

Final Report
of
O'Neill Management Consulting, LLC
in the Investigation of IPL,
Cause No. 44602

This report is the final report of O’Neill Management Consulting, LLC in the Indiana Utility Regulatory Commission (“IURC”) investigation of Indianapolis Power & Light (“IPL”), Cause number 44602, IN THE MATTER OF THE INDIANA UTILITY REGULATORY COMMISSION’S INVESTIGATION INTO INDIANAPOLIS POWER & LIGHT COMPANY’S ONGOING INVESTMENT IN, AND OPERATION AND MAINTENANCE OF, ITS NETWORK FACILITIES.

Executive Summary

After a series of electrical events (outages, smoke, and fire) in downtown Indianapolis in 2011, the IURC and IPL agreed to engage an independent consultant (our firm, O’Neill Management Consulting, LLC) to assess IPL’s downtown network facilities. Recommendations were made and IPL began their implementation. After a period of relatively good performance in 2012 and 2013, events in 2014 and again in 2015 induced the IURC to begin a formal investigation in March, 2015 with the order opening Cause number 44602. (See the sections below on the Order and on the Background).

On April 10, 2015, the IURC formally consolidated Cause number 44602 with Cause number 44576, IPL’s general rate case. Discovery and testimony proceeded in the ensuing months, including public hearings from September 21, 2015 through October 1, 2015. On March 16, 2016, the IURC issued its final order on the combined cases.

A key directive in the final order was the establishment of a collaborative process between IPL and the IURC, and including other intervenors in the IPL rate case, such as the Indiana Office of Consumer Counselor, the City of Indianapolis, the Citizens Action Coalition, and others. That process involved regular (typically monthly) meetings during which detailed information was provided and discussed by IPL regarding its asset management process. In addition, a regular metrics reporting process was established which involved detailed design of particular pages of a proposed annual report (and interim versions of such a report were provided for review and further refinement of concepts).

The end result has been a significant step increase in the visibility to the public of IPL’s processes for managing its investment in, and operations and maintenance of, its network facilities. We believe that this collaboration has been a success and will form the basis for better future communication between IPL and the public, especially through the IURC and other participants in the collaborative. We believe that this visibility and communication will ensure IPL’s appropriate diligence in the means by which it manages the performance of its network facilities and will also enhance communication about the cause and severity of any future electrical events, should they occur.

In many ways, we believe IPL has been responsive to the increased scrutiny by taking positive steps forward during the investigation and during the collaborative process. Some of the highlights are listed below in the section entitled “Progress made by IPL”. Our view of the collaborative process is also positive. We know of no other jurisdiction where such a collaborative process exists. The close coordination over the period of the collaborative between the Commission Staff, the regulated utility, and stakeholders is unique, and we believe the work will continue to pay dividends to all the parties in transparency and communication.

The rest of this report consists of the following sections, much of which is also contained in two other documents – O’Neill Management Consulting’s summary of IPL’s progress since 2011 in rising to the next level of performance, and Testimonial Staff’s comments of IPL’s Compliance Filing:

- The Order initiating Cause 44602 and the subsequent consolidation and final order
- A review of the background of events and actions taken since 2011
- Our summary understanding and organization of IPL’s compliance filing
- Our understanding of Appendices D, E, and F to IPL’s Asset Management Assessment
- Our explanation of the Asset Management Attributes Matrix, a set of rows and columns that played a key part in communicating the current state of IPL’s asset management
- Our response to IPL’s Asset Management Self-Assessment
- Our response to IPL’s Proposed Performance Reporting
- Our general observations and conclusions about the process so far and going forward

The Order

The investigation was begun on March 20, 2015. As the IURC stated in its opening paragraph of the 3-page order,

“The Indiana Utility Regulatory Commission (“Commission”) is aware of recent incidents involving Indianapolis Power & Light Company’s (“IPL”) network facilities. Based upon our concern over the persistence of such events and previous information received from both IPL and an independent auditor during public meetings in 2011 and 2014 regarding underground network failures, the Commission finds it appropriate to commence this formal investigation into any and all matters relating to IPL’s investment in, and operation and maintenance of, its network facilities.”

