October 3, 2014

Via Hand Delivery and Email

Ms. Beth Krogel Roads
General Counsel
Indiana Utility Regulatory Commission
101 W. Washington Street, Suite 1500 East
Indianapolis, Indiana 46204

Dear Ms. Roads,

Indianapolis Power & Light (IPL) is pleased to provide the Commission with the root cause analysis report from the 26 S. Meridian Street Network Event on August 13, 2014.

The report was prepared by the IPL T&D Engineering and Operation groups, working in cooperation with the O'Neill Management Consulting group and supported by underground network experts from Eaton Corporation. The report provides a comprehensive review of the downtown network event consistent with our enhanced failure analysis procedures and provides a set of nine (9) recommendations from lessons learned from this specific event. In addition, IPL continues to meet or exceed our commitments from the prior O'Neill Management Consulting report issued December 2011.

IPL looks forward to the comments from the O'Neill Management Consulting group regarding this event, the root cause analysis and our recommendations for continuous improvement from the lessons learned from the event.

If you have any questions or would like to discuss further, please call me at (317) 261-8600 or contact me via email at joe.bentley@aes.com.

Respectfully submitted,

Barry J. Bentley
Senior Vice President, Customer Operations
Indianapolis Power & Light Company

Cc: Mr. Robert Veneck, IURC
Mr. Brad Borum, IURC
O'Neill Management Consulting

ROOT CAUSE ANALYSIS
FOR
26 S. MERIDIAN STREET
NETWORK EVENT ON
AUGUST 13, 2014

Prepared by T&D Engineering
Issued on October 3, 2014

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Executive Summary

On Wednesday, August 13, 2014 IPL experienced a serious failure of a network protector in the 480-volt spot network vault at 26 S. Meridian Street in the UG 651 bay. The event occurred at 1:25 p.m. and lasted for approximately 15 minutes. During the event several loud bangs were heard at street level and heavy brown smoke could be seen coming from the vault. IPL personnel responded quickly to the event, both to the scene and to the Transmission Operations Control Center. We are not aware of any damage to public or customer facilities and there were no injuries. There was minor customer outage after the event while IPL crews made safety clearances in the vault. By 8 p.m. Wednesday evening all customer service had been restored and the last IPL crews left the scene by 9 p.m. The equipment protection systems all worked as designed during this event.

The failure which occurred with the network protector is rare. The previous similar failure on the IPL network system occurred in the early 1990's. When crews were able to enter the vault and inspect the damage they found that the UG 651 network protector had sustained significant damage. IPL began the investigation into the event even before crews were able to enter the vault late on Wednesday afternoon. Steps were taken to preserve and gather evidence for the ensuing investigation.

IPL engaged the Eaton Corporation to assist with the technical investigation into the possible cause. Eaton has technical experience, as a manufacturer of network protectors, and has technical experience and knowledge that would be beneficial to the investigation. Eaton was on site to oversee the dismantling of the failed UG 651 network protector; they submitted a written report of their findings to IPL. Eaton believes the failure of the UG 651 network protector was a dielectric breakdown in the bus support spool insulator at the bottom of the network protector. They had seen a few other failures similar to this one over the years and had investigated two other similar failures in 2014 at two separate utilities.

The potential problem with the bus support spool insulator can be linked to Westinghouse model CM-22 network protectors manufactured before 1985. The UG 651 network protector that failed was a 1959-60 vintage Westinghouse CM-22 network protector. IPL has identified 58[1] Westinghouse CM-22 480-volt network protectors on the downtown network system that are pre-1985 vintage. Earlier in 2014 a $15 million project was approved to replace all 137 480-volt network protectors as part of an arc flash mitigation program. As discussed further in Section 7.0 below, the replacement sequence for that program will now be modified to address the 58 network protectors identified during this investigation.

[1] Previously IPL shared with the Commission that there were 8 network protectors of the 1959-1960 vintage that failed at 26 S. Meridian Street. After learning of the possible spool insulator issue with pre-1985 network protectors, IPL determined there were 58 network protectors on its system that met that criteria, including the 8 originally identified.

The IPL investigation report contains 9 recommendations to address the cause of the event on August 13, 2014, recommendations to enhance the operation of the downtown network, and recommendations to enhance IPL's response to downtown network emergencies and to assure that qualified staffing is in place now and in the future to handle emergencies like the one on August 13th.

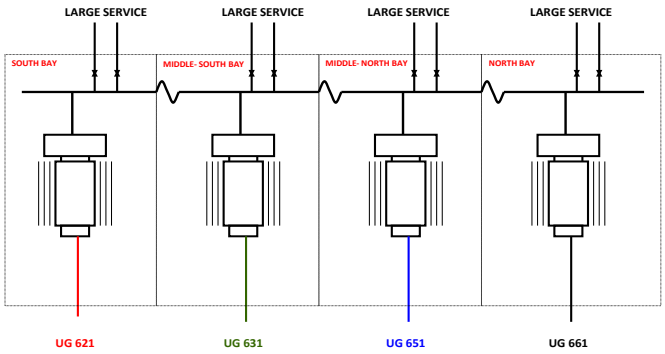
1.0 Introduction

This report has been prepared as the result of the network event that initiated at 1:25 p.m. EDT, Wednesday, August 13, 2014. The event occurred at 26 S. Meridian Street and involved an internal failure of the 1,600-amp 480-volt network protector on the Gardner Lane UG 651 network transformer at that spot network vault location. It lasted approximately 15 minutes. The 480-volt network protector fault was isolated when primary feeder that serve the Gardner Lane feeder UG 651 substation breaker was opened by the Transmission Operations Control Center via the Energy Control System (ECS) SCADA[2] control and the fuses that opened due to the 480-volt fault current. We are not aware of any damage to public or customer facilities and there were no injuries

The vault at 26 S. Meridian Street is a four-bay, 480-volt spot network[3] vault that serves a portion of the North Block of Circle Center Mall and the 30 S. Meridian office building along Meridian Street. The vault contains four 1,000 KVA 13.2 kV to 277/480-volt network transformers. Each transformer has a 1,600-amp, 480-volt network protector attached to it. Each transformer is located in a separate bay with fire doors between each bay. A common 480-volt collector bus runs the length of the vault. There are 3,000 amp high capacity fuses between each bay. The customer service cables are attached to the collector bus along with the leads from each network protector. The customer service cables all have cable limiters[4] on the vault side and at the customers' main disconnect switch.

The diagram below shows the layout of the 480-volt spot network vault at 26 S. Meridian Street where the event occurred on the UG 651 network protector.

26 S MERIDIAN STREET 480 VOLT SPOT NETWORK VAULT



[2] SCADA is an acronym for Supervisory Control and Data Acquisition.
[3] A spot network vault serves load only at that location and is not electrically connected at the secondary voltage level to another vault.
[4] A Cable Limiter is like a fuse but is rated to the size of the conductor it is attached to in order to isolate the cable from the system should the cable short circuit. It is not an over-current device that will operate on load current like a fuse.

2.0 Background

The fault event that occurred at 26 S. Meridian Street on August 13, 2014 was a rare event in the history of IPL's downtown network system. Senior staff members could recall only one other event in the last 35 years when a network protector failed in a manner causing such a total destruction of the device. That event took place back in the early 1990's at the 37 W. Ohio Street vault.

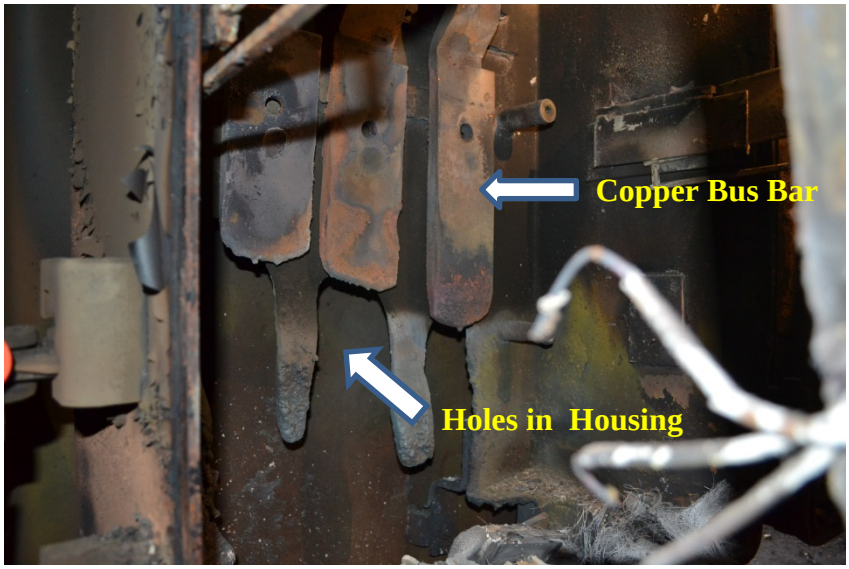
The picture below is of the UG 661 network protector at 26 S. Meridian Street. It is the same style and vintage as the UG 651 network protector. This photo shows what the UG 651 network protector would have looked like before the event on August 13, 2014.

UG 661 Network Protector – 26 S Meridian Street – Same Model and Vintage

The picture below was taken when the UG 651 network protector door was first opened and shows the damaged UG 651 network protector at 26 S. Meridian Street. The picture shows the complete destruction of the interior of the network protector, including the breaker mechanism and the controls. The public heard loud banging and saw brown smoke coming from the vault. This was the result of the burning of the network protector parts that produced the loud, banging noise and brown smoke during the event.

UG 651 Network Protector – 26 S Meridian Street – Post Event – Photo 1

The picture below shows the damage to the copper bus in the back of the network protector. It also shows the holes that were burned in the back of the network protector housing from the arcing that occurred. This copper bus connects directly to the transformer secondary low voltage output.



UG 651 Network Protector – 26 S. Meridian Street – Post Event – Photo 2

After the event an investigation team was assembled. Mike Holtsclaw, Director of Transmission and Distribution Engineering, was directed to take the lead for the investigation by Joe Bentley, Sr. Vice-President of Customer Operations. The investigation team included:

Mike Holtsclaw	Director, T&D Engineering
Jim Sadtler	Director, Transmission Field Operations
Barry Feldman	Director, Asset Management
Jim Page	Manager, Substation & Network Field Operations
Mike Lee	Team Leader, Network Operations
Bob Vasel	Manager, Major Projects Engineering
Rick Leffler	Team Leader, Major Underground Projects Engineering

3.0 Sequence of Events

The following sequence of events has been developed using information from IPL records and from the Indianapolis Fire Department Computer Aided Dispatch records and incident reports.

Time	Event Description	Source
~1:00 p.m.	Network SCADA[5] Gateway Vault Circuit 04 goes into Telemetry Error. This circuit serves 26 S. Meridian Street 480-volt Spot Network Vault and 10 other vaults.	PI[6]
1:03 p.m.	A small 0.3 MVAR spike on all three banks at Gardner Lane Sub is observed	PI
1:25 p.m.	13.2 kV Capacitor Bank faults on UG 650E cable at Gardner Lane substation	PI
1:25 p.m.	Gardner Lane UG 650E Breaker reported open by SCADA	PI
1:25 p.m.	PI data shows MVAR on Gardner Lane Transformer Unit 3 begins to fluctuate Gardner Lane feeder UG 651 primary current also shows fluctuations starting at the same time	PI
~1:25 p.m.	IPL employee Carol Simpson happens to be on the sidewalk north of the vault bay at 26 S. Meridian Street when there is a loud boom, and smoke is seen coming from the North Middle Bay. It is believed this is the start of the event at 26 S. Meridian Street.	Oral
1:26 p.m.	911 Dispatch receives public report of underground explosion and fire in the 100 block of South Meridian Street	IFD
1:26 p.m.	Substation Switchman dispatched to Gardner Lane substation to investigate relay operation of UG 650E breaker	Log

[5] SCADA is an acronym for Supervisory Control and Data Acquisition.
[6] PI is the database system on the Energy Control System that stores historical data such as equipment status and electrical values like voltage and current. All data is date and time stamped.

Time	Event Description	Source
1:27 p.m.	Employee Carol Simpson calls Greg Fennig, Vice President, Public Affairs, advising him that something has happened in the IPL vault on S. Meridian Street; she reported a loud bang and lots of smoke coming up from the vault.	Cell Records
1:28 p.m.	IFD dispatches 18 pieces of equipment on the report of an explosion and smoke coming from a vault on S. Meridian Street in front of the Oceanaire restaurant.	IFD
1:30 p.m.	Greg Fennig calls Jim Sadtler to advise him of the call from Carol Simpson. Jim is in his car on his way to the Electric Building on Monument Circle for a meeting. Jim heads towards the reported scene.	Cell Records
1:31 p.m.	1st IFD unit marks on the scene at 100 S. Meridian Street. IFD Squad 13 establishes Command, reports noise and smoke coming from underground structure.	Cell Records
1:31 p.m.	Jim Sadtler notifies IPL Transmission Operations Control Center (TOCC) that there is a report of an explosion and smoke coming from the vault on South Meridian Street in front of the Oceanaire Restaurant. He is headed to the scene.	Cell Records
1:33 p.m.	IPL employee John Willey, Team Leader Field Service Support, is northbound on Meridian Street and is directly across from the 26 S. Meridian Street vault when he hears a loud boom and sees smoke coming from the vault on the west side of Meridian Street. He immediately stops his vehicle in the curb lane of northbound Meridian Street to investigate.	Oral, Telogis[7]
1:40 p.m.	Employee John Willey calls the TOCC by cell phone and advises them that there is a fire in the vault on S. Meridian Street.	Log

[7] Telogis is the vehicle tracking system that IPL uses. It can show the vehicle location, vehicle speed, and other data that is data and time stamped.

Time	Event Description	Source
1:40 p.m.	TOCC evaluates the situation and finds that the primary current on Gardner Lane UG 651 is spiking. The decision is made to open Gardner Lane UG 651 feeder breaker first before opening the other primary feeder breakers in the Gardner Lane South Network.	Oral
1:40 p.m.	TOCC opens Gardner Lane UG 651 feeder breaker by SCADA. This de-energizes the 13.2 kV primary source to the Middle North unit at 26 S. Meridian Street	PI
~1:41 p.m.	The report from the field to the TOCC is that the smoke and noise coming from the 26 S. Meridian Street vault has decreased after the UG 651 feeder breaker was opened	Oral
~1:45 p.m.	Switchman reports the overhead capacitor bank at Gardner Lane substation connected to feeder UG 650E has failed; leads damaged on all three potheads on the underground riser on the third capacitor bank.	Log
2:35 p.m.	Eric Peterson, IPL Substation Mechanic, reports that he has visited all spot vault and network vault locations on UG 651, network protectors are open and the Primary Oil Switches were opened except at 26 S Meridian street.	Log
2:40 p.m.	Eric Peterson racks Gardner Lane UG 651 feeder breaker out and places Hold Card[8]	Log
2:48 p.m.	Eric Peterson racks Gardner Lane UG 650E and 640E breakers out and places Hold Cards. UG 640E is the breaker on the other end of the tie cable that is normally open.	Log
3:00 p.m. to 4:00 p.m.	Eric Peterson requests TOCC to open all network protectors at 26 S. Meridian Street by Network SCADA. TOCC cannot perform that operation since all units are in Telemetry Error.	Notes

[8] A Hold Card is part of IPL's Lockout/Tag Out procedures for worker safety when de-energizing equipment to help prevent accident re-energization while workers are servicing a piece of equipment. A Hold Card prohibits operation of the equipment while the Hold Card is in place.

