RESPONSE OF INDIANAPOLIS POWER & LIGHT COMPANY ("IPL") TO INDIANA UTILITY REGULATORY COMMISSION QUESTIONS FOR JULY 7, 2011 PUBLIC MEETING

1. As part of your presentation on July 7TH please explain how the downtown network system works, in terms of system protection. Explain the various components and their characteristics (cables, transformers, circuit breakers, etc.) and what happens when various components fail, as well as what causes explosions, fire, and smoke. Explain the interface with customer-owned equipment.

IPL Response:

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. A secondary network consists of a grid of cables operating at the same voltage level with multiple sources feeding into the grid. In IPL's case this is 120/208 volts. This grid is energized at numerous supply points from network transformers served from multiple 13,800 volt primary feeders. The system is designed so that the loss of any one component will not cause a loss of service. The key to the design of the secondary network system is its redundancy.

<u>Components</u>

The components that make up a secondary network system include:

- Manholes: These are used as junction/splicing points for the underground cables. Workers physically enter these structures, which vary in size but are typically 5 feet wide by 10 feet long. Manholes are considered a confined space and require additional safety precautions to be followed for entry.

- 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 four 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 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 cables: IPL's primary network cables operate at 13,800 volts. These are installed in the manholes and conduits from the source substation to the underground network transformers in the vaults.

- Secondary Cables: These 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 will clear short circuit conditions or faults that have high sustained current flowing through them. Cable limiters will not reliably clear an arcing fault where the current is fluctuating rapidly from high to low.

- Network transformer: The underground 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. 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.

- 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.

- 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.

System Configuration

The Indianapolis Downtown Network system is divided into five independent secondary network areas. Each of these secondary network areas is served by four to five primary network feeders from one of three substations that serve the downtown area. There are no ties between the secondary network systems. They each operate independently from one another. There are no ties between the primary network feeders, which operate independently from each other.

Causes of Interruptions

The primary and secondary cables used for the Downtown Network system are very reliable. 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. 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 pipe system, which contributes 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.

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.

Event Sequences

The network system is designed with redundancy in order to provide continuous service to customers when a system abnormality, such as a primary cable failure, occurs.

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 network secondary 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 gas 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 12 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.

<u>Interface to Customer-Owned Equipment</u>

IPL owns and maintains the network primary and secondary 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 distribution network. The details on service requirements for customers are provided in IPL's Electric Service and Meter Manual (a.k.a., "The Gold Book").[1] 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.

2. Please provide the root cause of each over-pressurization event with underground utility plant that occurred on January 8, 2005 and any other event that has occurred through May 1, 2011, including events on August 17, 2010, August 19, 2010, January 30, 2011, and April 27, 2011. Also, please explain. For purposes of identifying the actual number of pressurized events in the downtown area during this period, an event should be defined as a single occurrence on a single day at a single location. Please provide a description of the root analysis methodology employed.

IPL Response:

The information below provides details and analysis of over-pressurization manhole and vault events that have occurred from January 1, 2005 through May 1, 2011.

1) January 4, 2005 – 114 W. North Street. The network secondary cables short circuited and resulted in a sustained secondary network fire. There were multiple manhole covers that were dislodged in this event. It was necessary to de-energize that portion of the secondary network to contain the fire and minimize further damage to the network system. There were

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

customer outages associated with this event until the damaged area could be isolated and the secondary network re-energized.

IPL actions: IPL was not able to determine an exact cause for the failure of the secondary cable due to the fire damage. IPL replaced more than 2,000 feet of network primary and network secondary cables that were damaged as a result of this incident.

2) January 8, 2005 – 137 W. Market Street. The network secondary cables between two IPL manholes in the 100 block of West Market Street failed from excessive heat coming from a leak in a Citizens Thermal steam line located directly below the duct line. A secondary network fire occurred resulting in damage to primary and secondary cables in the area and an over-pressurization event occurred in the basement of the Bookland Building at 137 W. Market Street. Carbon monoxide gas from the secondary network fire entered the basement of the building through the service entrance conduits. The fire department investigation did not determine the ignition source, but the pilot light on a gas water heater in the basement may have been the source that ignited the carbon monoxide gas.