In the body of the order, after establishing its jurisdiction over the matter, the IURC notes the background and history of the IURC’s specific interest in the performance of IPL’s network facilities, especially the underground secondary network in downtown Indianapolis, beginning with incidents that occurred in 2011 which culminated in September of 2011 with the IURC encouraging IPL, and IPL agreeing, to engage an independent consultant to study the problem. The authors of this report, O’Neill Management Consulting, LLC, were chosen, from a group of vendors, by the IURC to perform the work, which resulted in ten recommendations, as detailed in a report provided in December, 2011. IPL committed to implement the recommendations, and issued annual progress reports each January of 2012, 2013, and 2014.

Despite progress in implementing the recommendations, in 2014 in March and September, more events occurred that were significant in nature, including smoke pouring out of an underground vault on South Meridian within blocks of Monument Circle. Once again, O’Neill Management Consulting, LLC was asked to assist IPL with the investigation and root cause analysis, and additional recommendations were recommended and agreed to.

Then, in early 2015, after additional incidents, including one in which a manhole cover was launched high into the air and then crashed to the ground (without anyone injured), the IURC issued its order for a further investigation into IPL’s network facilities. A technical conference was set up for April 2, and the IURC engaged O’Neill Management Consulting out of its own funding (the previous studies were paid for voluntarily by IPL). In addition, the IURC assigned Brad Borum and Morgan “Bob” Pauley as testimonial staff, to be represented by Assistant General Counsel, Jeremy Comeau.

On April 10, 2015, the IURC formally consolidated Cause number 44602 with Cause number 44576, IPL’s general rate case. Discovery and testimony proceeded in the ensuing months, including public hearings from September 21, 2015 through October 1, 2015. On March 16, 2016, the IURC issued its final order on the combined cases. With regard to the investigation which was the subject of Cause number 44602, the IURC accepted the recommendations of O’Neill Management Consulting and Testimonial Staff that a collaborative be established to further communicate IPL’s asset management processes and also to establish a system of performance metrics by which IPL could communicate significant aspects of its

performance in the future, which itself might form the basis for a future paradigm of a performance incentive mechanism. The order also established a time frame for establishing the collaborative and reporting on its progress.

Within a month of the order, the collaborative began to meet.

The Collaborative first met on April 22, 2016 at IPL's Morris Street facility and then regularly through March 8, 2017. The initial meetings included updating Stakeholders on the current state of IPL's Central Business District (CBD) underground network system, reviewing IPL's asset management implementation, and developing a Collaborative Project Charter. With focus on common Collaborative goals established by the IURC's Order, the Stakeholders began discussing and drafting the Oversight Process and determining appropriate performance metrics.

The Oversight Process, including categories of measurement metrics presented in this filing, addresses IPL's Asset Management Process in a cost-effective and efficient manner in order to report on IPL's progress in implementing its Asset Management Process by, among other things, developing holistic performance metrics to measure IPL's performance over time and in comparison to other utilities. As part of the Oversight Process, the Collaborative engaged in initial "deep dives" into particular Asset Management topics.

The Collaborative has been successful in offering a path for the asset management assessment and performance metrics initiative, while leaving open the opportunity for adjustments and improvements as needed. In addition, all matters pertaining to this initiative were discussed collegially and generally resolved with engagement of all participating Stakeholders.

Background

Back in the fall of 2011, the O’Neill Management Consulting team of Daniel O’Neill and Charlie Fijnvandraat (“FAY-van-DROTT”) were selected from a group of vendors to provide IPL and the IURC with an independent assessment of the downtown Indianapolis underground network. At that time, we noted that while the network was well designed and was maintained in generally good condition there were a number of improvements which could be made to improve the safety and reliability of the network. Our report on 13 December 2011 included a number of recommendations, some of which included endorsement of actions IPL had already planned to implement, e.g., the SCADA system for the network, and the development of various asset management plans and processes. The report also integrated lessons learned from the 19 November 2011 manhole fire at S. Delaware and Pearl Street, where the impact of steam leaks was likely a significant factor.