Time	Event Description	Source
3:00 p.m. to 4:00 p.m.	After discussion between the TOCC, Engineering, and the Field the decision is made to get all load off the 26 S. Meridian Street vault by having the customers open their main disconnect switches. IPL crews will then enter the vault to open the remaining three network protectors.	Notes
3:00 p.m. to 4:00 p.m.	Request are made to customers served from 26 S. Meridian Street vault to open their main disconnect switches, taking load off the vault. This action Impacts 30 South Meridian /Kite Realty (multiple tenants), Oceanaire Restaurant, Napolese Pizzeria Restaurant, and Carson's Department Store.	Notes
4:20 p.m.	Customers report their main disconnect switches Open	Estimate
4:30 p.m.	Eric Peterson given permission by the TOCC operator to enter the vault at 26 S. Meridian Street	Log
4:40 p.m.	Opened network protectors on UG 621, UG 631, and UG 661 at 26 S. Meridian Street. This isolates the 480-volt bus	TOCC Log
4:45 p.m. to 5:30 p.m.	Opened the UG 651 primary oil switch on the network transformer. Inspection finds C Phase 3,000 amp high capacity bus fuse blown in 480-volt bus between Middle South and Middle North bays (Between UG 631 & UG 651)	
4:45 p.m. to 5:30 p.m.	Inspection finds the C Phase network protector fuse blown in the UG 661 network protector unit	
4:45 p.m. to 5:30 p.m.	Inspection finds extensive damage to UG 651 network protector.	
4:45 p.m. to 5:30 p.m.	IPL crews Live End Cap UG 651 in the Middle North bay of 26 S. Meridian Street. Hold cards are placed on the Live End Caps. UG 661 network protector fuse was replaced, and the 3,000 amp bus fuse was replaced	
5:47 p.m.	Last IFD unit released and marks in-service	IFD

Time	Event Description	Source
6:30 p.m.	Gardner Lane UG 661 feeder breaker opened, network protector at 26 S. Meridian placed in the automatic position to allow it to close	PI
6:42 p.m.	Gardner Lane UG 661 feeder breaker closed, then the UG 661 network protector that was placed in automatic closed, energizing the 480-volt collector bus at 26 S. Meridian Street	PI
~6:45 p.m.	IPL crews close network protectors on UG 621 and UG 631 at 26 S. Meridian Street. Good voltage verified in all four bays on the cables going to the customers services	Oral
6:50 p.m.	Customers notified they can close their main switches, restoring their load	Oral
8:00 p.m.	All customer load restored and back to normal	Log
~8:30 p.m.	IPL crews take thermal imaging scans of all electrical connections in the 26 S. Meridian Street vault. No hot spots are detected.	Oral
~9:00 p.m.	All crews clear of the scene – End of Event	Oral

4.0 Investigation and Analysis

The investigation into the cause of the network event at 26 S. Meridian Street began as soon as the arcing stopped, and it was safe to enter the vault. The sections below describe the facilities involved, observations made during and after the event, and other pertinent information to the investigation.

4.1 Meridian Street Facilities

The IPL vault at 26 S. Meridian Street is a four-bay, 480-volt spot network vault. The vault was rebuilt in 1994 as part of the Circle Center Mall project. The original 120/208-volt vault equipment was removed. The original vault structure was demolished, and a new 277/480-volt structure for 277/480-volt equipment was constructed. The depth of the vault was decreased, and the secondary collector bus was built to 480-volt spacing. The vault contains four 1,000 KVA network transformers, one per bay. Each network transformer has a 1,600-amp network protector. There are two different manufacturers of network protectors at 26 S. Meridian Street: two General Electric MG-8 style and two Westinghouse CM-22 style.

4.2 Observations during the Event

The event was first observed by the public who reported an underground explosion and smoke in front of the Oceanaire Restaurant at 28 S. Meridian Street. Multiple calls were placed by the public to 911. The Indianapolis Fire Department (IFD) dispatched Engine 7, Ladder 7, Squad 7, and Battalion Chief 7 to the scene.

The first IFD units on the scene reported smoke coming from the underground vault structure. They did not report seeing any flames.

IPL employee Carol Simpson was walking south on the west side of Meridian Street. She was just north of the 26 S. Meridian Street vault when she heard a loud bang and saw smoke coming up through the grating of the vault. She called Greg Fennig, her supervisor, and reported what she had just witnessed. She does not remember hearing any unusual noises just prior to hearing the loud bang and then seeing the smoke. Greg Fennig placed a call to Jim Sadtler and let him know what Carol had just witnessed.

IPL employee John Willey was traveling northbound on Meridian Street in his company vehicle when he heard a loud bang and saw heavy smoke coming from the vault on the west side of Meridian Street (based on the YouTube video this wasn't the first event). John was directly across from the vault when this occurred. He stopped his vehicle and put his flashers on. He called the TOCC and advised them that there was a vault fire on South Meridian Street.

Employee Jim Sadtler was on his way to a meeting at the IPL Corporate offices on Monument Circle when he received the call from Greg Fennig. Jim had just turned north on Meridian from South Street when he got the call from Greg Fennig. Prior to receiving the call from Greg he observed what appeared to be brown smoke to the north and east of his location over the buildings. As Jim proceeded north on Meridian Street he could see heavy smoke on the west side of Meridian Street, north of Maryland Street. Jim parked his car at Meridian and Maryland streets and called the TOCC.

There are at least four YouTube videos that have been posted of the event. Links to these videos can be found in Appendix C of this report. The YouTube videos show the event from about the minute it started until the event ends at 1:40 p.m. In the videos heavy brown smoke is visible, and loud, banging sounds can be heard. The smoke and banging sounds are consistent with a 480-volt arc fault produced under test conditions. Links have been included in Appendix C of test faults at 480-volts and show the brown smoke and bang that occurs with a 480-volt arc fault. In the videos a comment is made that the lights are still on in the Oceanaire Restaurant.

IPL has a security camera on the southeast corner of the corporate office on Monument Circle. This camera was panned south to show the event on Meridian Street at 1:33 p.m. by security personnel in the IPL Security Operations Center. They left the camera in this position for the remainder of the event.

All of the videos help show that there was an initial event that occurred at 1:25 p.m. and lasted for 6 to 7 minutes. The smoke and noise die down for a period of 7 to 8 minutes and then increases for the final 3 to 4 minutes.

4.3 Observations after the Event

After the Gardner Lane UG 651 feeder breaker was opened at 1:40 p.m. the banging noises stopped and smoke began to dissipate. People on the scene did report hearing two to three additional bangs, but by 2 p.m. the UG 651 bay was quiet. At this point, the 480-volt collector bus A & B phases were still energized from the UG 621, UG 631, and UG 661 network transformers and C phase in the South and Middle South bays were energized via UG 621 & 631. The A & B phase network protector leads from the 480-volt collector bus for the UG 651 network protector were still energized up to what remained of the UG 651 network protector. The exact condition of the UG 651 network protector was unknown since no one had been allowed to enter the vault yet. Visually from street level, crews could not discern the conditions in the UG 651 bay.

Units from the Indianapolis Fire Department deployed ventilation fans to help IPL clear the smoke from the vault. Once the smoke was cleared, IPL crews briefly entered the vault to check the status of the fire doors on the UG 651 bay. They found the fusible links had melted, but the doors had not closed as they were designed to do. IPL crews manually closed the fire doors and exited the vault. The damage was

contained to the UG 651 bay. There was no evidence of smoke damage in the other bays. The failure of the fire doors to close in the UG 651 bay did not impact the outcome of the event.

At 4:40 p.m. IPL Network crews were given permission to enter the vault to open the remaining network protectors. Their first actions were to manually open breakers on the remaining three network protectors on UG 621, UG 631, and UG 661. This de-energized the 480-volt collector bus and de-energized the cable leads going to the UG 651 network protector. The crews also opened the primary switch on the UG 651 network transformer, isolating it from the 13.2 kV primary network.

Before entering the vault the crews were instructed to preserve evidence to the extent possible while isolating the failed equipment. They were instructed to take pictures of the failed UG 651 network protector before attempting to open the housing door. The network protector door was still secured and had not been forced open by the forces and pressures from the events inside the UG 651 network protector.

During the inspection, IPL crews found extensive damage to the UG 651 network protector. It was effectively destroyed during the fault event. There were no signs that the UG 651 network transformer had leaked any oil from the main tank, indicating the integrity of all of the transformer gaskets remained intact. The temperature gauge on the transformer was pegged, indicating that the oil temperature had reached over 120 degrees C. The normal operating temperature range is less than 80 degrees C. The crews found that the C phase bus fuse between the Middle South and Middle North bays had operated and was open. They also found the C phase network protector fuse open in the UG 661 network protector. The 480-volt collector bus was contaminated with soot from the smoke, but was otherwise undamaged.

The Network SCADA Blue interconnection wiring was extensively damaged around the UG 651 network protector. This damage would have prevented any communications with the network protector relays on Gateway Vault Circuit Number 4 (GV04) after the damage occurred. The damage effectively shorted out the communications signal.

4.4 Network SCADA Information

In 2009 IPL began a program to replace all of the network protector relays with a relay that had two-way communication capability. These new relays would allow monitoring of the network protector status and the electrical values from the network protector. The relays would also provide remote control capability of the network protector. Included in this program was the deployment of a fiber optic and hardwire communication system. This communication system allowed the ECS SCADA system to monitor and control the network protectors in each vault. The Network SCADA was placed in service in 2013. The network protector relays in the 26 S. Meridian Street vault were replaced in 2010 in preparation for the Network SCADA system.

Unfortunately, the network SCADA system was of limited use for this particular event. GV04 went into telemetry error at approximately 1:03 p.m., 22 minutes before the event was observed by the public. This means the Gateway Vault Relay was having problems communicating with the network protector relays in the vaults. While in telemetry error, the data from the network protector relays cannot be considered valid. The reason for the initial telemetry error has not been determined. We know from experience that a loose connection of the Blue connecting wire on a terminal block can cause telemetry errors.

During the event the Blue wire connecting the network protector relay to the Gateway Vault Relay was badly damaged from the heat caused by the arcing in the UG 651 bay at 26 S. Meridian Street. This shut down communications on the GV04 communication circuit until repairs were made later in the evening.

The Network SCADA data was analyzed for the period prior to 1:03 p.m. It did not show any anomalies in the currents or voltages of the four network protectors at 26 S. Meridian Street. The Network SCADA showed that prior to 1:03 p.m. all four network protectors were closed and carrying load.

4.5 Maintenance and Inspection Records

IPL's current inspection cycle for vaults and network protectors is two calendar years. The failed network protector was last inspected in February 2012 and was to be inspected in 2014 as part of the two-year inspection cycle. Maintenance and inspection actions are based on time intervals triggered by completion of the previous work. For example, a two year interval means the activity should occur within two years of the calendar year of the previous activity. If an asset is inspected any time in 2012 on a two year cycle, then the next inspection should occur no later than the end of 2014. If the 2014 inspection does occur on time, then the next inspection is due in 2016. If for some reason the 2014 inspection occurred in 2013, then the next inspection would be due in 2015.

The 2012 inspection did not result in any follow-up work orders being issued. Inspections are scheduled using the EMPAC asset and work management system. The EMPAC system also is the source for asset information such as type of protector, age, manufacturer, serial number, location, ratings, IPL stock numbers, relay information and other key asset details.

The retention of inspection records has migrated from a paper system to an electronic tablet recording of inspection observations and measurements. This allows more visibility and easier tracking of the total inspection and maintenance process.

The electronic tablet software has business rules that guide the field technician through the inspection process. For example, if "Severe rust" is observed the tablet application requires a picture to be taken before the next step can be completed. In the evening the

tablet is docked, and inspections results along with any pictures taken with the tablet are uploaded and viewable on an internal web site. Below is a table showing the indicator names and states that are recorded during this process.

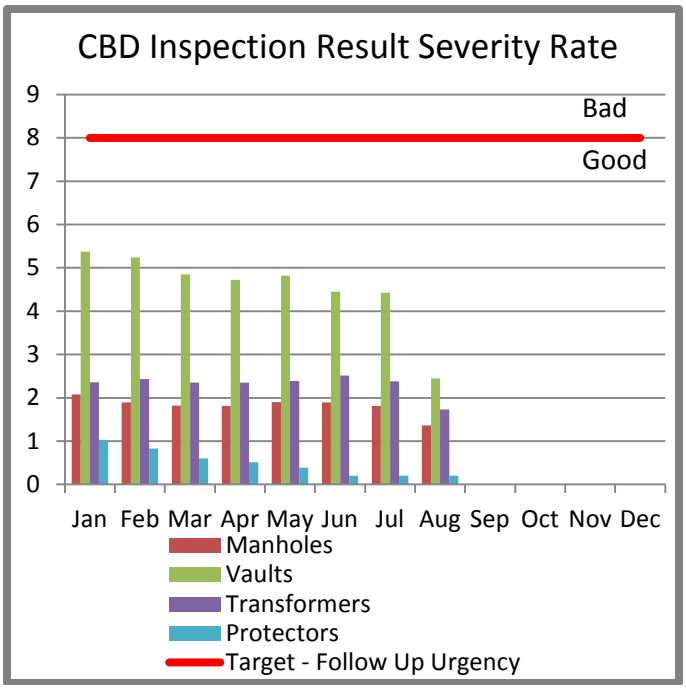
Vault Network Protector Inspection Indicators and Indicator States

INDICATORNAM	STATENAME	Trigger E-Mail?	Repaired?	If STATENAME in column "B" is chosen do the following next step.	If STATENAME in column "C" is chosen do the following next step.
Can the Protector Inspection Be Completed?	Yes	No			
Can the Protector Inspection Be Completed?	No	No		Enter why in comments.	If this is chosen - skip all remaining items
Vault - Check Network Protector - Rust	Normal	No			
Vault - Check Network Protector - Rust	Some rust	No	Yes/No	Take Picture	
Vault - Check Network Protector - Rust	Severe rust	No	Yes/No	Take Picture	
Vault - Check Network Protector - Rust	Rust and oil seeping	No	Yes/No	Take Picture	
Vault - Check Network Protector - Evaluation	Normal	No			
Vault - Check Network Protector - Evaluation	Indications of water ingress	No	Yes/No	Take Picture	
Vault - Check Network Protector - Evaluation	Indications of oil	No		Take Picture	
Vault - Check Network Protector Bus Type	Normal - Copper	No			
Vault - Check Network Protector Bus Type	Unsure/Not Applicable	No			
Vault - Check Network Protector Bus Type	Aluminum	No			
Vault - Check Network Protector - Ductor Phase A	Normal - < 900 micro-ohms	No		Record Reading	
Vault - Check Network Protector - Ductor Phase A	Warning - 900 - 1500 micro-ohms	No	Yes/No	Record Reading	
Vault - Check Network Protector - Ductor Phase A	Alarm - > 1500 micro-ohms	No	Yes/No	Record Reading	
Vault - Check Network Protector - Ductor Phase B	Normal - < 900 micro-ohms	No		Record Reading	
Vault - Check Network Protector - Ductor Phase B	Warning - 900 - 1500 micro-ohms	No	Yes/No	Record Reading	
Vault - Check Network Protector - Ductor Phase B	Alarm - > 1500 micro-ohms	No	Yes/No	Record Reading	
Vault - Check Network Protector - Ductor Phase C	Normal - < 900 micro-ohms	No		Record Reading	
Vault - Check Network Protector - Ductor Phase C	Warning - 900 - 1500 micro-ohms	No	Yes/No	Record Reading	
Vault - Check Network Protector - Ductor Phase C	Alarm - > 1500 micro-ohms	No	Yes/No	Record Reading	
Vault - Check Network Protector - Relay Close Volts	Normal < 4 Volts	No		Record Reading	
Vault - Check Network Protector - Relay Close Volts	Warning > 4 Volts	No	Yes/No	Record Reading	
Vault - Check Network Protector - Relay Trip Amps	Normal < 10 Amps	No		Record Reading	
Vault - Check Network Protector - Relay Trip Amps	Warning > 10 Amps	No	Yes/No	Record Reading	

Network Protection Inspection Indicators and States

Results of the inspections are recorded in the IVARA Asset Management software. With the input of subject matter experts every indicator state has a criticality level assigned in the IVARA software. These indicator criticalities create business rules in the software that create alarms requiring follow-up action. Based on the alarm severity a follow-up work order is created in EMPAC and tracked through completion. All information and inspection findings and the history for all of this work are clearly visible to responsible personnel through the entire process via a searchable website.

The overall health of the Central Business District (CBD)assets is tracked by reviewing algorithms that are a combination of all of the inspection results and indicators. This "criticality follow up" score tracks this health on a 12 month rolling average. Below is a graph from IPL monthly metric reporting showing CBD assets.



2014 Network Inspection Follow Up Urgency Indicators

The 2012 inspection noted the UG 651 network protector had copper bus, no rust and was in good condition. This inspection did not result in any follow up work orders being issued. Below is a summary of the EMPAC work order history for the network protector.

