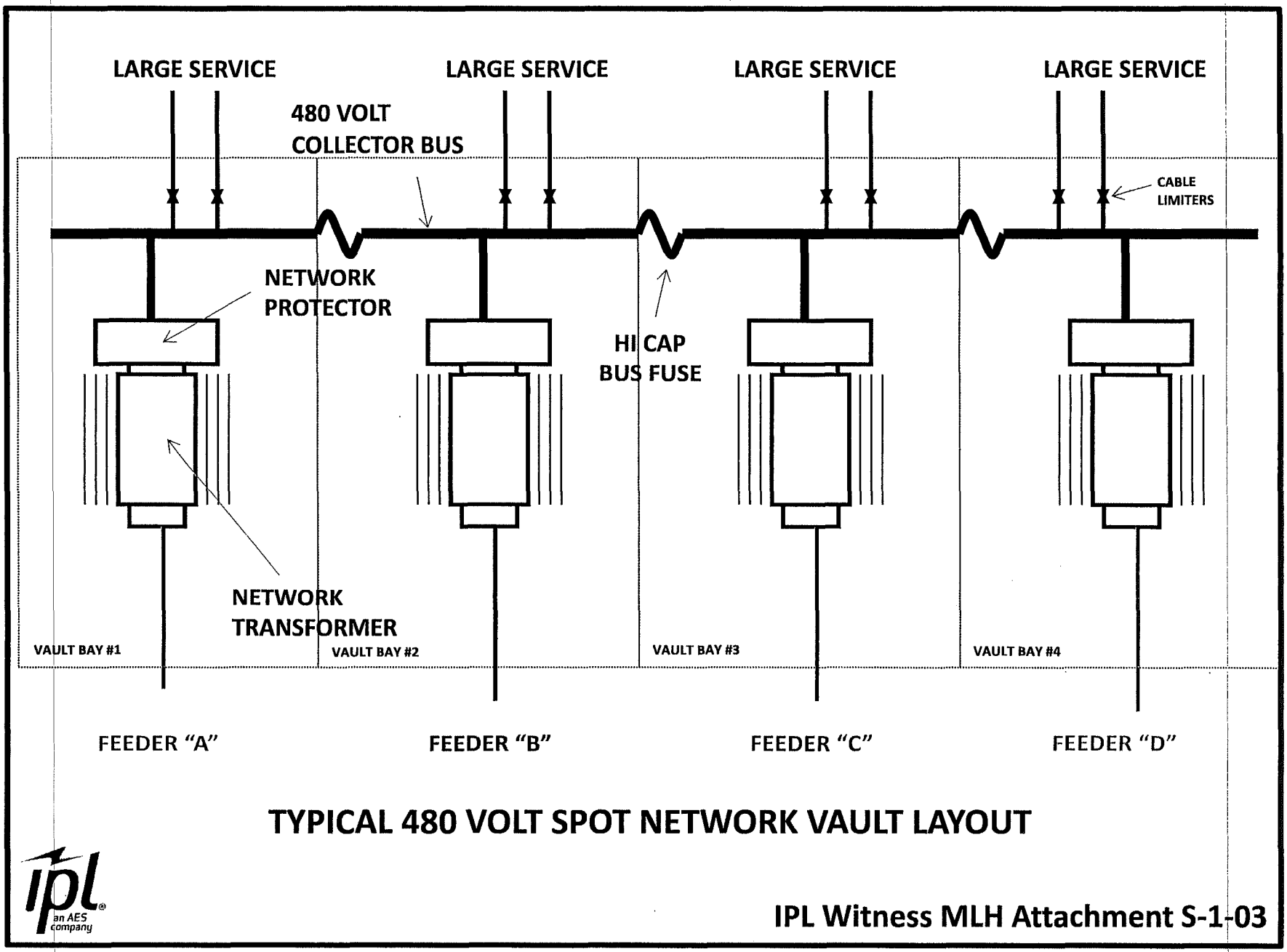
IPL Witness MLH Attachment S-1-02



TYPICAL SECONDARY NETWORK DESIGN

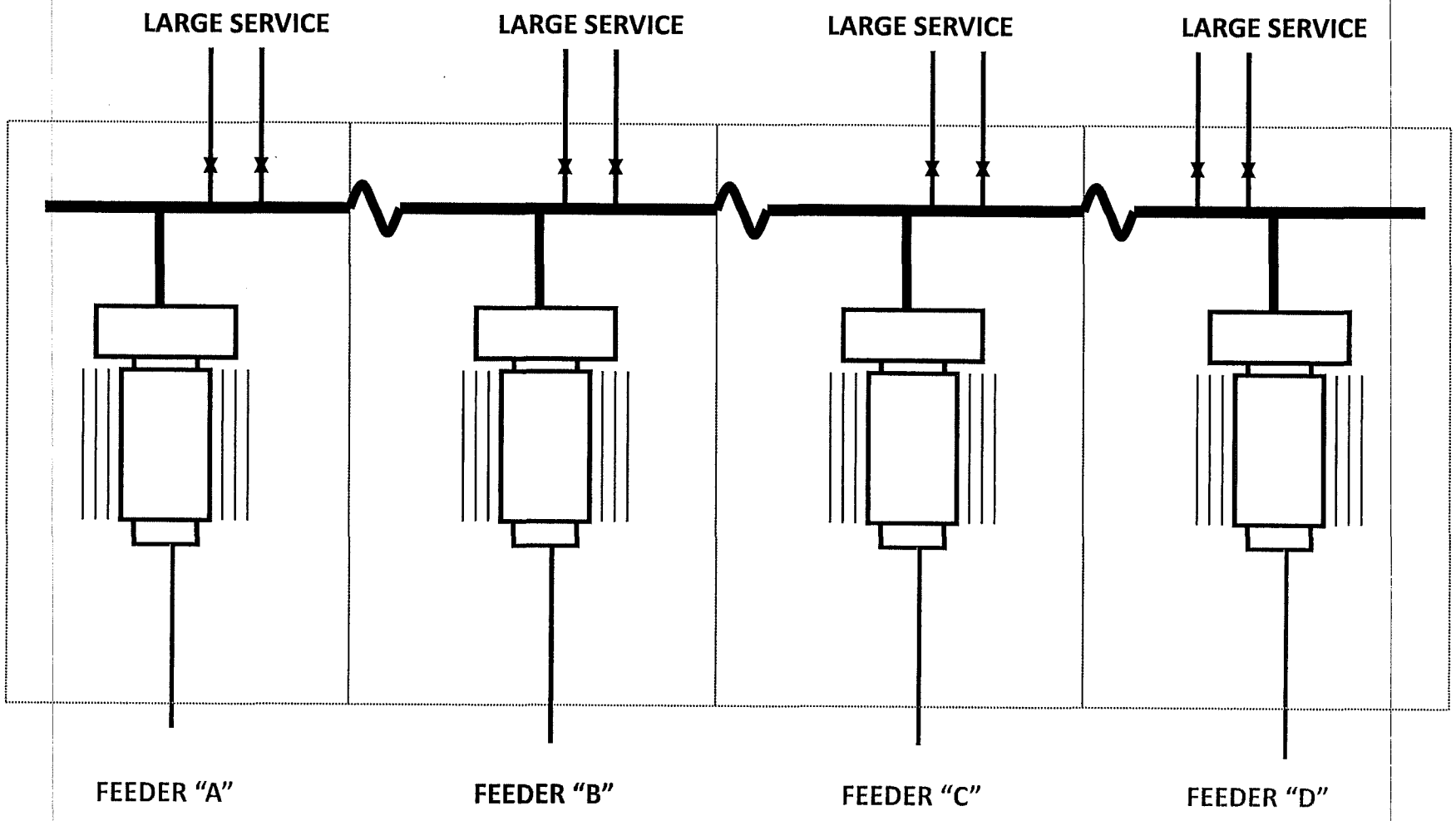