During 2012 we assisted the parties in monitoring the implementation of IPL’s plan. We also assisted the IURC in developing a specific set of inquiries regarding asset management and risk management. During 2012 there were four reportable incidents: (The text below is as summarized by the Indy Star; our comments on each are in italics):

Jan. 16, 2012: An explosion and fire broke out at IPL's Center Substation near West and Morris streets. The fire was caused when a breaker failed, and caused nearly 10,000 IPL customers to lose power. *[This was not an underground network event, but we still addressed it in our comments to the IURC on IPL’s action plan.]*

July 4, 2012: Flames erupted from an underground electrical vault near the Westin Hotel Downtown, causing flames to shoot up from a sidewalk grate on South Capitol Avenue. *[This was a termination chamber failure, the severity of which would have been avoided by the completion of the replacement of the dielectric fluid with fire retardant fluid. Unfortunately, although that work had begun, it had not yet reached that particular unit.]*

July 5, 2012: Pressure from an underground cable caused a manhole lid to slide in the 300 block of Massachusetts Avenue Downtown. *[Although reportable, this was a minor event, being merely a displaced cover caused by a primary cable fault.]*

July 15, 2012: An underground cable in a manhole shorted out on East 16th Street Downtown. When firefighters arrived, they found smoke coming from the manhole. *[Once again, this was a minor event due to a feeder fault. By year’s end, feeder faults were being reduced.]*

In January 2013, IPL reported to the IURC its substantial progress on all ten of the O’Neill report recommendations as well as the other commitments IPL had made. The progress included:

- 1) 48% reduction of network events (including non-reportable minor events)
- 2) Installation of 202 Swiveloc™ manhole covers (152 before the Super Bowl)
- 3) All 315 network transformers had their termination chambers retro-filled with fire retardant (FR) dielectric fluid, and tested for dissolved gas, as a baseline for future measurement

- 4) 65 network protectors suspected of having aluminum bus tested: 25 found, replacement begun; 13 network protectors tested for toluene gas; none found; maintenance procedure changed; 154 deflector shields installed to mitigate debris on vault equipment
- 5) Over 500 repair work orders completed based on 2011 inspections; 153 work orders for steam-related issues completed in cooperation with Citizens Thermal
- 6) 66 Fault direction indicators installed to reduce restoration time for network feeders
- 7) 6 new network transformers were received based on the new standard specification (no termination chamber); 18 designated to be retrofit
- 8) 10 handheld tablets integrated with Ivira software for enhanced inspection review; 244 inspections completed using tablets
- 9) 6 thermal imaging cameras purchased for use in inspections; 549 infrared inspections done
- 10) All 5 networks modeled using Cyme network loadflow software; accuracy proven
- 11) 1 additional engineer hired for the asset management group

During the year 2013 there were no reportable events. Unfortunately, the events of 2014 raised new concerns, beginning with an event on 14 March 2014 involving a high-energy fault and smoke near Delaware and Market Streets. Then, on 15 August 2014, a very significant incident took place at 26 S. Meridian, where a fault in one of the network protectors led to a considerable amount of noise and smoke as well as temporary disruption of service to some nearby establishments. As a result, we were asked to come back on site and review the root cause analysis that IPL was preparing of that event. We agreed with the recommendations that arose from that analysis, the main one of which, replacement of a class of network protectors, would need to take place over the next five years.

In March of 2015, there were two events within three days of each other. The first, on March 16 on Massachusetts Avenue near E. New York Street was another termination chamber failure. In this instance, the FR fluid had been installed and the resultant event was fairly minor, with no sustained fire and only the report of a noise and a small amount of smoke. Three days later, however, an event took place which was clearly major, beginning on North Street near Capitol Avenue and causing a number of manhole covers to be lifted and at least one to fly high in the air, and also causing an outage to six square blocks as IPL worked to contain the impacts of the event.

As a result, the IURC opened Cause 44602 "to consider and review IPL's ongoing investment in, and operation and maintenance of, its network facilities." Once again, we were asked to assist in performing an independent review. This time, however, we were aided by a group of IURC staff who were partitioned off from the ongoing IPL rate case (Cause 44576) so as to remain independent of that proceeding. IPL itself engaged outside consultants to assist in the root cause analysis.