Work order	Status	Reconciliation	Category	Year	Priority	Entered	Complete	Description	Action
12-008334-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2012	4	1/26/2012	2/14/2012	CBD:INVESTIGATE - Check thickness of bus with fabricated guage. Take 8 pictures of breaker, bus, and interior. Take 8 pictures of exterior, terminations, throat mount, etc. Take pictures of spec plate on exterior/interior so that numbers can be read.	PD-Preventive
12-004781-000	Closed	Cancelled - Duplicate Work Order	PD - NWK PROTECTOR TESTING	2012		1/16/2012	3/27/2012	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
11-008851-000	Closed	Completed As Planned	PD - NWK PROTECTOR	2011	2	1/31/2011	1/31/2011	CBD: MIKE COCHRAN - Protector continues to cycle through open/close please investigate. Project#121696-8220	PD-Preventive
10-021616-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2010	4	5/10/2010	8/19/2010	CBD: Network SCADA Daisy Chain Relays Gateway Vault #4 - Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Using twisted pair cable connect relays in a "daisy chain" fashion. Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Project#900642-5000	PD-Preventive
09-036129-000	Closed	Completed As Planned	PD - NWK PROTECTOR	2009		8/26/2009	10/5/2009	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
08-019612-000	Closed	Completed As Planned	PD - NWK PROTECTOR	2008	4	4/24/2008	6/24/2008	CBD:Test, inspect, repair if necessary, and perform maintenance on network protector. 121696-8220	Predictive Maintenance

Network Protector EMPAC Work Order History

The only item out of the ordinary that did not involve routine inspections is a work order on January 31, 2011 for the network protector cycling. This work order was created and completed on the same date. Additionally, with the implementation of network SCADA the protector is continuously monitored for abnormal conditions. Protector cycling, protector relay temperature, open/close status, relay alarms and electrical quantities are viewable in the ECS for the TOCC and through database tools for engineering, construction, and field personnel. The SCADA history does not show anything abnormal. In short, nothing in the inspections or history of this equipment gave indication of a potential incident.

The inspection of the 26 S. Meridian Street vault was on the work plan for 2014 and was to be scheduled for the latter half of the year when the failure occurred on August 13, 2014. The consensus of the industry is that even if the network protector had been inspected the previous day this insulator failure is extremely unlikely to have been found to prevent the failure. Inspections for all of the equipment at this location were completed the week after the event.

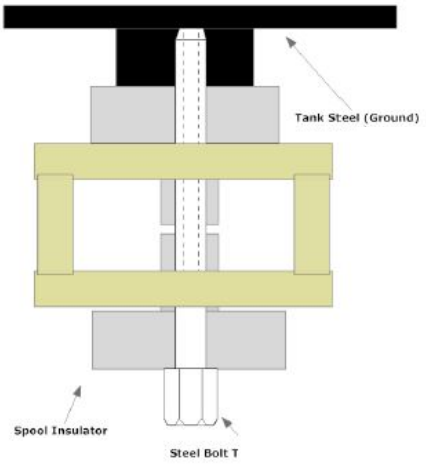
During the review of inspection and maintenance records for this root cause analysis, it was identified that improvements need to be made in the completeness of some of the back office record keeping. There was a lack of paper records for some of the inspections done prior to electronic data collection. Additionally, some of the maintenance work order repairs did not describe the issue found and corrective action during the repair of the equipment. Based on these observations, it is recommended additional processes be implemented to audit inspection and maintenance record completeness to better support future analysis of network performance.

4.6 Network Protector

The network protector that failed was a Westinghouse CM-22, 1,600-amp, 480-volt network protector. It was serial number 43Y5287-6 and was manufactured in 1959-1960. It was installed at the 26 S. Meridian Street vault in 1995 when the vault was rebuilt.

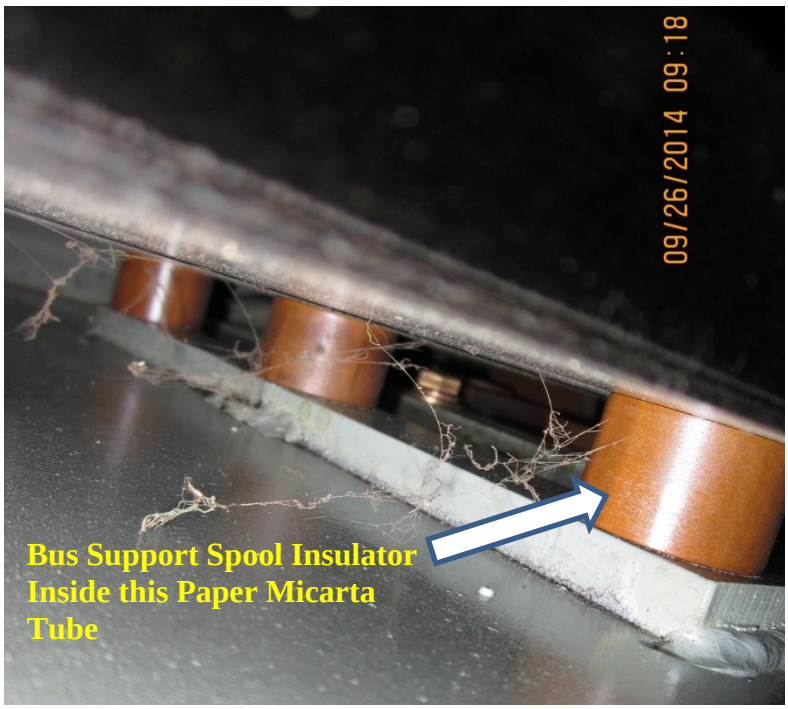
During the post-event investigation it was learned that Westinghouse had changed the design of the transformer bus support insulator in 1985. This change was made because of the possibility of a dielectric breakdown of the spool insulator that was used prior to 1985. The top half of this spool insulator is shown in the picture below. The cross-section picture shows how the copper transformer bus in the network protector would have been supported by the gray spool insulator. IPL has since learned of two other failures in 2014 at other utilities of Westinghouse CM-22 480-volt Network Protectors believed to have been caused by a failure of the gray spool insulator. It is not clear how widespread the knowledge is within the utility industry as to the potential issues with the spool insulator used prior to 1985. A quick survey of other utilities with network systems revealed a few knew about the spool insulator issue, but many others were not aware of it. IPL Engineering and Field Operations personnel were not aware of this issue until this investigation.

Westinghouse Gray Spool Insulator (Top Half)



Cross Section View of Gray Spool Insulator

The UG 661 network protector is also a Westinghouse CM-22 with the serial number of 43Y5287-3. Based on the serial number series it also was manufactured in the 1959-1960 timeframe. The UG 621 and UG 631 network protectors in the 26 S Meridian Street vault are General Electric model MG-8. The General Electric protectors utilize a different transformer copper bus bar design than the Westinghouse protectors. The picture below show the bottom bus support spool insulators in the UG 661 network protector. The bus support insulator is located inside the paper Micarta tube which is shown as the reddish brown supports in the photo.



View of Location of Gray Spool Insulators in UG 661 Network Protector

A review of the IPL Asset Management databases shows that there are 58 Westinghouse 480-volt CM-22 network protectors in-service on the secondary network system manufactured prior to 1985. The location of these network protectors and which network feeders they are on have been determined from these databases.

4.7 Third Party Assistance

The day after the event, IPL engaged the Eaton Corporation to assist with the analysis of the failed network protector. Eaton was not the manufacturer of the network protector that failed. Through a series of acquisitions Eaton does own the intellectual rights and copyrights to the Westinghouse CM-22 network protector design. Eaton's knowledge and expertise in the manufacture of network protectors were thought to be beneficial in the investigation as to what may have happened.

Richard Hotchkiss, Lead Protector Technician in the Network Protector Group for Eaton, came to Indianapolis on Monday August 25, 2014 to inspect the failed network protector and to oversee the disassembly. Mr. Hotchkiss visually inspected the failed network protector and took numerous pictures as the network protector was disassembled by IPL field crews under his direction. Mr. Hotchkiss has supplied IPL with a written report of his findings, and it is attached as Appendix B.

In the report from Eaton, they believe the failure is attributed to a dielectric breakdown of the transformer bus support spool insulator that resulted in an electrical arc to ground most likely on C phase of the transformer bus. This arcing occurred in an area

of the network protector that is defined by IEEE as the unprotected zone[9]. A failure in this area is rare but can result in severe damage to the network protector if it does occur.

IPL has also reached out to other utilities with network systems to find out if they have experienced similar failures. From the utilities that responded, there were only a couple of reported instances of a similar failure. This failure mode does not appear to occur with any frequency and seems to be rare based on the comments IPL received.

4.8 Gardner Lane Capacitor Bank

The first indication of any problems was alarms in the ECS SCADA system indicating that Gardner Lane Breaker UG 650E had tripped. This breaker is a normally closed tie breaker between Transformer #2 and Transformer #3 13.2 kV busses. The other end of the tie is normally open and was open at the time. There is also a 13.2 kV capacitor bank that is fed from this breaker for reactive support of the network. The UG 650E breaker tripped when a failure occurred on one of the capacitor banks. This breaker tripped at 1:25 p.m., which is believed to be the same time the UG 651 network protector failed at 26 S. Meridian Street.

The capacitor bank sustained a failed can on the capacitor bank, and the 4/0 copper leads from the underground cable to the overhead conductor were burned off from fault current. It is believed that a can on the capacitor bank[10] failed from a voltage transient from the initial fault in the network protector at 26 S. Meridian Street. Primary feeder UG 651 and the capacitor bank connected to the UG 650E breaker are on the same 13.2 kV bus section on Transformer #3 at Gardner Lane substation.

Although it is not possible to be completely certain, based on the ECS SCADA data that was available, IPL believes that it is reasonable to assume that the capacitor bank failed at Gardner Lane Substation as a result of the network protector failure at 26 S. Meridian Street and was not the cause of the network protector failure.

5.0 IPL Emergency Response Plan – Network Events

Whenever an event occurs on the downtown network system there has been an un-written procedure that IPL has followed to address the situation and to assure that adequate resources are available to assist with the situation. The TOCC operators have operational control and authority over the downtown network. The Network & Substation Field Operations group handles the construction and maintenance responsibilities for the downtown network. The Major Underground Projects

[9] The unprotected zone is defined as the area between the secondary terminals of the network transformer and the line side of the network protector breaker. A short circuit in this area is hard to detect and must rely on the protective relaying on the primary feeder back at the substation.

[10] Capacitor Bank is a device used to help manage the voltage on the electrical system. A capacitor bank is constructed with multiple cells or "cans" on each phase.

Engineering group handles the engineering and design functions for the downtown network. All of these groups have a role when an event occurs. Others in the Customer Operations leadership also provide support.

The downtown network is monitored by the ECS SCADA system and the Network SCADA system. Both of these SCADA systems provide the operators in the TOCC with real-time information as to the status of the system. When a feeder breaker opens at one of the downtown network substations, an audible alarm goes off in the TOCC control room. There is also a text message that is displayed on the ECS SCADA Alarm screen that tells the operator what the alarm is.

During normal business hours the Team Leader of Network Operations is notified of the alarm and situation and he will assign a field crew to respond. After-hours the TOCC will call the Team Leader of Network Operations at home or his backup if he is not available. The TOCC operator will send out a message through the Everbridge[11] emergency messaging system. This will notify a predefined group of people that an event has occurred on the downtown network.

The Everbridge message is meant to notify the various support people that something has happened and their assistance maybe needed. At this point they will stand by and await further instructions. Many of the support people also have IPL radios and will monitor the radio traffic between the field crews and the TOCC to help assess the situation and what the appropriate response should be.

The Distribution Operations Control Center (DOCC) has a direct phone line to the Marion County 911 Dispatch Center. If the 911 Center gets a report of any kind of event in the downtown that might involve IPL facilities, they will immediately call the DOCC on the direct line. The operators in the DOCC will then call the TOCC and pass the information along. Both the TOCC and the DOCC are staffed 24 hours a day, seven days a week. If it is after normal business hours the DOCC will dispatch a one-person trouble truck to the reported location. The TOCC will pass the information from the 911 Center on to the Team Leader of Network Field Operations.

During normal business hours the Customer Operations Leadership will respond to the TOCC upon receiving the Everbridge notification. The Leadership's role at this point is to handle further notifications so the TOCC operators can concentrate on the event. After assessing the situation the Leadership may notify others such as the Major Underground Projects Engineering group that their assistance is needed. In most cases the Major Underground Projects Engineering group will be dispatched to the scene to provide technical support to the field crews.

[11] Everbridge is the internet based emergency messaging system that IPL uses for various notifications. Users select a predefined message template that also has a predefined recipient distribution list based on the message type. The user can edit the message as appropriate and then send it. The message is setup to send an email, call the recipient's office phone, and call the recipient's cell phone. The message delivery is logged to indicate when and how the recipient confirmed receipt of the message.

The incident is managed by the senior System Coordinator on duty, the Team Leader System Operations, and the Team Leader Network Field Operations. Everyone else is in a support role to these three individuals, answering questions, researching information, and making notifications. The final decision on what action to take rests with the senior System Coordinator.

5.1 Staffing

The staffing required for a network event can vary but the primary groups that are involved are the TOCC operators, the leadership and field resources in the Network Field Operations groups, and the leadership and engineers in the Major Underground Projects Engineering group. Others in the Customer Operations organization provide support, such as the Director, T&D Engineering and the Director, Asset Management.

Having adequate staff resources and a knowledgeable staff is critical to the successful operation of the entire IPL system, including the downtown network system. In 2012 IPL performed a study to look at succession planning for key technical experts, leadership positions, and field resources. The results of that study were used to identify people for the key roles and to prepare development plans for those people to prepare for potential future roles.

The succession planning study helped to identify the number of field technicians needed for the Network Field Operations group. The Company has worked to maintain that number to assure adequate crew resources are available.

An example of how IPL is handling change is the Team Leader of Major Underground Projects Engineering who retired at the end of September 2014. He has played a key role in supporting the restoration efforts for network events. His position is in the process of being filled. Upon the retirement announcement the need for the position to be filled was reviewed and confirmed, the position job description was reviewed for changes and submitted to Human Resources (HR), the job was posted both internally and externally by HR, the candidates were screened by HR and then submitted to the selecting officials for interviews, multiple interviews were conducted, the successful candidate will be selected, and an offer will be made to that candidate. Once in place the successful candidate will receive the necessary training to allow them to fulfill the technical support role during a network event as their predecessor had done. The retiring Team Leader has also been retained as a consultant in order to provide support and maintain his expertise for IPL through the transition period and beyond if needed.

5.2 IPL's August 13, 2014 Response

For the event on August 13, 2014, the TOCC received nearly immediate notification that a serious event was unfolding on the downtown network. Two IPL employees were eyewitnesses to the initial start of the event; the TOCC was notified immediately of the event and its location separately by both employees.

The TOCC notified the Team Leader Network & Substation Operations who was filling in for the Team Leader, Network Field Operations that day. Network Field Operations crews were dispatched to the scene by the Team Leader Network & Substation Operations who also responded. Joe Bentley, Senior VP, Customer Operations responded to the TOCC and his office notified Mike Holtsclaw, Director, T&D Engineering that there was a situation on the network and he responded to the TOCC.

Telephone conversations took place between Jim Sadtler, Director, Transmission Field Operations and Joe Bentley in the TOCC. John Willey, Section Leader, Field Service Support was one of the witnesses and was on the scene talking to the System Coordinator in the TOCC.

Mike Holtsclaw called Rick Leffler, Team Leader, Major Underground Projects Engineering and requested that Rick respond to the scene to provide on-site technical support. Mr. Holtsclaw and Mr. Bentley were both responding to questions from Brandi Davis-Handy, Director of External Communications, who was getting questions from the media as to what was happening.

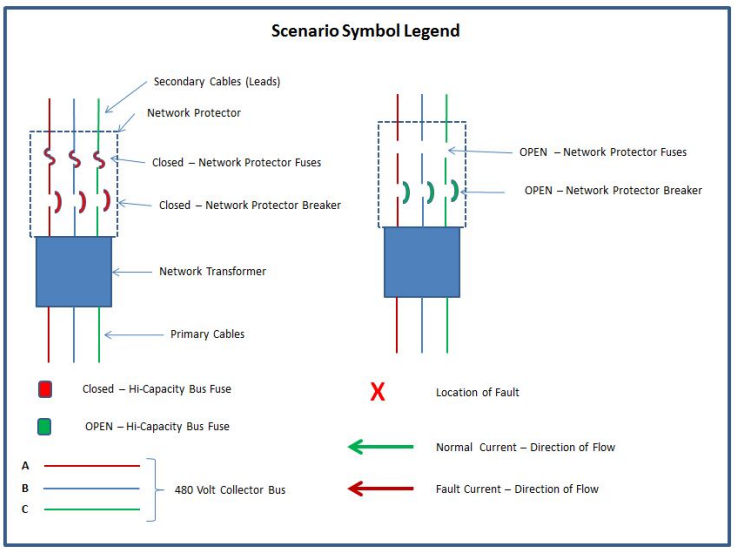
Once on-scene, Rick Leffler handled most of the communications with the IFD Public Information Oficer Rita Reith. Rick was answering questions IFD had about the situation and keeping IFD informed of the possibility that IPL might have to de-energize the Gardner Lane South secondary network. Other engineers from the Major Underground Projects Engineering group also responded to the scene and assisted with technical support.

An Everbridge message was unnecessary for this event because of an almost immediate notification and the rapid response of people to the TOCC. Everbridge messages for downtown events are normally sent to alert designated people of a cable failure or other event occurring on the network.