   IPL actions: A leak in a steam line directly below the IPL duct bank caused a deterioration and failure of IPL network secondary cables at the point of the steam leak. Carbon monoxide gas from the faulted network secondary cables was able to enter the basement of the building at 137 Market due to the lack of duct-sealing materials in the service conduits to the building. The duct-sealing materials had been removed to facilitate a service upgrade that was in progress, and they had not yet been replaced.

   IPL works closely with Citizens Energy when gas or steam incidents occur to coordinate service restoration. Citizens Energy made repairs to their steam line. After this event, IPL inspected the downtown manhole system with an emphasis on inspecting and repacking service ducts as needed to generally prevent water and gases from entering customer premises through IPL structures.

3) September 8, 2005 - Talbot and Vermont Street. A network primary cable on Edison Feeder UG 431 faulted in the duct line at North and Capitol. The network protector on Edison Feeder UG 431 at 117 E. Michigan Street failed to open on reverse power flow. The secondary network continued to supply fault current to the faulted feeder. The secondary network tie cables between the 117 E. Michigan Street Vault and the 114 E. Vermont Street vault failed from carrying fault current for an extended period of time. The secondary cable failure damaged Edison Network Feeder UG 412, causing it to relay out of service. One manhole did have an over-pressurization event during this incident.

IPL actions: The cause of the initial primary cable fault was not determined. The cable did fail in the duct line between manholes. The subsequent events were the result of the network protector failing to open on reverse power flow. IPL replaced the UG 431 transformer and network protector in the 117 E. Michigan Street Vault. Network protectors in the adjacent vault were all tested to confirm that they would operate correctly. All damaged primary and secondary cables were replaced.

4) February 17, 2010 – 215 E. Ohio Street. A customer owned transformer at this location suffered an internal electrical failure. The tank on the transformer ruptured resulting in an oil fire that was contained to the transformer vault. There was no damage to any IPL facilities.

   IPL actions: IPL did not perform a root cause analysis for this incident because it was customer owned equipment that failed and IPL's facilities were not damaged in the event. The customer did not require IPL to install temporary facilities. They were able to repower their building from the two remaining transformers, and the transformer involved in this event was replaced by the customer.

5) August 18, 2010 – 535 Massachusetts Avenue. The question referred to an incident on August 17, 2010, but the actual date was August 18, 2010. A failure occurred in the primary termination chamber on the network transformer connected to Edison Substation Feeder UG 422 in this vault. A small flash fire occurred and flames came through the vault grating.

   IPL actions: The network transformer was replaced.

6) August 19, 2010 – 342 Massachusetts Avenue. At 4:18 a.m. Edison Substation Feeder UG 459 relayed out of service for a splice failure. There was no manhole over-pressurization event associated with this failure. At 8:16 a.m. Edison Substation Feeder UG 449 relayed out of service from a splice failure. There was a manhole over-pressurization event associated with this second splice failure with the manhole cover becoming dislodged. When Feeder UG 459 relayed out of service from the first splice failure, the load current it had been carrying was picked up on Feeder UG 449. Our investigation revealed an undersized section of underground primary cable in the Feeder UG 449 circuit where the second splice failure occurred. We believe that heating from the higher load current flowing through this section of cable from the first splice failure contributed to the second splice failure.

   IPL actions: An undersized section cable resulted in overheating of the cable. This heat was transferred to the splice causing it to fail. The section of cable was replaced with larger cable. IPL inspected the adjacent sections of cable to verify that the cable data records matched the cable that was in the field. No other discrepancies were found.