More recommendations were made, and IPL volunteered more commitments. The IURC accepted those commitments and ordered the two main recommendations involving clarification of IPL's asset management practices and establishing a process of collaboration to communicate IPL performance.

Progress made by IPL

Throughout this time, from its report in January of 2013 through its root cause analyses of subsequent events, IPL has continued to make progress in a number of areas. The result has been a definite step change in IPL's management of its downtown networks (and, as the collaborative has learned, in other parts of its system as well). In addition to the 11 milestones listed above, we think it right to note the following:

- 1) Retirement of Substation 3, the oldest of the substations feeding the downtown underground network, and the re-routing of feeders from the Edison substation to carry that load
- 2) Upgrade of all of the network feeder relays in Edison and Gardner Lane substations, replacing older electromechanical relays with modern electronic relays for better system protection
- 3) Completion of the network SCADA project (partially funded by a DOE grant) to improve monitoring and operation; subsequent improvement in error rate as well
- 4) Completion (by a third party) of a survey of the downtown network for evidence of energized structures and equipment ('stray voltage')
- 5) Completion of and further revisions to asset management life cycle plans, including asset health/risk indices based on asset condition and criticality
- 6) Further replacement of deteriorated primary and secondary cable
- 7) Development of a network emergency plan and communicating it with IFD
- 8) Installation of Swiveloc™ covers on all downtown network manholes, an action not matched by any other utility in the country at that time
- 9) Successful piloting of an industry-leading technology for using fiber optic cable to sense the severity and location of hot-spots in cable ducts and manholes, e.g., likely due to steam leaks
- 10) Further integration of the MobileFrame™ digital tablets and Ivara asset management system
- 11) Continued progress on replacement of older 480V network protectors such as those involved in the vault event at 26 S. Meridian in August 2014
- 12) Development of a collaborative communication process whereby IPL's performance and process improvement can be communicated to the IURC and other parties

The impact of all of these milestones of progress may not be obvious to the lay observer, but careful observation by an experienced eye reveals that these activities are very likely to produce noticeable improvement in performance of the downtown network, some of which can already be seen in measures like:

- Network feeder faults are decreasing
- The Swiveloc™ covers should significantly reduce the risk of a manhole fire, as has already been evidenced in the 18 January 2017 event.
- Termination chamber faults that formerly would likely have caused a significant fire in an underground vault that is grated to the sidewalk, now likely results in a fairly minor event – a loud noise and a puff of smoke

- A potential source of future trouble, Substation Three, is gone
- Sources of steam-caused damage to cable and ducts are being identified and eliminated
- The 480V spot network protectors are being systematically replaced with new units, avoiding a repeat of the 26 S. Meridian event
- The potential for shock or injury from energized structures, which had not been a problem in Indianapolis but had been elsewhere, is being monitored and addressed as necessary
- Enhancements in system inspection, monitoring, and control technology and processes (tablets, infrared camera, SCADA, CYME, smart relays, fault detectors, fiber optic thermal sensors) will provide better early warning of problems and better control

In addition, IPL Asset Management as applied to other areas besides the downtown network is likely to improve performance there as well, and the new system of reporting will allow visibility of that performance.

We wish to note here as well that IPL continues to develop the technology for its fiber optic cable to sense the severity and location of hot-spots in cable ducts in the downtown network, listed in (9) above. It is worth noting that IPL is a pioneer in this technology, as we know of no other utility in the world attempting this type of temperature monitoring. We are aware that IPL continued to refine the process, and has even been willing to present to others in the utility industry about its experience with the technology.

None of this will guarantee that there will be no further downtown network events, as the 18 January 2017 event proves. But all of these, taken together, significantly reduce the chances of such an event and also the risk that any such event will lead to significant property damage or injury.

IPL’s Annual Report

The collaborative process culminated in IPL’s first annual report filed on March 31, 2017.