6.0 Findings

As part of the process to help determine the cause of the failure and what may have happened, a review of the known facts was performed. From that review, two possible scenarios were developed and are described in detail in this section. Scenario 1 was developed based on the investigation by Eaton and the report they submitted to IPL. Scenario 2 was developed based on the known facts and the evidence. Both scenarios are plausible. Because of the severity of the damage, the exact scenario and sequence of events cannot be known for sure cannot be determined with certainty.

The following is the legend that shows the symbols that are used in the figures to help explain each of the scenarios.



Scenario Legend

6.1 Known Facts

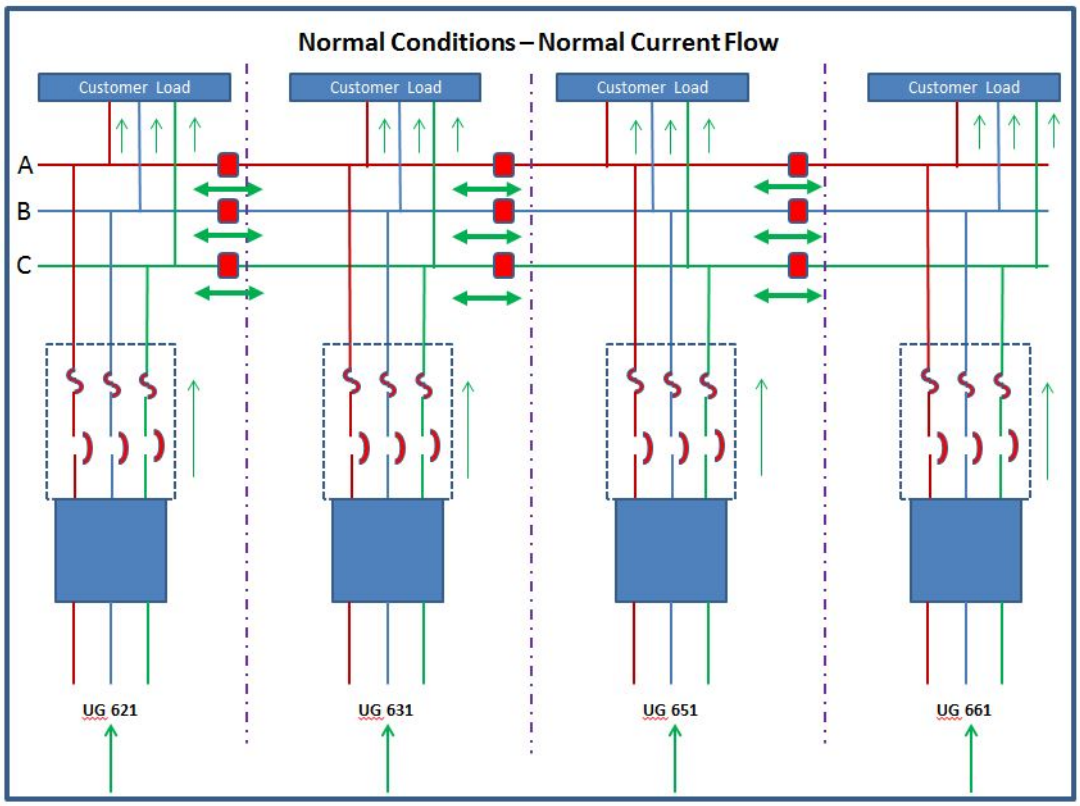
The table below is meant to list the known facts as they have been determined during the investigation.

	Location	Known or Deduced Facts	Additional Information
1	Gardner Lane SCADA	Transformer 1, 2,& 3 – All analog & status data available in the ECS PI Historian. Data is Satellite time stamped.	
2	26 S Meridian SCADA Data	Data available up to 1:03 p.m., after that GV04 goes into telemetry error and data after 1:03 p.m. is not usable for analysis.	
3	Gardner Lane Substation	Capacitor Bank Failure event details	Cutouts Open, stingers burnt off, can failed on capacitor bank
4	26 S Meridian Street vault		Fire Doors found Open either side of the UG 651 bay
			No evidence of fire or smoke damage in any bays other that the UG 651 bay
			3000 Amp bus fuse found open on C Phase between UG 631 and UG 651 bays
5	26 S Meridian – UG 651 network protector	Pattern of internal damage	Copper bus bars melted all 3 phases
			Melted from bottom up
			NWP contacts were clean, indicates protector was open
			NWP Relay & wiring burnt up
			NWP breaker mechanism burnt up
			A & B phase fuse links melted
			C phase fuse link intact
		NWP Internal Housing Damage	Holes in bottom of the housing
			Severe damage to back of housing
			C Phase NWP bushing tilted and fallen into the housing
			A & B phase NWP bushings damaged
			NWP door closed
			Some gasket material still present
		NWP External Housing Damage	C Phase bushing dropped into housing
			Network SCADA Blue Communications wire burnt up
			Smoke but no fire visible above vault grating during the event.
6	6-7 minute gap in 480-volt arcing		Obtain buildings security video
7	Color of Smoke	Smoke was light brown in color	Matches 480-volt arc flash demos, not consistent with an oil fire (nor was any source of oil found – all tanks intact)

	Location	Known or Deduced Facts	Additional Information
8	Loss of Communications	Lost Communications at 1:03 p.m.	Data available prior to that time
9	Public calls to 911	Able to hear loud banging during calls	Have obtained audio from IFD
10	YouTube Videos	Provide visual evidence of the event as it happened	Links included in Appendix C
11	IPL Security Video	Provides visual evidence of the event from 1:33 p.m. until well after the event was over	

6.2 Normal Conditions

Before the a discussion of the two possible event scenarios begins, it may be helpful to understand what the normal condition in the 26 S. Meridian Street vault would have looked like. The picture below depicts how the power would be flowing to the customer loads under normal conditions. Each of the four network transformers would have been supplying approximately an equal amount of power. Power would flow from the network transformer through the network protector and into the collector bus. Customer loads are connected in each of the four transformer bays to the collector bus. Power would be flowing through the collector bus to the customer loads.



Normal Power Flow Under Normal Conditions

6.3 Scenario 1 – Eaton Analysis

The results of the Eaton analysis of the cause of the event on August 13, 2014 at 26 S. Meridian Street was a dielectric breakdown of the transformer bus support spool insulator on C Phase inside the network protector. This resulted in an arc to ground or short circuit in the unprotected zone of the network protector. Fault current for this fault was being supplied primarily through the network transformer connected to Gardner Lane UG 651.

The following describes what is believed to be the sequence of failure that took place during the fault event. The total timeline for the event is 15 minutes. There is approximately a 6-7 minute period in the middle of the event that the arc and smoke settled down and was not as prevalent. This was confirmed by the YouTube videos posted after the event and from the IPL Security video of the event.

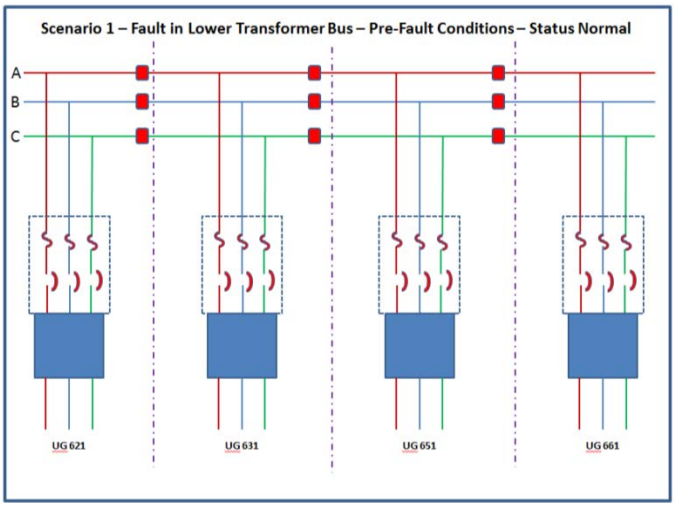


Figure 1

Figure 1 shows the pre-fault event conditions in the vault at 26 S. Meridian Street prior to 1:25 p.m. The network protectors on all four network transformers are believed to have been closed, based on Network SCADA records prior to 1 p.m. The customer load that was being served would have been spread relatively even across the four network transformers.

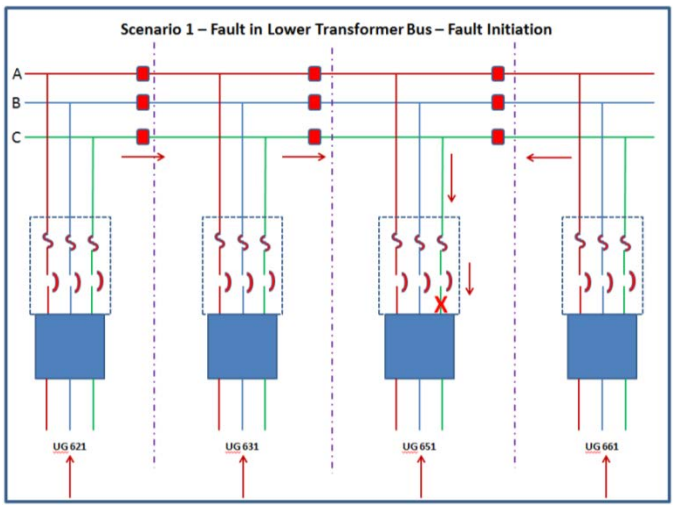


Figure 2

Figure 2 shows the initiation of the event. The current arcs to ground across the bottom bus support spool insulator from C phase bus bar to the grounded case of the network protector. This results in fault current flowing to that point from the low voltage side of the network transformer from Gardner Lane UG 651 and from the 480-volt collector bus being fed from the Gardner Lane UG 621, UG 631 and UG 661 network transformers. The red arrows in Figure 2 show the direction the fault current was flowing. At this point there is momentarily reverse current flow through the UG 651 network protector back towards the primary side of the network transformer. The initial 480-volt fault caused the first loud bangs that would have been heard at street level, and smoke would have been observed coming from the vault.

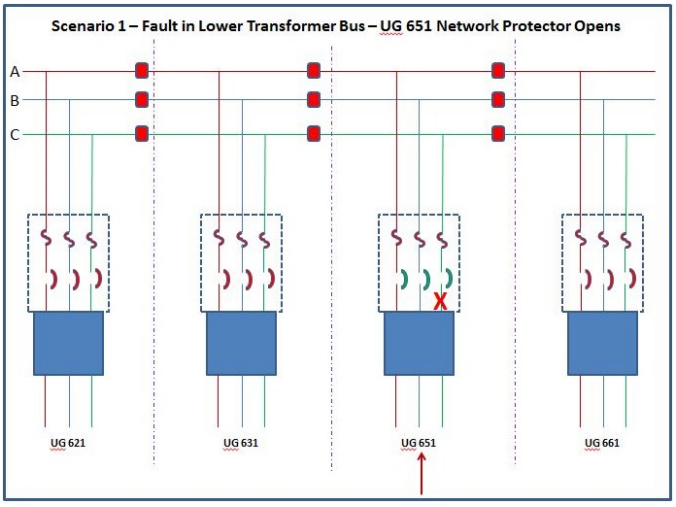


Figure 3

Figure 3 shows that the UG 651 network protector opens on the reverse current flow. The fault current is now being supplied only by the UG 651 Primary feeder through the network transformer. When the UG 651 network protector opened, all fault current flowing from the 480-volt collector bus would have ceased. The arcing to

ground at the C Phase spool insulator would have continued from the transformer source.

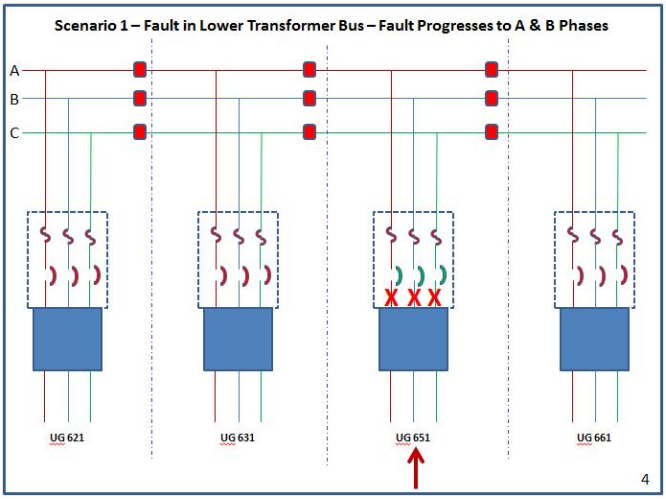


Figure 4

Figure 4 shows that the C Phase fault now spreads and involves A and B phases. The failure event is still contained to the transformer side of the network protector, and all fault current is still being supplied only by the UG 651 Primary feeder. The loud bangs heard at street level would continue and heavy smoke would have been seen coming from the vault.

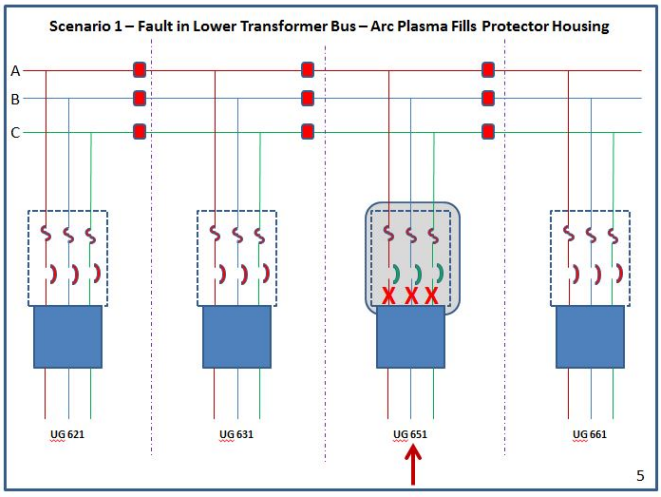


Figure 5

Figure 5 shows that the arc plasma, which occurs in high-energy failures, and other gases created during the arcing fault now fills the network protector housing. The arc plasma is highly conductive. The loud bangs heard at street level would continue, and heavy smoke would have been seen coming from the vault.

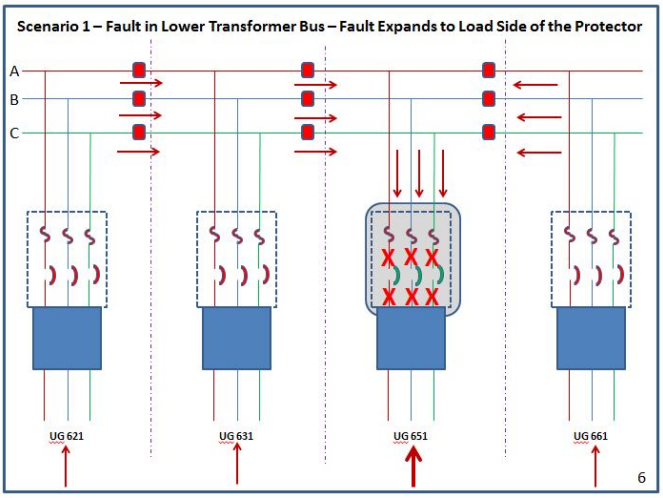


Figure 6

Figure 6 shows that the load side of the network protector flashes over in the arc plasma, and the fault now fills the network protector housing. Fault current now flows from the 480-volt collector bus into the multiple faults inside the UG 651 network protector. Fault current is being supplied by all four Network Primary feeders, with a larger percentage still being supplied by UG 651 as confirmed by ECS SCADA data. During this time, heavy smoke would be seen coming from the vault and numerous loud bangs would be heard from the 480-volt arcs to ground that were occurring inside the UG 651 network protector. The loud bangs heard at street level would continue and heavy smoke would have been seen coming from the vault.

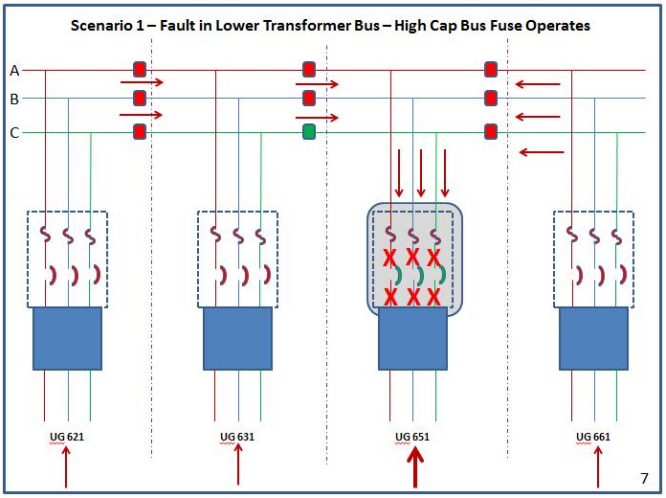


Figure 7

Figure 7 shows the 3,000 amp High Capacity Bus fuse between the Middle South and Middle North vault bays operates and opens due to the fault current flowing through it. That removes the fault current source for C Phase from the UG 621 and UG 631 units. Those units continue to supply fault current on A and B Phases. It is believed because of the nature of the arcing fault, these fuses did not operate. The UG 661 unit

continues to supply fault current on all three phases to the faults in the UG 651 network protector. The loud bangs heard at street level would continue and heavy smoke would have been seen coming from the vault.