7) January 30, 2011 – E. Michigan Street & New Jersey Street. At 6:36 a.m. the Indianapolis Fire Department was dispatched on the report of a gas odor in the vicinity of the Athenaeum on the southeast corner of Michigan and New Jersey. At 6:38 a.m. a manhole over-pressurization event occurred in the intersection of Michigan and New Jersey. IPL determined that a secondary cable failed in that manhole. Over the next few minutes two additional manhole over-pressurization events occurred. One occurred while a fire truck was parked over a manhole and the second was in a manhole next to the Athenaeum. There was no damage to the fire truck, but a window was broken at the Athenaeum. IPL believes that a combustible gas, possibly natural gas, was present in the manhole/duct line system and contributed to the two later manhole events. We do not believe that a sufficient quantity of carbon monoxide would have been generated from the original secondary cable fault to sustain the latter two manhole events.

   IPL actions: IPL installed new secondary cable and splices.

8) April 27, 2011 – 20 W. Court Street. Around 6:00 a.m. a failure occurred involving customer owned cables in the customer's junction box. This failure on the customer's service cables led to a failure of IPL secondary cables in a manhole just outside the building. When the IPL secondary cable failed, a manhole over-pressurization event occurred. The IPL secondary cables failed from the high amounts of current flowing through the cable to the faulted cables in the customer's building.

   IPL actions: A customer-owned secondary cable failed between the customer's Junction Box and his main switchgear. Fault current flowing to this fault lead to a failure of IPL's network secondary cable in a manhole just outside the customer's building. IPL replaced 300 feet of secondary cable and installed cable limiters on the service cables going to 20 W. Court. IPL also required the customer to install cable limiters on his cables where they connect to the main switchgear.

In most cases, IPL performs an investigation to determine the root cause of an event. These investigations are conducted by either Operations personnel or Network Engineering personnel. The investigation methods include a site visit to examine conditions at the location of the event, visual inspection of the faulted equipment, and a review of system data available from the Energy Control System, including event messages, sequence of events, equipment status, recorded voltages and currents. In some cases, faulted equipment may be sent to a lab or a vendor for further analysis. When damage to the affected electrical components is too severe, or when outside factors clearly caused the event, we proceed to replacing the damaged components.

3. Please provide an analysis of the incident that occurred on May 31, 2011 on the Capitol Street side of the Indiana Statehouse.

IPL Response:

On May 31, 2011 at 4:59 p.m. IPL's underground Feeder UG 641 relayed out of service. A few minutes later IPL received a report from the Indianapolis Fire Department of a possible electrical fire at 46 N. Capitol on the west side of the Indiana State Capitol Building. IPL personnel were dispatched to the scene to meet the Fire Department. Upon arrival at the scene, IPL personnel determined that a failure had occurred in the Primary Termination Chamber on the West Transformer in the North Bay of the 46 N. Capitol vault. The transformer in question is connected to the UG 641 circuit that relayed.

Upon further investigation, IPL determined that the stress termination on the center phase in the termination chamber failed. The cable faulted to ground in the chamber with some collateral damage to two of the three cables. The arc from the failure likely heated the mineral oil in the chamber, breaking the oil down into various gases. The pressure in the termination chamber likely built to the point that the cover ruptured, releasing the gases and hot oil, which likely would have been ignited from the arc. There were approximately 10 gallons of mineral oil in the termination chamber. This likely resulted in a brief flash fire until the oil was quickly consumed and the fire went out. Confirmed accounts by conversation with a credible eyewitness indicated duration of the flash fire above the grating was less than 10 seconds.

The exact reason for the failure of the stress termination cannot be determined because it was completely consumed in the arcing from the fault. The likely cause for this type of failure would be some type of void in the stress relief tape. The void would have created an area of high electrical stresses which would have lead to the failure. The oil level in the termination chamber or possible contamination, such as moisture in the mineral oil, would not cause this type of failure.