IPL’s annual report is 173 pages long (not including the three pages of the submittal letter and service list), of which 154 pages are eight lettered appendices. The first 19 pages consists of:

- Title page and Table of Contents (2 pages)
- Executive Summary (2 pages),
- Background (1.5 pages),
- Collaborative Oversight Process (11.5 pages), including
 - Objectives
 - Process Overview
 - Asset Management Oversight (with the first Report in Appendix D)
 - Proposed Performance Metrics (including domains, peers, and reports)
- Conclusion and list of Appendices (2 pages)

For the eight appendices, although the Table of Contents does not show their starting pages, for your convenience we show them here, along with the length of each (including title pages):

Appendix	Title	Pdf page	Length (Pages)
A	Collaborative Project Charter	24	4
B	Meeting Agendas and Attendee Sheets	28	35
C	AES – Asset Management Policy - US SBU	43	2
D	IPL’s Asset Management Program Oversight Report	45	22
E	IPL’s Central Business District Underground Network Asset Management Program Oversight Report	67	17
F	CBD Underground Network Gantt Chart	84	9
G	2016 Annual Performance Metrics Report	93	33
H	IPL Asset Management Self-Assessment	126	50

We have no issue with IPL’s explanation of the Collaborative Oversight Process, partly because we found it essentially acceptable in its first draft, and partly due to IPL’s adoption of some of the collaborative members’ suggested edits to the earlier language.

The sections that bear some explanation from us, we think, are appendices D, E, F, the 2016 Annual Performance Metrics Report, and the IPL Asset Management Self-assessment. Each is treated below.

Appendices D, E, and F

As noted on page 2 of Appendix D, the Report is divided into three parallel “tracks” by which to assess IPL’s asset management process:

- Asset Management Life Cycle Plan Status
- Asset Management Program Implementation
- Topical Areas for “Deep Dive” Presentations during Periodic Oversight Process Sessions

The first track (pages 3-11 of the 24-page appendix) provides a detailed status for 18 asset categories (types of equipment, like power transformers, circuit breakers, etc.) on 14 asset attributes (e.g., maintenance plans, renewal rates). This is discussed in more detail in our section on the Asset Management Attribute Matrix below. This approach was suggested by O’Neill Management Consulting.

The second track (pages 12-14 of the 24-page appendix) looks at the asset management programs from a process viewpoint, emphasizing different “attributes” (same word, but different meaning in this case), this time not by asset category, but by program implementation status, i.e., effectiveness, current status, next steps. This approach was suggested by IPL and its consultant, UMS Group. We found it useful in its own way.

The third track (pages 15-16 of the 24-page appendix) lists the topical areas for some of the more detailed analyses of interest to the collaborative members. Known as “deep dives”, these represented typically half-day collaborative sessions devoted to detailed examination of topics such as the CBD inspection and work order process, capital spending optimization, or the customer service operations (including a tour of the call center).

Pages 17-23 include a list of abbreviations used throughout the document and a more detailed explanation of the attributes described in the first track. (The 24th page was the title).

Appendix E is an extension of the methods of Appendix D, but focused on an additional 9 asset categories pertaining to the CBD underground network. Although the “first track” asset management attribute matrix is followed consistently and applied to the CBD assets, the rest of the appendix focuses on tracking the status of existing commitments and initiatives made by IPL with respect to the CBD assets (stemming from previous investigations of incidents and the ensuing root cause reports).

Appendix F shows the progress of those initiatives in the form of a detailed Gantt chart with milestones on a timeline for each initiative or commitment.

IPL's Performance Metrics Report

The 2016 Performance Metrics report is the first annual report, and subsequent annual reports will be filed by IPL in March of each year. The metrics depicted in that report are also discussed in more detail in the Collaborative Oversight Process document in the beginning of the filing (pages 13-20 of the pdf). The Collaborative worked at some length to design a set of Tier 1 (high level) and Tier 2 (more detailed) metrics that could inform the IURC and intervenors about the Company's performance in a number of key areas, dubbed "domains".

We feel that the report as currently constituted is a reasonable starting point for a process that was described in the proceedings of Cause 44602 as one that might evolve over the next few years, as the Company and the IURC get more experience with what the report tells them.