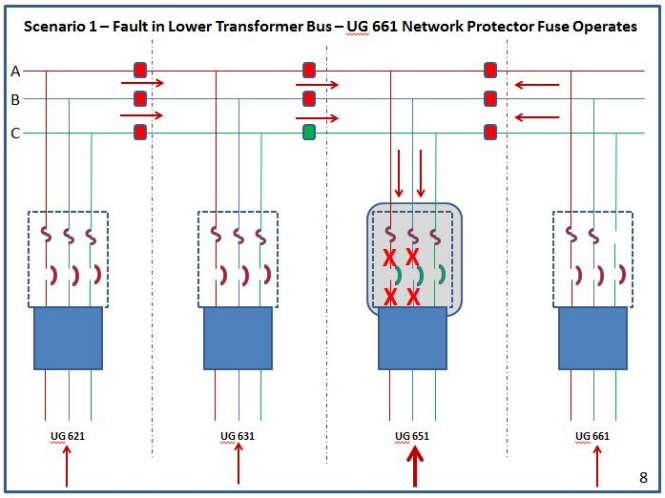


Figure 8

Figure 8 shows that the network protector C phase fuse in the UG 661 network protector opens due to the fault current that has been flowing through it. Fault current now ceases to flow into C phase of the UG 651 network protector. It is believed this is the time that the smoke and banging sounds die down as is seen in the various videos of the event. The timeline is approximately 5 minutes into the event. This period will last for approximately 6 to 7 minutes.

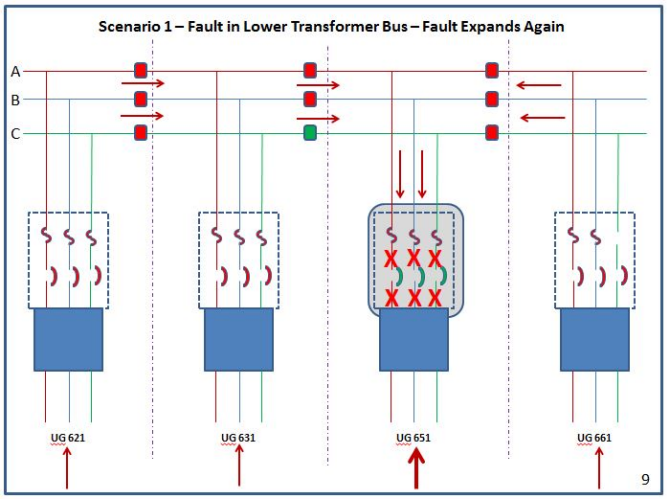


Figure 9

Figure 9 shows that the fault inside the UG 651 network protector begins to expand again and the smoke and banging sounds would have increased significantly. The arcing at this point has consumed the network protector breaker element and the controls. The copper transformer bus is being consumed and is melting towards the

low voltage terminals of the network transformer. Numerous arcs to ground are occurring resulting in loud bangs being heard at street level again along with a considerable amount of smoke.

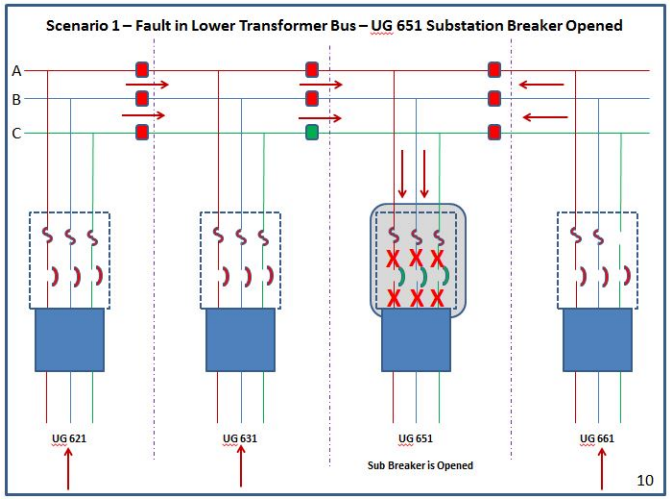


Figure 10

Figure 10 shows the point where the Gardner Lane UG 651 Primary feeder breaker is opened by the operator in the TOCC. Operators in the TOCC had been analyzing and discussing how to best isolate the 26 S. Meridian Street vault from the network. As they looked at the ECS PI historian data for the four Gardner Lane feeders they observed there was higher and more erratic current flow on the UG 651 feeder than on the other three feeders. The decision was made to open the Gardner Lane UG 651 Feeder Breaker by ECS SCADA control to see if that would de-escalate the situation in the field. If it didn't, then operators were prepared to drop all five primary feeders in the Gardner Lane South secondary network. At 1:40 p.m. the operator in the TOCC opened the UG 651 Primary feeder breaker by SCADA control. The immediate report from the scene was that the banging had nearly stopped and the smoke immediately was lessening.

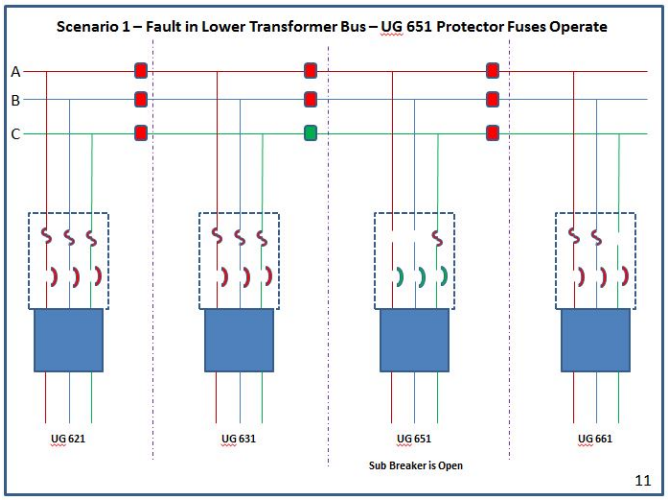


Figure11

Figure 11 shows that the network protector fuses on A and B phase of the UG 651 network protector have opened. It is believed that they opened immediately following the opening of the UG 651 feeder Breaker at Gardner Lane substation. It appears that the primary current on UG 621 and UG 631 dropped back to normal level at the same time the UG 651 feeder breaker was opened. This would indicate that UG 621 and UG 631 were still supplying fault current into the UG 651network protector fault through the 480-volt collector bus up to the point in time the UG 651 feeder breaker was opened. The network protector fuses in the UG 651 network protector would have been severely compromised at this point from the fault current that had been flowing and from the high heat in the network protector. The event is over at this point. The event lasted approximately 15 minutes from start to finish.

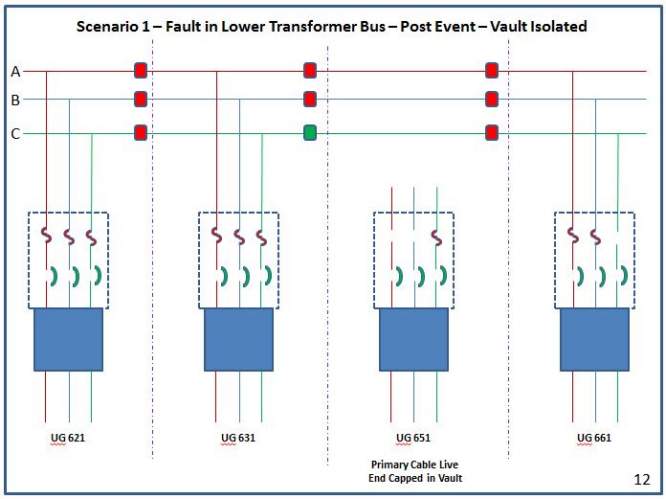


Figure 12

Figure 12 shows the final steps that were taken to isolate the 26 S. Meridian Street vault from the network to allow IPL field crews to safely perform work in the vault and begin inspecting the damage. Prior to entering the vault, the customers served by

the vault were asked to shut their loads down and open their main service disconnect to isolate their loads from the vault. That was accomplished at 4:20 p.m. Field crews entered the vault at 4:30 p.m. and manually opened the network protectors on UG 621, UG 631, and UG 661.

During this time the network protector leads on the UG 651 network protector were removed, and the UG 651 Primary cable was cut and live end capped. This electrically isolated the UG 651 transformer and network protector from the network system. At 6:42 p.m. the 480-volt collector bus was energized, restoring it to service, and was verified to have good voltage. This was done by putting the UG 661 network protector in automatic mode and then closing the UG 661 feeder breaker at Gardner Lane substation. The UG 661 network protector automatically closed when the UG 661 network transformer was energized. At 6:50 p.m. the customers were notified they could begin restoring their loads. At 8 p.m. the customers all reported their loads were restored and everything was now normal.

6.4 Scenario 2 – Possible Alternate Cause

A review of the data does suggest a possible alternate scenario that is plausible. Under this scenario the fault still initiated inside the UG 651 network protector. The initial fault would have been the result of a failure of the secondary terminal bushing connected to C Phase. This failure could have been the result of a cracked bushing or a failure in the area of the connection of the bushing to the network protector fuse. There would have been an arc to ground as the initial event, only it starts at the top of the network protector instead of the bottom. The following describes step by step what could have happened under this scenario.

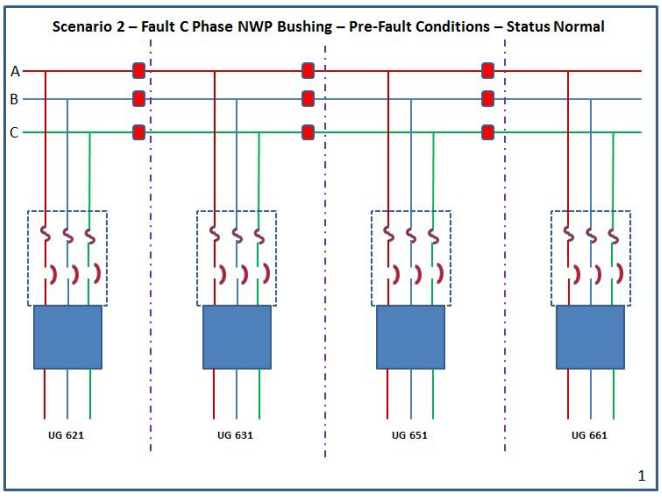


Figure 13

Figure 13 shows the pre-fault event conditions in the vault at 26 S. Meridian Street prior to 1:25 p.m. These are the same conditions described in Scenario 1. The network protectors on all four network transformers are believed to have been closed, based on

Network SCADA records prior to 1 p.m. The customer load that was being served would have been spread relatively even across the four network transformers.

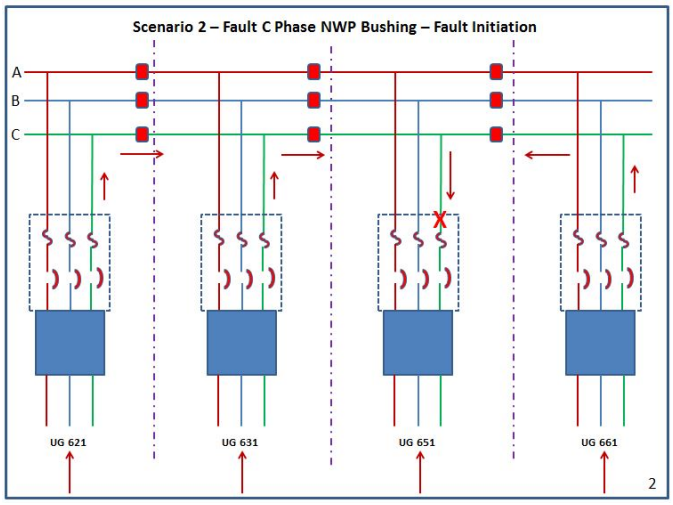


Figure 14

Figure 14 shows the initiation of the event. A failure occurs with the C phase bushing on the UG 651 network protector. There is a current arc to ground inside the network protector. Fault current flows from the 480-volt collector bus to the fault at the C phase bushing in the UG 651 network protector. The fault current is being fed from Gardner Lane network feeders UG 621, UG 631, UG 651, and UG 661. The initial loud bangs and the first smoke would have been heard and seen coming from the vault. The time is believed to have been 1:25 p.m. EDT.

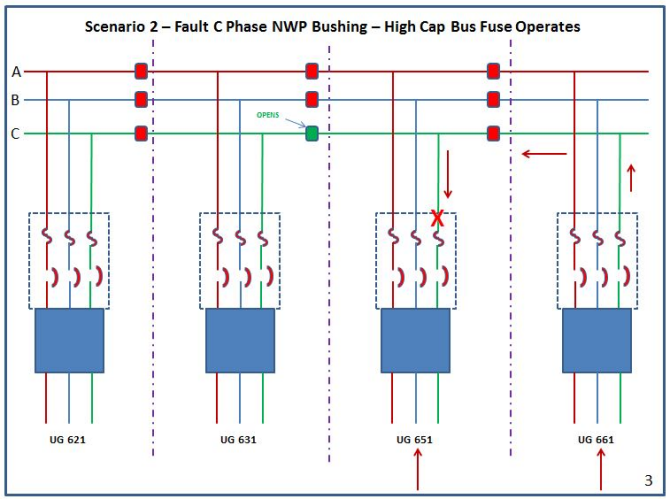


Figure 15

Figure 15 shows that the C Phase 3,000 amp High Capacity fuse between the Middle South and Middle North vault bays opens due to the fault current flowing through it. That removes the fault current source for C Phase from the UG 621 and UG 631 network transformers. The UG 661 network transformer continues to supply fault

current to the C Phase fault in the UG 651 network protector. While this fault is occurring, liquid metal and other by-products are falling to the bottom of the UG 651 network protector. The load banging heard at street level would continue and heavy smoke would have been seen coming from the vault.

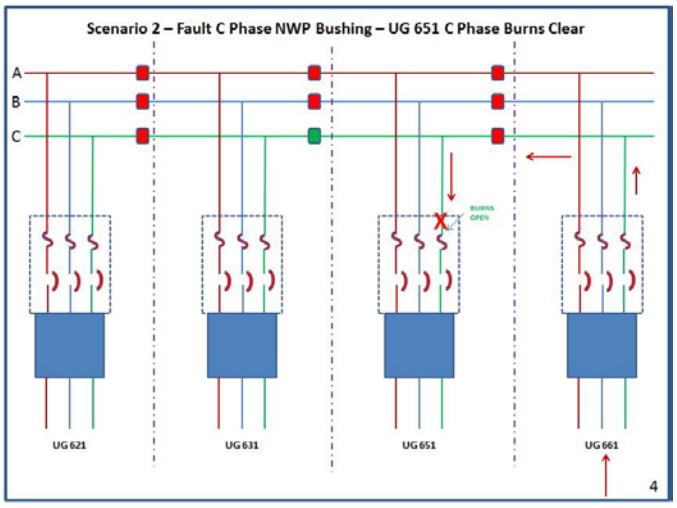


Figure 16

Figure 16 shows that the bottom side of the C phase network protector bushing burns in the clear above the UG 651 C phase network protector fuse. The bushing continues to arc to the case of the network protector from fault current momentarily being supplied by the UG 661 network transformer.

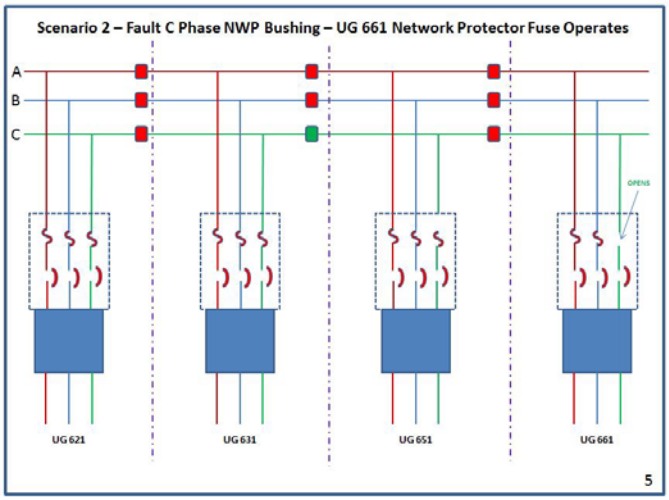


Figure 17

Figure 17 shows that the C Phase UG 661 network protector fuse opens from the fault current flowing through it. C Phase of the 480-volt collector bus is now de-energized in the UG 651 and UG 661 bays. All fault current from the 480-volt collector bus momentarily ceases. The loss of C Phase resulted in a partial interruption of service to customers with services connected to these two bays because only two of the three

phases were still energized. Molten metal and other by-products have collected at the bottom of the UG 651 network protector around the spool insulator on C Phase. Loud bangs continue to be heard at street level and smoke can be seen coming through the vault grating.