IPL actions: IPL will be replacing the network transformer involved in this event. We are working to schedule this change-out. IPL also plans to conduct oil quality tests and Dissolved Gas Analysis on all 315 network transformers. This testing requires that the transformer be de-energized, which requires taking the network feeders serving the transformers out of service. Ambient temperatures and loading on the network feeders must be lower than current conditions before we can schedule this work. We will commence work on this project as soon as we can reliably do so.

4. Please provide information related to the number of over-pressurization events with underground plant experienced at utilities similarly situated to IPL. The IURC is most interested in underground facilities in urban downtown areas in similarly-sized Midwestern cities over the past five years. We would like a minimum of three additional examples for comparison purposes.

IPL Response:

IPL has not identified a publicly available study of the number of "over-pressurization events" for the past five years in similarly-sized Midwestern cities.

IPL's research indicates inconsistent definitions of network events and the date ranges for such events. Because of this inconsistency, IPL recommends caution in using this information to draw definitive conclusions. In communications with IPL, industry experts and Electric Power Research Institute ("EPRI") staff echoed these concerns about consistency of the available information. Subject to these caveats, the information IPL was able to find from the District of Columbia and Massachusetts is presented below.

Summary of Other Utility Manhole Events

State	Companies	Date Range	Manhole Events	# of Manholes	# of Vaults	# yrs of data
DC[2]	Pepco	Jan 2000- Dec 2000	48	n/a	n/a	1
		Jan 2001- July 2001	46	n/a	n/a	0.58
MA[3]	NSTAR	July 2004 - Dec 2005	44	38000	800	1.5
	National Grid	Aug 2004 - Dec 2005	20	20735	1675	1.4
	WMECO	June 1999- Dec 2005	30	3750	250	5.5
	Unitil	1998- Dec 2005	0	192	30	8

[2] The report "The Assessment of Underground Distribution System of the Potomac Electric Power Company Final Report", dated December 7, 2001 and referenced in May 2007 Filing No. 991-E-218 can be viewed at http://www.utilityregulation.com/content/reports/DCSWFinalReport.pdf

[3] The report "Independent Assessment of Dislodged Manhole Covers Prepared for The Commonwealth of Massachusetts Department of Telecommunications & Energy Massachusetts Report", dated December 9, 2005 can be viewed at http://www.mass.gov/Eoca/docs/dte/distribution_system_safety_plans/12905siemensreport.pdf

5. Please provide details regarding IPL's process for qualifying customers for interconnection with IPL underground facilities and whether any periodic inspections are performed by IPL or if any certifications are maintained on the condition of the said interconnection facilities and customer equipment. What training and/or certification is 1) required of and 2) provided by IPL for customers who interconnect with IPL via its underground facilities?

IPL Response:

In order to take service from IPL, customers are required to have a qualified electrician install the service facilities and obtain the necessary permits from the City of Indianapolis. The electrician must install the customer's equipment according to the current version of the National Electric Code (NEC) and meet IPL's requirements for service as outlined in IPL's Electric Service and Meter Manual. For all new services or service upgrades downtown, a member of IPL's Network Engineering group will meet with the customer's electrician to review the proposed work. The application for a permit from the City of Indianapolis triggers an inspection of the customer's electrical service equipment by the city electrical inspector. Once the electrical inspector determines the installation is compliant with all applicable current codes, IPL installs the meters and makes the final connection to the IPL underground system. While the NEC is updated every two years, it is not retroactive. As customers upgrade electrical systems to accommodate changes or building additions, any new facilities must meet the current NEC requirements. Customers are not required to modify or upgrade existing facilities not involved in the upgrade. As mentioned in the response to Question 1, IPL's service requirements are posted on its website as Electric Service and Meter Requirements ("The Gold Book").

6. Is IPL aware of the extent to which other peer group electric utilities regularly inspect customer-owned equipment that connects to the utility's underground facilities?

IPL Response:

IPL is not aware of any peer electric utility that regularly inspects customer owned equipment connecting to its underground facilities.