FIGURE 2

IPL Witness MLH Attachment S-1-02



TYPICAL 480 VOLT SPOT NETWORK VAULT LAYOUT

IPL Witness MLH Attachment S-1-03



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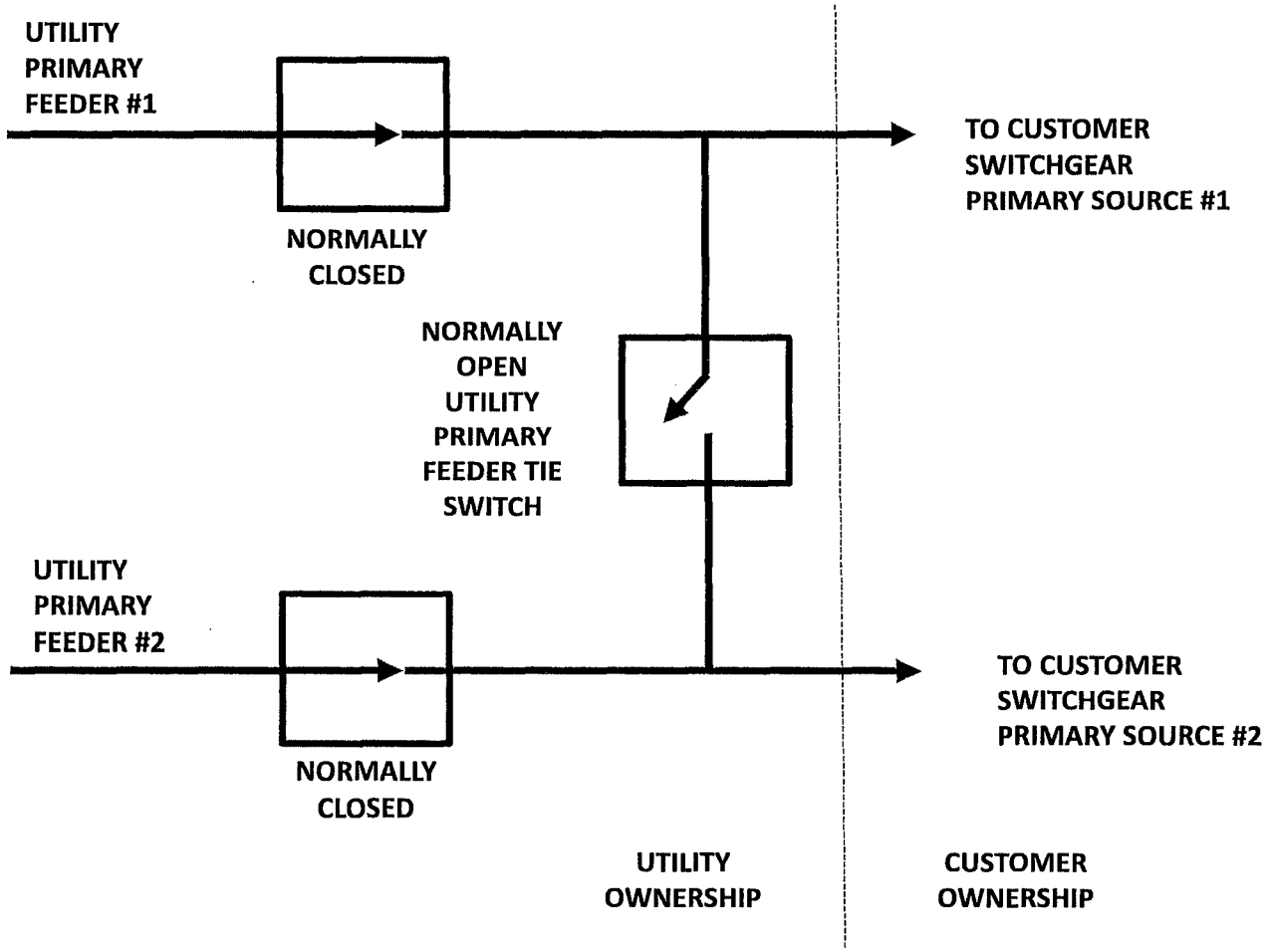

TYPICAL NON-NETWORK SERVICE/VAULT LAYOUT

IPL Witness MLH Attachment S-1-04