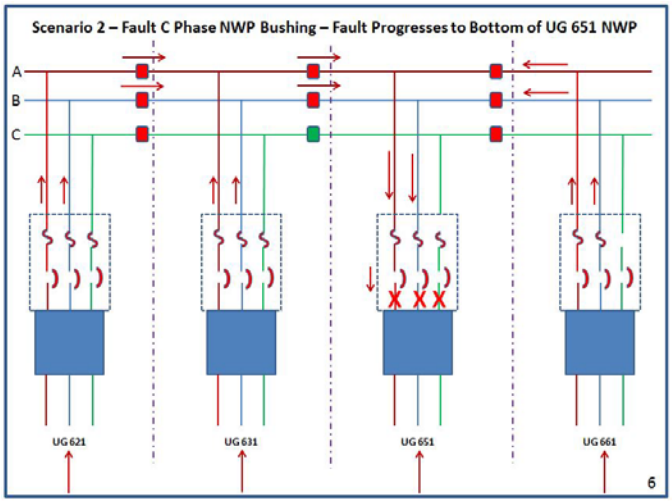


Figure 18

Figure 18 shows that enough material has built up in the bottom of the UG 651 network protector and C phase arcs to ground and then spreads to B Phase and then to A Phase. This occurs in a matter of cycles. There is fault current being supplied on A and B Phases from the 480-volt collector bus and from all three phases from the UG 651 network transformer. The banging sounds would now increase in intensity and the smoke would get heavier.

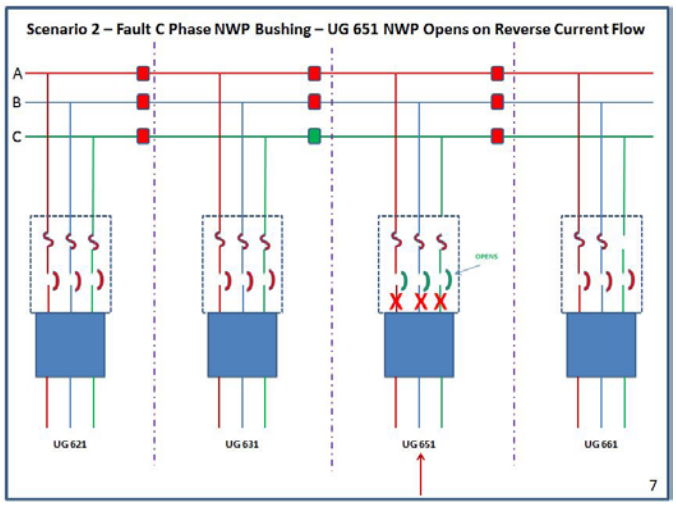


Figure 19

Figure 19 shows that the UG 651 network protector has opened from the reverse current flow on A and B phases from the fault shown above in Figure 18. All fault current is again being supplied only by the UG 651 network transformer. Fault current

from the 480-volt collector bus momentarily ceases. The banging sounds would decrease in intensity and the smoke would lighten up slightly.

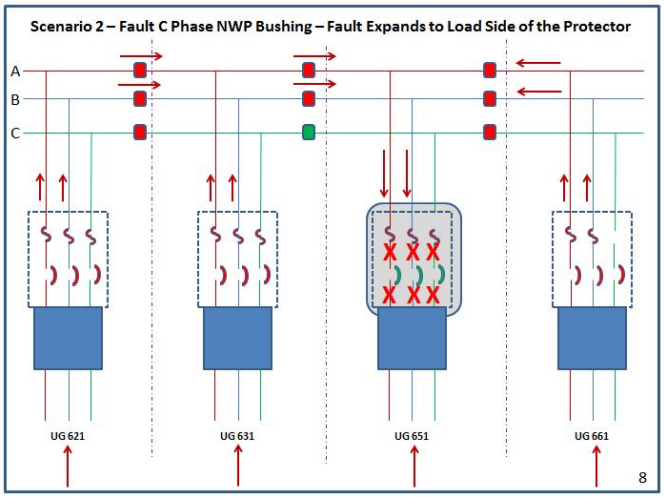


Figure 20

Figure 20 shows that the arc plasma, which occurs in high-energy failures, and other gases created during the arcing fault now fills the network protector housing. The arc plasma is highly conductive. The 480-volt bus inside the network protector flashes over on the load side of the open network protector breaker. Fault current again flows from the 480-volt collector bus on A and B phases from the UG 621, UG 631, and UG 661 network transformers. Fault current continues to flow from the UG 651 network transformer. The loud bangs heard at street level would continue, and heavy smoke would have been seen coming from the vault.

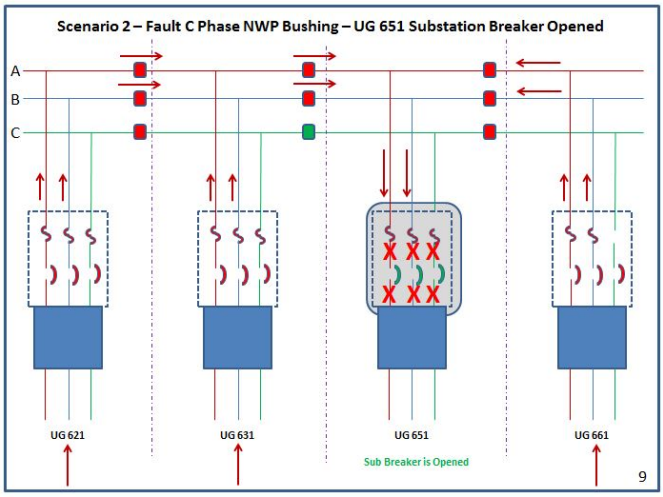


Figure 21

Figure 21 shows the point where the Gardner Lane UG 651 Primary feeder breaker is opened by the operator in the TOCC. Operators in the TOCC had been analyzing and discussing how to best isolate the 26 S. Meridian Street vault from the network. As

they looked at the ECS PI historian data for the four Gardner Lane feeders they observed there was higher and more erratic current flow on the UG 651 feeder than on the other three feeders. The decision was made to open the Gardner Lane UG 651 Feeder Breaker by ECS SCADA control to see if that would de-escalate the situation in the field. If it didn't, then operators were prepared to drop all five primary feeders in the Gardner Lane South secondary network. At 1:40 p.m. the operator in the TOCC opened the UG 651 Primary feeder breaker by SCADA control. The immediate report from the scene was that the banging had nearly stopped and the smoke was lessening.

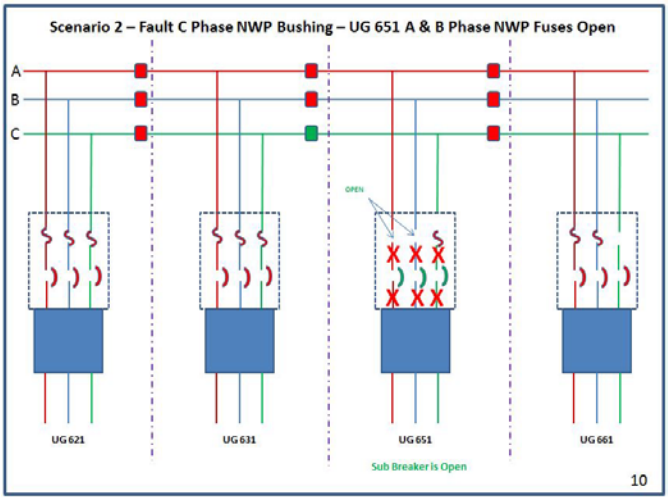


Figure 22

Figure 22 shows that the A and B phase network protector fuses in the UG 651 network protector have opened. This would have occurred within a few seconds of the Transmission operator opening the Gardner Lane UG 651 breaker shown above in Figure 20. The banging sounds would have stopped and the smoke would have immediately decreased. The field personnel did report a few additional bangs after the UG 651 breaker was opened at the substation. Given that the 480-volt collector bus is still energized on A and B phase up to top side of the damaged UG 651 network protector, some arcing could still have occurred just inside the UG 651 network protector.

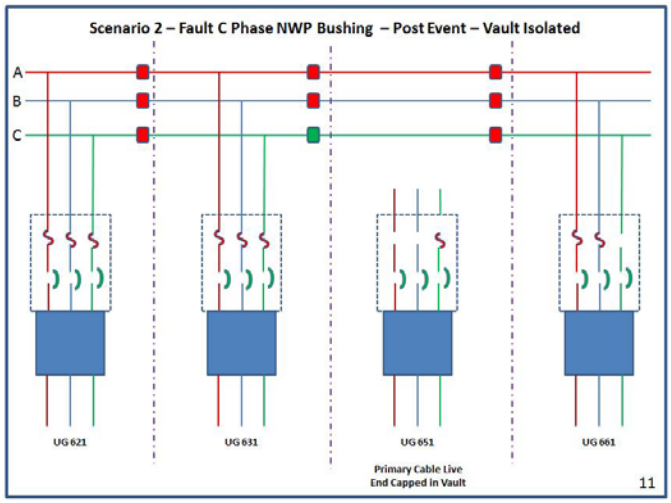


Figure 23

Figure 23 is the same as Figure 12 in Scenario 1 which shows the final steps that were taken to isolate the 26 S. Meriden Street vault from the network to allow IPL field crews to safely perform work in the vault and begin inspecting the damage. Prior to entering the vault, the customers served by the vault were asked to shut their loads down and open their main service disconnect to isolate their loads from the vault. That was accomplished at 4:20 p.m. Field crews entered the vault at 4:30 p.m. and manually opened the network protectors on UG 621, UG 631, and UG 661.

During this time the network protector leads on the UG 651 network protector were removed, and the UG 651 Primary cable was cut and live end capped. This electrically isolated the UG 651 transformer and network protector from the network system. At 6:42 p.m. the 480-volt collector bus was energized, restoring it to service, and was verified to have good voltage. At 6:50 p.m. the customers were notified they could begin restoring their loads. At 8 p.m. the customers all reported their loads were restored and everything was now normal.

6.5 Implications

The event that occurred on August 13, 2014 at 26 S. Meridian Street was a significant network event. IPL Operators were within minutes of making the decision to de-energize the entire Gardner Lane South Secondary Network area to control the event at 26 S. Meridian Street. However, this was not necessary because opening the Gardner Lane UG 651 feeder breaker stopped the arcing. This would have cut power to a large area of downtown Indianapolis. The area would have been from Washington Street to South Street and from Pennsylvania Street to West Street. Had opening the Gardner Lane UG 651 feeder breaker not stopped the arcing at 26 S. Meridian, the next step was to de-energize the entire Gardner Lane South Secondary Network.

The UG 651 network transformer was another concern for those responding to the event. Because they knew the UG 651 was providing high levels of fault current, they also knew that the transformer windings and dielectric fluid would have been getting very hot. There was concern about a gasket failure on the low voltage bushing that could result in the mineral oil dielectric fluid leaking and catching fire. The gaskets held, and the post-event inspections did not show any signs of leaking the dielectric fluid from the main tank of the transformer. The decision to open the UG 651 feeder breaker helped to prevent a further escalation of the event.

7.0 Arc Flash Mitigation Program

In 2011 IPL began studies to determine how best to comply with the new arc flash rules in the National Electric Safety Code 2012 code revision which the State of Indiana has not adopted as of this report. The results of the studies showed that an arc flash event in a 480-volt spot network vault would result in incident energy levels that were too high to protect a worker from injury. No level of Personal Protection Equipment (PPE) would protect a worker from an event of this type.

A team of managers, engineers, safety professionals, and network field operations personnel was assembled and charged with providing a recommendation of how to comply with the new rules once they were implemented. The team studied all of the work procedures that took place in the vaults and how that work was performed. From that, numerous options were considered, with the goal of finding a solution that would allow the work to be done safely with the vault energized and not have to take long, extended customer outages to do routine work. In late 2013 the team's final recommendation to senior management was to replace all 137 of the 480-volt network protectors with a new style that would afford IPL workers a safer working environment while allowing work to be performed with the vault energized without requiring customer outages. The new style protector had the ability to reduce the incident energy levels down to a point the workers could wear their standard 8 calorie/square centimeter PPE clothing and be provided safe working conditions in an energized 480-volt spot network vault.

In February 2014 the planning for a $15 million capital project began to replace all 137 480-volt network protectors over a five-year period. The plan is to replace approximately thirty 480-volt network protectors a year with the change-outs being completed by the end of 2018. The initial order for the new network protectors was placed in May 2014 and IPL took delivery of the first of the new network protectors took place at the end of August 2014. Training of IPL field crews on the new protector started in September 2014 and the first network protectors will be replaced starting in the 4th quarter of 2014.

8.0 Conclusions and Recommendations

8.1 Root Cause

The root cause of the failure of the UG 651 network protector at 26 S. Meridian Street is believed to be a dielectric breakdown of the transformer bus support spool insulator inside the UG 651 network protector.

8.2 Recommendations

The following recommendations are intended to address and mitigate the cause and implications of the network protector failure that occurred on August 13, 2014 at 26 S. Meridian Street.

1. Continue with the program to replace all 480-volt network protectors as part of the Arc Flash Mitigation Program. Verify the location of all 58 pre-1985 Westinghouse CM-22 network protectors and prioritize them in the replacement program. These pre-1985 CM-22 network protectors will be prioritized along with the network protectors identified with aluminum bus and those protectors identified as having issues with toluene out gassing. These priorities come from commitments made in IPL's 2012 response to the Independent Assessment of Indianapolis Power & Light's Underground Downtown Network, dated December 13, 2011. This recommendation will address the potential gray spool insulator problem identified in this investigation. Change-out of the network protectors would also address any concerns with the bushings discussed in the alternative scenario. These network protectors will be prioritized along with the network protector identified with aluminum bus and those protectors identified as having issues with toluene outgassing.

2. Develop a formal written Network Event Response Plan. This plan should include identifying the key personnel, ,and in what order, they should be notified, and the type of messages and how that message should be sent out. It should establish an incident command structure for handling the event and identify the on-scene IPL incident commander. Conduct a tabletop drill of the plan when completed.

3. Schedule a meeting with the Indianapolis Fire Department and review the response for a network event. This should include equipment staging, criteria for securing the scene, actions prior to IPL's arrival on scene, and coordination with IPL. *[This meeting took place on September 10, 2014 with Assistant IFD Chief Kevin Bacon and IFD Public Information Officer Rita Reith, one of the primary take-away from this meeting was for IPL to designate a single person for IFD to communicate with at the scene of a network incident.]*

4. Develop a mitigation strategy that would limit the severity and consequences of a network transformer failure or network protector failure, such as the one that occurred on August 13th. The mitigation strategy should consider changes to the protective relay settings on the underground primary feeders, ways to enhance the protection of the "unprotected zone" in the network protector, and the strategy could include retro-filling the main tank of selected network transformers with FR3[12] insulating fluid. This would reduce the fire risk in the event of a secondary transformer bushing failure or a tank rupture. All new network transformers are being purchased with FR3 insulating fluid in the main tank, along with the termination chamber and the switch compartment. This recommendation should be coordinated with Recommendation 7 as to which one would be more effective.

5. Conduct a review of all Gateway Vault circuits for communications stability and frequency of telemetry errors. Review the routing of Blue Network SCADA communications cable in the vaults. Determine if there is a way to provide increased fire protection during an event.

6. Enhance the network protector inspection process to ensure attention to the issues cited in this report. The enhanced inspection process should include a visual inspection of the bottom area around the transformer bus in the network protector for debris or evidence of tracking on the bus support insulators and visual inspection of the network protector bushing for signs of cracks or tracking. An example of this enhanced inspection process was the inspection of the bottom bus support insulators on the UG 661 network protector at 26 S. Meridian Street vault and 44 N Senate Avenue vaults and obtaining pictures of this area. *[The inspections at 44 N. Senate Avenue and UG 661 at 26 S. Meridian Street were completed on September 24th and 26th respectively.]*

7. To ensure no critical loss of talent during the near future and beyond, continue to monitor, update, and implement the Company's succession plan for key staff responsible for network operations and emergency response. This includes control room staff, first responders, engineering support, and those responsible for public and customer communications.