7. Please provide, to the extent IPL is aware, details of the requirements that utilities from other states follow that address issues related to the over-pressurization of underground utility plant.

IPL Response:

Electric utilities strive to utilize best practices to provide safe and reliable service to their customers. Utilities throughout the United States are required to abide by the following codes and agency rules:

- NESC – National Electric Safety Code
  - Clearances and operations
- Occupational Safety & Health Administration (OSHA)
  - Adequate training for electrical line workers
  - Confined Space entry procedures
  - Signing, signaling, flagging
- Environmental Protection Agency (EPA) Rules
  - PCB oil testing and containment
  - SPCC (Spill Prevention, Control, and Countermeasures)
- Local Electrical Permitting Practices
  - Connect only after inspection is complete and approved by appropriate permitting authority (such as the City of Indianapolis)

IPL researched regulatory reporting requirements from other states and reports the following:

California	CA PUC began an investigation into PG&E underground network events in late spring 2011.
Connecticut	In April 2007, the PUC required CL&P to continue a four-year inspection program of manholes and to replace a portion of its secondary network over a five-year period and to report project status quarterly. (Docket No. 06-10-21) In addition, the utility is required to file transmission and distribution maintenance plans on a two-year cycle. (Docket No 86-12-03) CL&P agreed to highlight network maintenance in future reports.
Massachusetts	The Department of Telecommunications and Energy ("DTE") initiated an "Independent Assessment of Dislodged Manhole Covers" in 2005 and required the four subject utilities to implement the following recommendations of the report: 1) create a technical working group - including DTE staff - to standardize

	definitions and event reporting; 2) complete inspections on a five-year cycle; 3) report quarterly findings; 4) document and log splicing activity; 5) complete failure analysis; and 6) file annual reports.
New York	Following a 1999 power outage, the New York DPS initiated an investigation of Con Edison underground incidents (Case 99-E-0930). On March 15, 2000, DPS Staff issued a report that contained 44 recommendations for the company to implement. The Commission ordered Con Edison to implement all of the recommendations and required Con Edison to file quarterly status reports on its plans to implement the recommendations. Con Edison subsequently filed a Petition requesting modification to allow reporting on a semi-annual basis (Nov 1 and May 1), which the Commission approved. In the first two years following the May 2000 order, Con Edison implemented 32 of the recommendations. As of May 1, 2011, Con Edison has completed all but one of the 44 recommendations.
District of Columbia	The DC PSC initiated an investigation and independent assessment following a series of manhole explosions in the late 1990s. Following independent reports by Stone & Webster and Siemens, the PSC ordered PEPCO to inspect manholes on a four year cycle, test new technologies such as remote monitoring and manhole covers that limit displacement in pressurization events, complete seasonal modeling and report quarterly and annual reports to the PSC.

8. For each year since 2000, what has been IPL's total capital investment in underground facilities? Please provide information that details the amount spent on the downtown area in particular.

IPL Response:

The table below shows the capital investment made in underground facilities for the years 2000 through 2011 year to date ("YTD"). The column labeled Downtown Underground Network Area is the area that comprises the secondary network area. The column labeled Underground Non-Network area is the balance of the IPL service territory served from the general distribution system with underground facilities. These values represent capital investment in new facilities to serve new or load additions, system upgrades, and replacement of facilities.

	Capital Investment		
Year	**Downtown UG Network Area**	**UG Non-Network Area**	**Total UG Capital Investment**
2000	$2,298,445	$18,200,740	$20,499,185
2001	$798,012	$19,525,405	$20,323,417
2002	$1,010,730	$19,943,938	$20,954,668
2003	$1,024,313	$26,023,139	$27,047,452
2004	$1,869,913	$18,213,189	$20,083,102
2005	$3,218,865	$19,221,403	$22,440,268
2006	$2,260,853	$19,988,977	$22,249,830
2007	$2,618,414	$20,302,278	$22,920,692
2008	$4,593,963	$16,751,397	$21,345,360
2009	$3,997,232	$15,428,193	$19,425,425
2010	$6,071,673	$13,584,576	$19,656,249
2011 YTD	$5,224,799	$6,791,042	$12,015,841