With some experience in designing performance metrics in other jurisdictions, we can say that the effort required to design and implement an all-encompassing set of performance metrics for a utility is substantial. The effort in this collaborative resulted in what we see as a comprehensive set of metrics that should prove useful to the Commission in its ongoing regulatory efforts. While the metrics may continue to be refined, we do not see any significant errors or omissions. The collaborative, and IPL, should be commended for implementing this complete package. Ultimately, the value of the metrics will be determined by whether the Commission continues to closely monitor and review the metrics over time.

We note, as well, that the "deep dive" part of the Collaborative allows for further insight into IPL's performance, and should be considered as an integral part of the overall reporting process.

IPL's Asset Management Self-Assessment

First, we note that earlier drafts of the Self-Assessment were available for our timely review, and comments made were incorporated by IPL in the final draft.

The IURC Testimonial Staff and its consultants, O'Neill Management Consulting, LLC, agree with the overall sense of IPL's Asset Management Self-Assessment, including statements in the Executive Summary regarding the extent to which IPL has achieved a current level of asset management process development that is exemplary in the industry. We note that it has taken the work of the Collaborative to bring us to this point, i.e., to be able to see clearly which aspects of its asset management were aspirational and which were operational, but having done so we now agree that IPL's current state, while still unfinished in certain (now) well-defined aspects, is laudable and should not in itself deserve a penalty for its efforts.

One example may serve to underscore this point. One of the attributes of asset management (one of the rows of the Asset Management Attribute Matrix shown in Appendices D and E) is Asset Health/Risk Indexing. This refers to a method or technique that the industry is in the process of adopting, that evaluates each asset within a category (e.g., each circuit breaker or transformer) as to its specific probability of failure and the impact of that failure, given its position in the network. Many companies now recognize this as an admirable and ultimately achievable goal, yet very few, if any, have achieved this level for all of their asset categories, and those who have done so for some assets often consider it in a pilot stage, sometimes relying too heavily on asset age rather than asset condition. IPL has made good progress in developing asset health/risk indices for a number of assets (see that row of the table for different columns), and has intentions to continue to develop them further.

We note as well that the final pages of the Executive Summary list seven commitments to further improvement which IPL intends to make. The IURC should monitor progress on them.

General Observations and Conclusions

We want to thank IPL and the members of the Collaborative, as well as the facilitator, Stewart Ramsay, for participating in the process with a commendable spirit of open and honest collaboration. Endeavors like this one can be impeded by certain kinds of behaviors that are excessively defensive, grandstanding, or narrowly self-serving. We were pleased to note the virtual absence of such behaviors, especially after the first few meetings. Extensive documentation was provided prior to many of the meetings, and the members did a reasonable job of reviewing the material before coming to the meeting. Various members of the Collaborative, including personnel from IPL, ourselves, the OUCC staff, the Citizens Action Coalition, and the City of Indianapolis participated actively in sub-committees that ironed out details so that issues could be reviewed efficiently by the entire Collaborative, making those meetings more productive.

We also noted the high level of commitment of IPL to the success of the process, as evidenced by the time commitment of senior executives and managers, and also the commitment of resources in terms of outside consultants and internal contributors (including substantial amounts of document production).

We end where we began. As we stated in our 22 Jun 2015 Report, we still believe the design, maintenance, and operation of IPL's downtown electrical network are basically sound and that the risk to the citizens of Indianapolis is low, and will remain low as IPL follows through on its commitments to improve the system. Many of these commitments are now complete. The Commission should continue to monitor IPL's performance metrics and follow up on any significant indications of concern.

IPL has continued to be very responsive to events in its downtown network and to inquiries from the Commission and stakeholders. As we stated previously, IPL has not hesitated to expend resources on discovering the causes and following through on programs to remediate any perceived deficiencies.

In the area of asset management, we note IPL's continued and significant improvement in asset management methods and procedures. IPL's deep dive during the collaborative on the issue of asset management was thorough, and we believe IPL has addressed our June 22, 2015 concerns about transparency in IPL's process of asset management, and through its work, including its self-assessment, has now detailed the process by which the asset management function serves to address the risk and performance of the system, all in the context of cost effectiveness. IPL is coming ever closer to realizing its goal of being a leader in asset management.

Finally, acknowledging as ever that no system is devoid of risk, we express our confidence that the risk to the citizens of Indianapolis is currently being effectively managed to an acceptably low level.