8. Continue commitment to participate in industry forums and conferences where other companies that operate secondary network system also participate. These

[12] FR3 is a natural ester insulating fluid that has a high flashpoint above 310 degrees C. It is basically a vegetable oil product. This helps to reduce the risk of fire in electrical equipment. It is used as the insulating fluid in transformers and is compatible with mineral oil so it can be used as a retro fill product for transformers previously filled with mineral oil.

meetings are key to information sharing between companies and suppliers on new equipment and designs as well as issues others have experienced. This commitment includes adequate annual budgeting for travel and memberships.

9. Take steps to improve the state of inspection and maintenance records by implementing periodic auditing to improve the retrieval and completeness of inspection and maintenance records so as to better support future root cause analysis of network equipment failures..

8.3 Action Plan

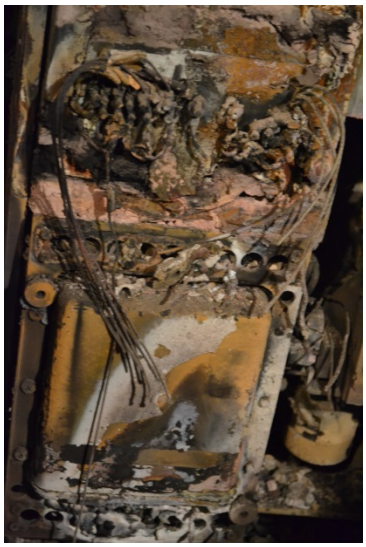
Recommendation	Resp. Party	Completion Date	Comments
1	Engineering Engineering	October 2014 (Start Change outs) Identify Pre-1985 CM-22 NWP 9/15/2014	Continue change outs thru the 4th Qtr 2018 Complete
2	Dir. T&D Engineering & Dir. Trans. Operations	1st Qtr 2015	
3	Dir. T&D Engr.	9/10/2014	Complete
4	Engineering	1st Qtr 2015	
5	Engineering	1st Qtr 2015	
6	Asset Management	11/1/2015	
7	Customer Ops Leaders	June 1st	Annually
8	Customer Ops Leaders	June 1st	Annually
9	Asset Management	1st Qtr 2015	

APPENDIX INDEX

Appendix A – Pictures of Failed UG 651 Network Protector

UG 651 network protector outside of the housing with the door closed post event

UG 651 network protector with the door open before any material is disturbed



UG 651 network protector control relay and control wiring damage

UG 651 network protector breaker mechanism

Holes burnt in the bottom the network protector housing. This is where the bus support spool insulators would have been mounted

Transformer bus work damage and holes melted in the rear of the network protector housing. The holes in the remaining copper bus are where the mounting bolts for the upper bus support spool insulators would have been.

Appendix B – Eaton Failure Analysis Report

Eaton Corporation
1520 Emerald Road
Greenwood, SC. 29646
tel: 864-330-2470

August 29, 2014

To: Michael Holtsclaw

Subject: Inspection of 1600A, 460V, CM-22 Built in 1959
Location: 26 S. Meridian St Indianapolis, IN

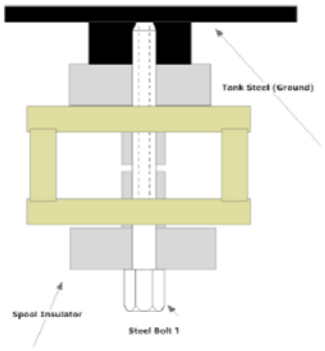
Inspection Date: August 25, 2014 by Richard Hotchkiss, Eaton.

The Protector in this case was damaged due to a strike to ground caused by failure of an obsoleted Westinghouse dielectric spool insulator design used in a CM-22 Network Protector. This design was replaced in the early 1980s due to the propensity of failure to ground accelerated by age. A failure in this area defined as the unprotected zone (IEEE C57.12.44-2000 Annex D) is destructive in nature leading to a complete burn down of the Network Protector. While this type of failure is rare, this is a typical point of failure for protectors with the spool type insulators.

Unprotected Zone Definition:

- Unprotected Zone in Network Transformer and Protector - From LV terminals of Network Transformer to fuses in NWP. A fault in this area would **NOT** be cleared by the phase or ground over current relays from the substation and the master relay of the Network Protector may not operate.

The figure below shows a top view of a section detail of area of concern. This design has been replaced by isolated standoff insulator design.



- Grey Spool was used on flat bus bar (small amperes), Square tube bus (shown- large amperes)
- Steel Bolt threads into tapped welded block on tank wall
- One Piece shown above, two combined have compressed gap
- Steel conductive bolt thru thin wall insulation
- In service Meggar testing, not possible without disconnecting transformer.

Photograph of ½ of the section of thru-spool design.

Failed Unit Findings:

Signs were apparent that several Arc Flash strikes initiating from the Transformer Bus to Tank or the Mounting Bolts of the Transformer Bus had occurred.

Each Arc Flash event from the Transformer Bus would enter the tank and find a path through the mounting bolts of the Breaker and Flash to the Breaker Bus that resulted in a Phase to Ground Arc on each phase.

There were several signs that confirm this theory:

- All six mounting bolts that hold the transformer bus in place were completely burnt off.
- The bottom left mounting bolt for the Breaker was completely burnt off plus 90% of the mounting boss was gone in the tank as was 50% of the bottom right mounting boss.
- The hinge and mechanism casting showed severe damage due to Arc Flash.
- All the moving contacts had been destroyed as was 80% of the transformer bus.
- All the mounting hardware for the breaker bus and mech had been destroyed due to arcing.
- Two recent Failure History of spool design in 2014.

It appears that breaker was open. The contacts were in the open state as found.

The heat at the top of the tank was above 327 degrees above Celsius because the lead that bonds the porcelain insulator to the mounting brackets had melted allowing the weight of the cables to push the porcelain insulator down, causing C phase fuse to bend and possibly aiding A and B phase fuses to blow.
Molten metal and extreme heat destroyed the internal barriers, arc chutes, control wiring, aux switches and relays.
The rear portion of the tank was melting away as fast as the transformer bus was melting.
In short every part of the unprotected zone of this protector was damaged.

On a side note, the damage could have been much worse if not for the fact the Protector door was sealed.

Please see attached pictures below of the transformer bus, tank and protector.

Regards,

Richard Hotchkiss

Appendix C – YouTube Video Links

2014 08 13 – Indianapolis – (View from the southeast corner of Meridian & Washington)
John Willey arrives at 1:34 into the video clip IFD not on-site
https://www.youtube.com/watch?v=kqNKwIyg0vc

2014 08 13 – Indianapolis – (View from in front of Hard Rock) IFD, John Willey, & Network Crew on-site
https://www.youtube.com/watch?v=CKO9G6-8zEo

2014 08 13 – Indianapolis – (View from the northeast corner of Meridian & Maryland)
https://www.youtube.com/watch?v=4LGWa_ySyKk

2014 08 13 – Indianapolis (Channel 6 news report)
https://www.youtube.com/watch?v=3h4PFHEuPpw

2014 08 13 – Indianapolis (Channel 8 news report)
https://www.youtube.com/watch?v=l3VF5LM37N4

2013 02 28 PG&E test facility in San Ramon 480-volt Arc
Note the brown smoke and noise
https://www.youtube.com/watch?v=DFw8t7tG1Y0

2011 07 31 PG&E test facility in San Ramon 480-volt Arc Linemen training
Note the brown smoke and noise
https://www.youtube.com/watch?v=Go6ckOylKdo

2010 09 28 – Westex Ultrasoft 40 cal-HRC- Arc Flash Suit on Ladder
Note the brown smoke and noise
https://www.youtube.com/watch?v=16OtKJKF1B4

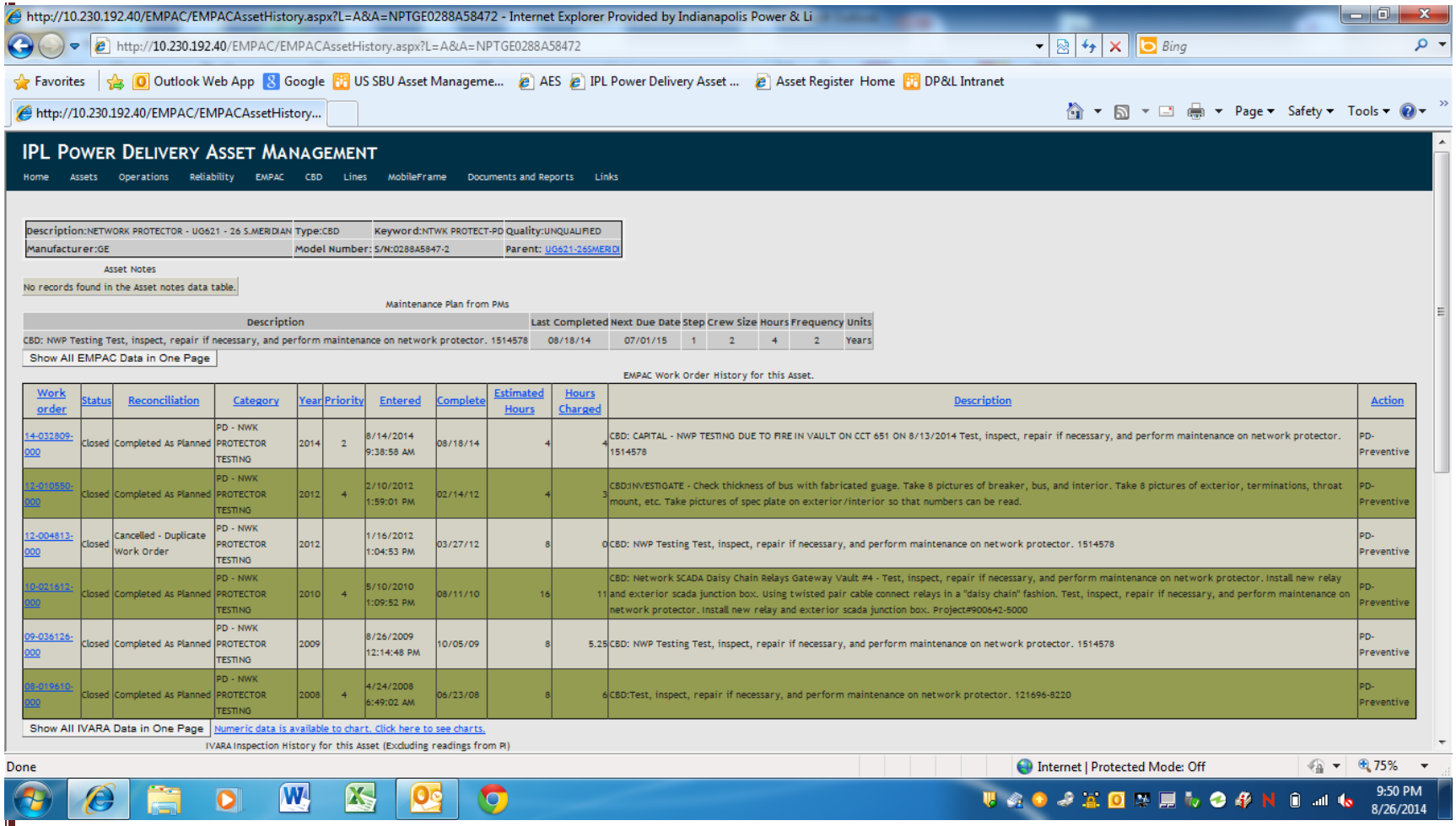
2008 11 08 – Columbus, Ohio Network Transformer Fire
Note the blue flame (oil burning)
1:33 to 3:00, 3:35 to 4:20, 4:50 to 5:20, 6:10 to 6:20, & 7:20 8:00 into the clip – it appears that a 480-volt flash occurred (sound and smoke)
http://www.youtube.com/watch?v=0_jLmAB3leA&list=PLiSsmhPOs15qpxFs_HgGj95zmIKqbsvHV&index=7

2006 11 06 – Lab Test – 480-volt # Phase Arc flash Demo
https://www.youtube.com/watch?v=-iClXrd50Z8

Appendix D – Inspection and Maintenance Records

Screen Shot of Vault Inspection Data for UG 621 Bay at 26 S. Meridian Street

The UG 621 network protector underwent a scheduled inspection in 2008 and 2009. In 2010 the new Network SCADA relay was installed and the protector went through another inspection. It was inspected in 2012 to see if it had aluminum bus work. It was found to have copper bus work. It was inspected in 2014 the week after the event in the UG 651 bay.


http://10.230.192.40/EMPAC/EMPACAssetHistory.aspx?L=A&A=NPTGE0288A58472 - Internet Explorer Provided by Indianapolis Power & Li
http://10.230.192.40/EMPAC/EMPACAssetHistory.aspx?L=A&A=NPTGE0288A58472
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Asset Register Home
DP&L Intranet
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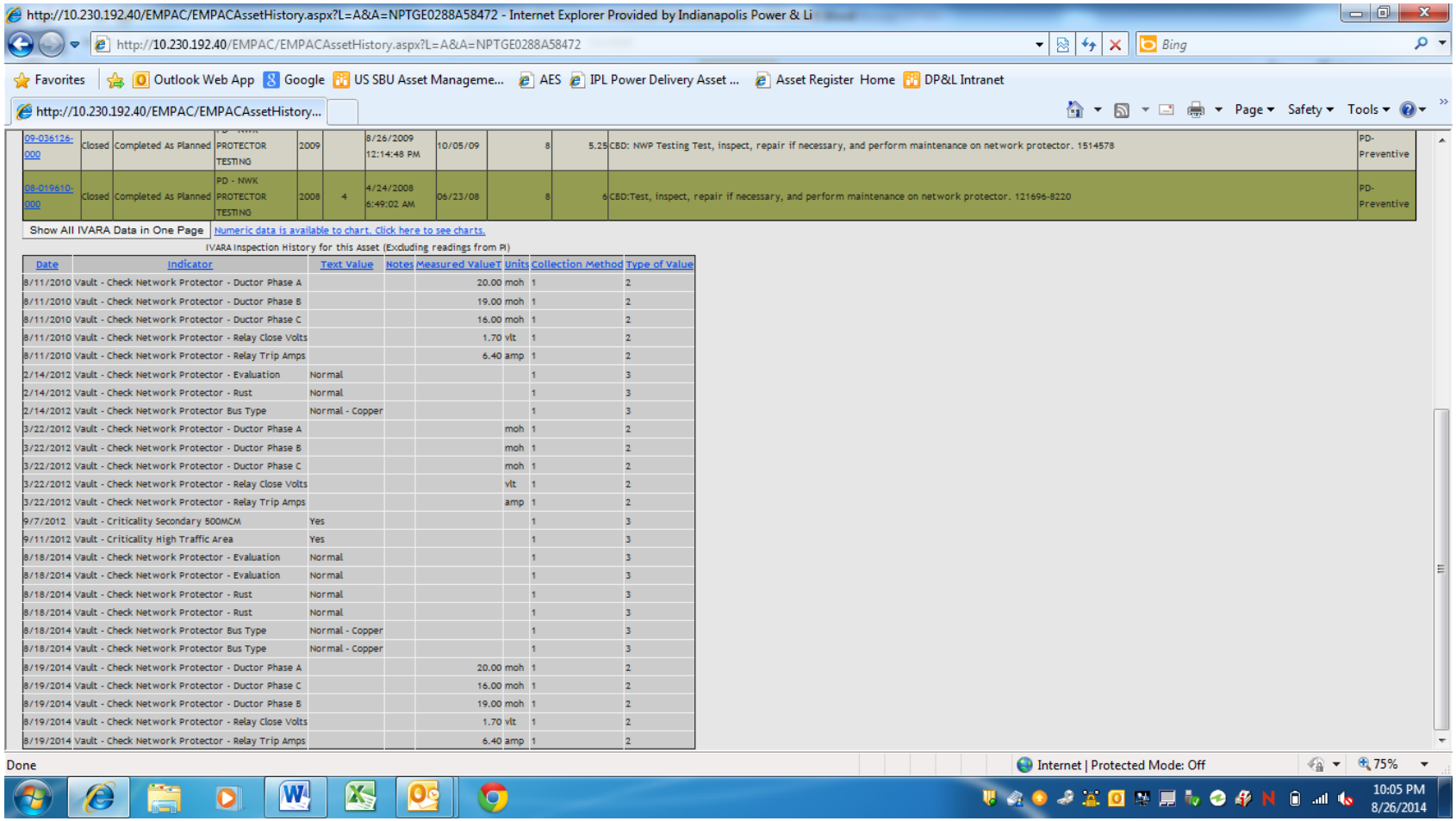
Page
Safety
Tools
IPL Power Delivery Asset Management
Home
Assets
Operations
Reliability
EMPAC
CBD
Lines
MobileFrame
Documents and Reports
Links
Description:NETWORK PROTECTOR - UG621 - 26 S.MERIDIAN
Type:CBD
Keyword:NTWK PROTECT-PD
Quality:UNQUALIFIED
Manufacturer:GE
Model Number:
S/N:0288A5847-2
Parent: UG621-26SMERIDI
Asset Notes
No records found in the Asset notes data table.
Maintenance Plan from PMs
Description
Last Completed
Next Due Date
Step
Crew Size
Hours
Frequency
Units
CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578
08/18/14
07/01/15
1
2
4
2
Years
Show All EMPAC Data in One Page
EMPAC Work Order History for this Asset.
Work order
Status
Reconciliation
Category
Year
Priority
Entered
Complete
Estimated Hours
Hours Charged
Description
Action
14-032809-000
Closed
Completed As Planned
PD - NWK PROTECTOR TESTING
2014
2
8/14/2014 9:38:58 AM
08/18/14
4
4
CBD: CAPITAL - NWP TESTING DUE TO FIRE IN VAULT ON CCT 651 ON 8/13/2014 Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578
PD-Preventive
12-010550-000
Closed
Completed As Planned
PD - NWK PROTECTOR TESTING
2012
4
2/10/2012 1:59:01 PM
02/14/12
4
3
CBD:INVESTIGATE - Check thickness of bus with fabricated guage. Take 8 pictures of breaker, bus, and interior. Take 8 pictures of exterior, terminations, throat mount, etc. Take pictures of spec plate on exterior/interior so that numbers can be read.
PD-Preventive
12-004813-000
Closed
Cancelled - Duplicate Work Order
PD - NWK PROTECTOR TESTING
2012
1/16/2012 1:04:53 PM
03/27/12
8
0
CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578
PD-Preventive
10-031612-000
Closed
Completed As Planned
PD - NWK PROTECTOR TESTING
2010
4
5/10/2010 1:09:52 PM
08/11/10
16
11
CBD: Network SCADA Daisy Chain Relays Gateway Vault #4 - Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Using twisted pair cable connect relays in a "daisy chain" fashion. Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Project#900642-5000
PD-Preventive
09-036126-000
Closed
Completed As Planned
PD - NWK PROTECTOR TESTING
2009
8/26/2009 12:14:48 PM
10/05/09
8
5.25
CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578
PD-Preventive
08-019610-000
Closed
Completed As Planned
PD - NWK PROTECTOR TESTING
2008
4
4/24/2008 6:49:02 AM
06/23/08
8
6
CBD:Test, inspect, repair if necessary, and perform maintenance on network protector. 121696-8220
PD-Preventive
Show All IVARA Data in One Page
Numeric data is available to chart. Click here to see charts.
IVARA Inspection History for this Asset (Excluding readings from PI)
Done
Internet | Protected Mode: Off
75%
9:50 PM
8/26/2014