Downtown UG Network Area - Work on the Cultural Trail began ramping up in 2007 and has continued through 2011. This project has required relocation and replacement of underground facilities including duct lines, primary cables, and secondary cables. In 2005, there were 4 major additions to the network including the Conrad Hotel, the Simon Office Building, Hudson Condos, and Homewood Suites Hotel. In 2008, the increase in spending is attributable to providing service to Lucas Oil Stadium. The increase in 2010 and 2011 YTD is attributed to the start of relocation work for the Georgia Street upgrades led by the City of Indianapolis.

UG Non-Network Area – The large increase in spending in 2003 can be attributed to the burial of several substation exit circuits for the interstate I-70 entrance to the new Indianapolis International Airport. In addition, 2003 saw a larger than normal expenditure for new UG commercial projects. The reduced expenditures that started in 2007 and continue to present are directly related to the slowdown in the economy.

***9. For each year since 2000, what have been IPL's total maintenance expenditures for underground facilities? Please provide information that details the amount spent on the downtown area in particular*.

IPL Response:

The table below shows the maintenance expenditures made in underground facilities for the years 2000 through 2011 YTD. The column labeled Downtown Underground Network Area is the area that comprises the secondary network area. The column labeled Underground Non-Network area is the balance of the IPL service territory served from the general distribution system with underground facilities. The values represent expenses for repairs of facilities, inspections, routine maintenance, and any non-capitalized work.

	Maintenance Expenditures		
Year	Downtown UG Network Area	UG Non-Network Area	Total UG Maintenance Expenditure
2000	See Note 1	See Note 1	$4,349,746
2001	See Note 1	See Note 1	$4,353,497
2002	See Note 1	See Note 1	$3,420,738
2003	See Note 1	See Note 1	$3,361,098
2004	$1,129,017	$2,953,399	$4,082,416
2005	$1,759,071	$3,048,405	$4,807,476
2006	$1,373,129	$2,597,986	$3,971,115
2007	$1,844,163	$2,647,764	$4,491,927
2008	$1,470,764	$2,981,070	$4,451,834
2009	$1,529,371	$2,872,771	$4,402,142
2010	$1,036,397	$3,243,648	$4,280,045
2011 YTD	$477,334	$1,179,689	$1,657,023

Note 1: For the period 2000 through 2003 the specific maintenance costs for the Downtown Underground Network cannot be broken out from the total dollars spent on underground maintenance. The total UG maintenance expenditures are relatively consistent throughout the period. We believe the split in underground expenditures between the downtown and the other underground areas in 2000-2003 would likely be similar to that in 2004 and beyond.

10. Does IPL have a long-term maintenance plan? Has IPL changed its underground maintenance practices over the last 10 years? If yes, please explain the specific changes and the reasons for each change.

IPL Response:

Yes, IPL has a long-term maintenance plan that includes the following features:

- A five-year inspection cycle of its manholes in the downtown area. The industry standard for good utility practice is to inspect manholes on a four-to-ten-year cycle. This means we enter and inspect about 260 manholes each year. [~1,266 manholes in inspection cycle]

  - We do a visual inspection of the structural condition of the manhole, looking for any water infiltration issues and any other conditions that warrant further investigation.
  - We inspect for damage to the fireproofing tapes on the cables, which help protect the cables from external heat.
  - We visually inspect splices for leaking and swelling, which indicates they need to be replaced.
  - We visually inspect for the presence and condition of duct sealing material, which prevents gases in the manhole from entering customer buildings.
  - We take current readings on all secondary cables, making note of any cable with 0 current or greater than 200 amps of current for further investigation. Here, we are looking for cables that may have experienced a short circuit and are open, or cables that are approaching their maximum capacity. Further review is performed by the crew on those circuits indicating 0 current to determine if a cable has opened and appropriate action is taken. If these conditions exist, Network Engineering follows up and corrective actions are taken.

- Network protectors are on a three-year inspection cycle to make sure they operate correctly and to verify their operating settings. A general vault inspection is also made at the same time as the network protector testing.

Additional aspects of the plan incorporated within the last 10 years include:

- In 2011, an infra-red (IR) camera was added as an additional preventive maintenance testing tool. The camera is used to look for potential hot spots on the network protectors, primary oil switches, and incoming primary cable feed to the transformers.

- Vault cleaning has been expanded to include an inspection of the vault structure and a visual inspection of the equipment. The structure is inspected to determine wall, roof, and drainage issues. The transformer is checked for potential leaks, rust, oil or other abnormal conditions. Ladders, vault lighting circuits, bus work, steam penetrations are also recorded conditions of the inspection. IR temperature guns (digital numeric display of temperature) were added for temperature recording in 2009.

- Beginning in 2005, manhole inspections included inspecting and repacking of service ducts as needed.

11. IPL, as part of its Summer Preparedness Presentation, listed five new initiatives it was taking in regard to the downtown network system. Please explain each of these in more detail as to cost, effectiveness, and retro-fit applicability and provide a timeline for the implementation of each.

IPL Response:

IPL has undertaken five initiatives to improve the Downtown Network system. These initiatives were briefly discussed at the 2011 Summer Preparedness meeting and are described in more detail below. In addition, IPL is in the process of completing a full inspection sweep of all manholes in the Downtown Secondary Network area.

- Network SCADA Projected Completion Date: 4/1/2013

  The purpose of this initiative is to install a control system, known as Supervisory Control and Data Acquisition ("SCADA") that will provide two-way communication and control with all of the network protectors on the Downtown Network. This system will provide various analog values such as voltages and currents at the Network Protector. The system will also provide for remote control of the Network Protector. This will allow IPL's System Operators to Open or Close a Network Protector remotely and eliminates the need for an IPL employee to enter the vault to perform that task.

  The project involves installing an underground fiber optic communication system. The fiber optic cable will be installed utilizing existing IPL conduits. The protection relay in the network protector will be replaced with one that has two-way communication capability. The relay will be connected to the fiber optic communication system. The network SCADA system will be operated through IPL's existing Energy Control System in the Transmission Operations Control Center.

  Approximately 44 percent of the required fiber optic cable has been installed, and 177 of 315 network relays have been installed for this project.

- Primary Cable fault detectors Projected Completion Date: 12/31/2012

  The purpose of this initiative is to install a device on the primary network cables that detects when fault current has passed through it. This device is called a fault detector or fault indicator. Fault detectors are used in an underground system to help determine the location of the fault. IPL will be able to read the device remotely from street level without having to enter the manhole. This will result in a considerable time savings to locate a cable fault and will reduce overall feeder restoration time. This project is in the design phase. Equipment purchase is expected to commence first quarter 2012.

- Install cable limiters at select locations   Study Completion Date: August 1, 2012

  The purpose of this initiative is to assess the feasibility of installing additional cable limiters at certain locations on the secondary network system to provide an additional level of protection. These additional cable limiters could help to isolate faulted secondary cables and reduce the risk of secondary network events. Care must be taken in the placement of these additional cable limiters in order not to increase secondary network events. The determination of the possible locations for placement of these cable limiters requires detailed models of the secondary network system, as well as performance of both power flow and fault current studies. Work has begun to develop the necessary electrical models needed for the studies to determine if and where additional cable limiters should be installed. A timeline for installation of additional cable limiters will be developed after the modeling and analysis is complete. Our plan is to complete the study and analysis phase by August 1, 2012.

- Evaluate Thermal Imaging   Projected Completion Date: 08/01/2011

  The purpose of this initiative is to evaluate the effectiveness of thermal imaging through infrared cameras on components of the Downtown Network system. IPL has been using thermal imaging on the overhead transmission and distribution systems and on substation facilities for a number of years. These efforts have proven to be effective in finding problems before they become a failure and potential outage. Early thermal imaging cameras were very large and bulky and did not lend themselves for use in the confined spaces found on the Downtown Network system. As the thermal imaging technology has matured, the size of the equipment has decreased significantly. There are now hand-held devices about the size of a large flashlight that can be used in confined spaces. IPL has purchased two hand-held infrared cameras, which it is piloting in the full sweep of manholes and vaults. Test inspections with the cameras began on June 3, 2011. Initial results have shown that the cameras can be effective on connections and terminations.

- Combination Locking and Pressure relieving manhole covers

  Project Completion Date: 9/2011 to take delivery of the first covers

  The purpose of this initiative is to install and evaluate the effectiveness of a manhole cover that can be locked in place to prevent unauthorized access to the underground facilities, while, at the same time, allow gases in the manhole to vent in case of an over-pressurization. Until recently, no such product existed. A Michigan-based company working with EPRI has now developed a manhole cover that is locked in place through a mechanism attached to the underside of the cover. This mechanism will allow the cover to rise three to four inches and vent the pressure that can build up during an over-pressurization event. This locking manhole cover was used by Detroit Edison when Detroit hosted the Super Bowl in 2009. The security protocols for the Super Bowl require that manhole covers within the security perimeter be secured. With Indianapolis hosting the 2012 Super Bowl, IPL has been investigating the use of these covers.

IPL is working with the supplier to finalize the design of the manhole cover so that it will fit IPL's existing manhole rings. IPL expects to take delivery of the first of these covers by early September of 2011. Approximately 75 of these covers will be installed around Lucas Oil Stadium and along Georgia Street prior to the Super Bowl.

12. If IPL were to design and install a downtown network today, would the technology be similar to the existing network, or would it be different? If different, can any new plant added today take advantage of the new technology?

IPL Response:
The basic components/theory of a network would remain the same, *i.e.,* vaults, manholes, network transformers, network protectors, cable, single contingency design, concrete encased duct banks, etc.

An underground network built today would also have a SCADA system. This technology facilitates remote control and monitoring of the network system. As mentioned in response to Question 11, IPL is in the process of installing such a system for its Downtown Network.

13. Please explain the extent to which IPL coordinates with or shares information with Citizens Energy in regard to underground plant and emergency response in the downtown network system area.

IPL Response:

IPL has a very open relationship with Citizens Energy and Thermal. The utilities all respond in a timely manner to field events and emergency conditions to protect the public and maintain reliable services. Concerns we have with each other receive a timely response. When steam leaks are found that could jeopardize IPL's electric facilities, Citizens Thermal is contacted and they address the issue.

IPL has a good rapport with all utilities occupying the same area in the downtown Indianapolis.

14. Please explain how IPL coordinates with emergency responders in the event of a downtown underground explosion or fire.

IPL Response:

IPL and the Indianapolis Fire Department (IFD) have established specific protocols to respond to Downtown Network incidents. Whenever IFD makes a run on a report of a manhole event or other electrical issue in the downtown area, they notify the IPL Distribution Operations Control Center (IPL DOCC). This call is made via a direct phone line between the IFD Dispatch Center and the IPL DOCC. IPL immediately dispatches a truck to the reported location. IPL DOCC will immediately notify the IPL Transmission Operations Control Center (IPL TOCC) of the event. IPL TOCC will then notify the appropriate Network Operations leadership of the event so they can also respond to the scene. Upon arrival on the scene, IFD is to secure the area and take a defensive position. They are not to enter manholes or vaults and they are not supposed to put water or chemicals on any fire in a manhole or vault until IPL personnel arrive on the scene and determine the safe way for IFD to proceed. The safety of the public and the firefighters is our number one priority.