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http://10.230.192.40/EMPAC/EMPACAssetHistory...

Page | Safety | Tools

09-036126-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2009		8/26/2009 12:14:48 PM	10/05/09	8	5.25	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
08-019610-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2008	4	4/24/2008 6:49:02 AM	06/23/08	8	6	CBD:Test, inspect, repair if necessary, and perform maintenance on network protector. 121696-8220	PD-Preventive

Show All IVARA Data in One Page | Numeric data is available to chart. Click here to see charts.

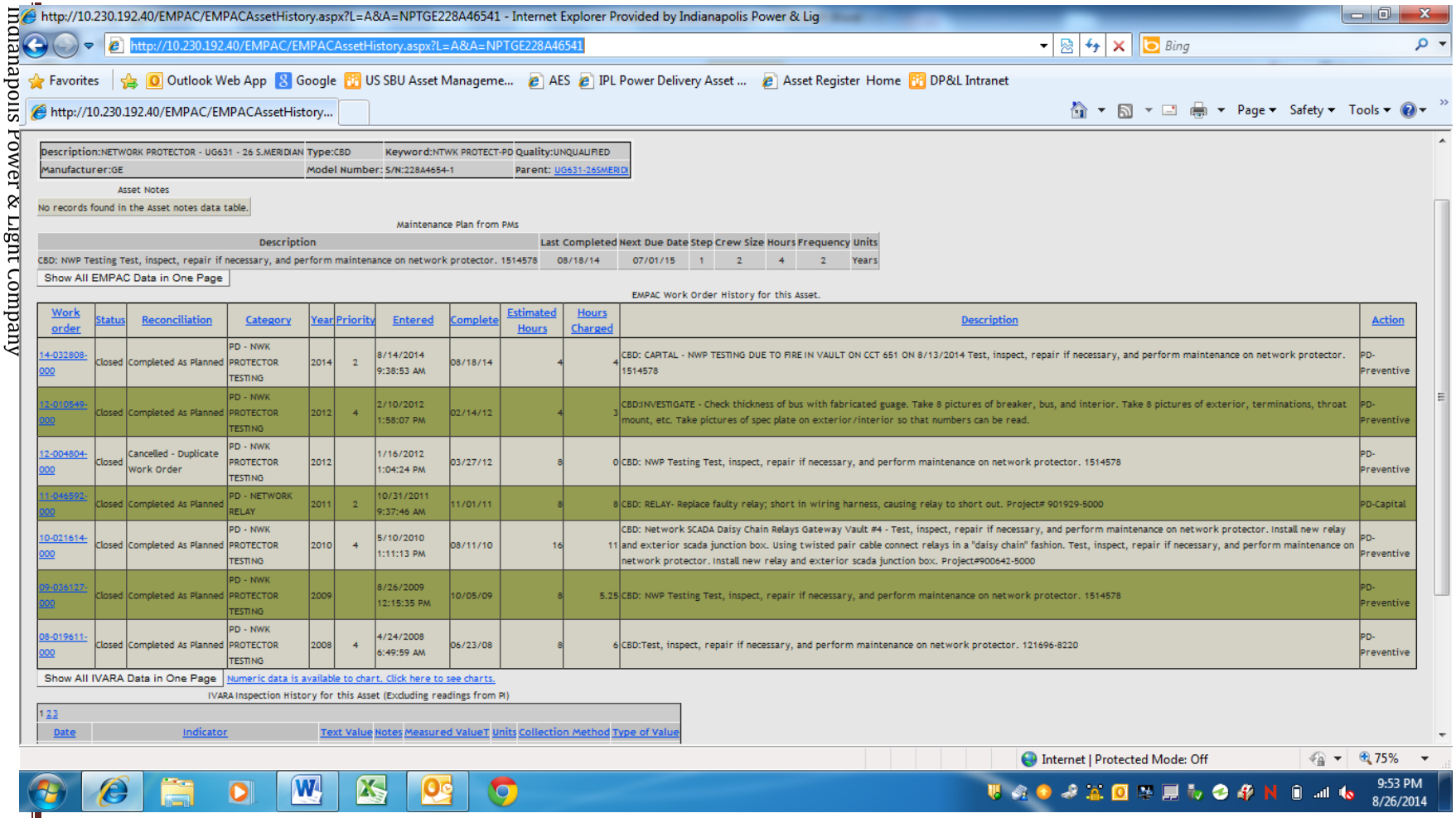
IVARA Inspection History for this Asset (Excluding readings from PI)

Date	Indicator	Text Value	Notes	Measured ValueT	Units	Collection Method	Type of Value
8/11/2010	Vault - Check Network Protector - Ductor Phase A			20.00	moh	1	2
8/11/2010	Vault - Check Network Protector - Ductor Phase B			19.00	moh	1	2
8/11/2010	Vault - Check Network Protector - Ductor Phase C			16.00	moh	1	2
8/11/2010	Vault - Check Network Protector - Relay Close Volts			1.70	vlt	1	2
8/11/2010	Vault - Check Network Protector - Relay Trip Amps			6.40	amp	1	2
2/14/2012	Vault - Check Network Protector - Evaluation	Normal				1	3
2/14/2012	Vault - Check Network Protector - Rust	Normal				1	3
2/14/2012	Vault - Check Network Protector Bus Type	Normal - Copper				1	3
3/22/2012	Vault - Check Network Protector - Ductor Phase A				moh	1	2
3/22/2012	Vault - Check Network Protector - Ductor Phase B				moh	1	2
3/22/2012	Vault - Check Network Protector - Ductor Phase C				moh	1	2
3/22/2012	Vault - Check Network Protector - Relay Close Volts				vlt	1	2
3/22/2012	Vault - Check Network Protector - Relay Trip Amps				amp	1	2
9/7/2012	Vault - Criticality Secondary 500MCM	Yes				1	3
9/11/2012	Vault - Criticality High Traffic Area	Yes				1	3
8/18/2014	Vault - Check Network Protector - Evaluation	Normal				1	3
8/18/2014	Vault - Check Network Protector - Evaluation	Normal				1	3
8/18/2014	Vault - Check Network Protector - Rust	Normal				1	3
8/18/2014	Vault - Check Network Protector - Rust	Normal				1	3
8/18/2014	Vault - Check Network Protector Bus Type	Normal - Copper				1	3
8/18/2014	Vault - Check Network Protector Bus Type	Normal - Copper				1	3
8/19/2014	Vault - Check Network Protector - Ductor Phase A			20.00	moh	1	2
8/19/2014	Vault - Check Network Protector - Ductor Phase C			16.00	moh	1	2
8/19/2014	Vault - Check Network Protector - Ductor Phase B			19.00	moh	1	2
8/19/2014	Vault - Check Network Protector - Relay Close Volts			1.70	vlt	1	2
8/19/2014	Vault - Check Network Protector - Relay Trip Amps			6.40	amp	1	2

Done | Internet | Protected Mode: Off | 75% | 10:05 PM 8/26/2014

Screen Shot of Vault Inspection Data for UG 631 Bay at 26 S. Meridian Street

The UG 631 network protector underwent a scheduled inspection in 2008 and 2009. In 2010 the new Network SCADA relay was installed and the protector went through another inspection. In 2011 the network relay was replaced and repairs were made to the wiring harness. It was inspected in 2012 to see if it had aluminum bus work. It was found to have copper bus work. It was inspected in 2014 the week after the event in the UG 651 bay.



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Description:NETWORK PROTECTOR - UG631 - 26 S.MERIDIAN	Type:CBD	Keyword:NTWK PROTECT-PD	Quality:UNQUALIFIED
Manufacturer:GE	Model Number:	S/N:228A4654-1	Parent: UG631-26SMERID

Asset Notes

No records found in the Asset notes data table.

Maintenance Plan from PMs

Description	Last Completed	Next Due Date	Step	Crew Size	Hours	Frequency	Units
CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	08/18/14	07/01/15	1	2	4	2	Years

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EMPAC Work Order History for this Asset.

Work order	Status	Reconciliation	Category	Year	Priority	Entered	Complete	Estimated Hours	Hours Charged	Description	Action
14-032808-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2014	2	8/14/2014 9:38:53 AM	08/18/14	4	4	CBD: CAPITAL - NWP TESTING DUE TO FIRE IN VAULT ON CCT 651 ON 8/13/2014 Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
12-010549-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2012	4	2/10/2012 1:58:07 PM	02/14/12	4	3	CBD:INVESTIGATE - Check thickness of bus with fabricated guage. Take 8 pictures of breaker, bus, and interior. Take 8 pictures of exterior, terminations, throat mount, etc. Take pictures of spec plate on exterior/interior so that numbers can be read.	PD-Preventive
12-004804-000	Closed	Cancelled - Duplicate Work Order	PD - NWK PROTECTOR TESTING	2012		1/16/2012 1:04:24 PM	03/27/12	8	0	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
11-046592-000	Closed	Completed As Planned	PD - NETWORK RELAY	2011	2	10/31/2011 9:37:46 AM	11/01/11	8	8	CBD: RELAY- Replace faulty relay; short in wiring harness, causing relay to short out. Project# 901929-5000	PD-Capital
10-021614-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2010	4	5/10/2010 1:11:13 PM	08/11/10	16	11	CBD: Network SCADA Daisy Chain Relays Gateway Vault #4 - Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Using twisted pair cable connect relays in a "daisy chain" fashion. Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Project#900642-5000	PD-Preventive
09-036127-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2009		8/26/2009 12:15:35 PM	10/05/09	8	5.25	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
08-019611-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2008	4	4/24/2008 6:49:59 AM	06/23/08	8	6	CBD:Test, inspect, repair if necessary, and perform maintenance on network protector. 121696-8220	PD-Preventive

Show All IVARA Data in One Page | Numeric data is available to chart. Click here to see charts.

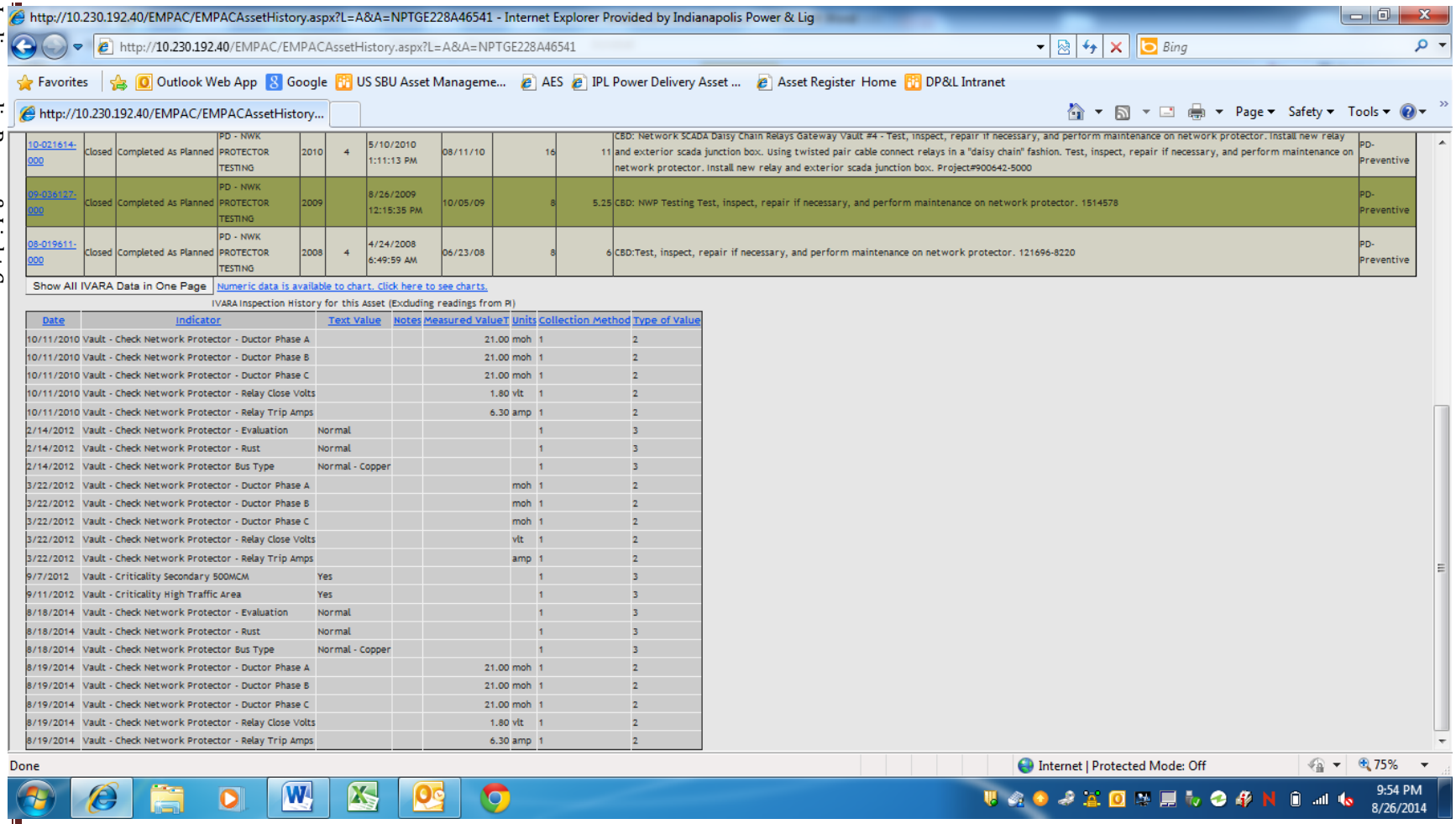
IVARA Inspection History for this Asset (Excluding readings from PI)

1 2 3

Date	Indicator	Text Value	Notes	Measured ValueT	Units	Collection Method	Type of Value

Internet | Protected Mode: Off | 75%

9:53 PM 8/26/2014



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http://10.230.192.40/EMPAC/EMPACAssetHistory.aspx?L=A&A=NPTGE228A46541

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http://10.230.192.40/EMPAC/EMPACAssetHistory...

10-021614-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2010	4	5/10/2010 1:11:13 PM	08/11/10	16	11	CBD: Network SCADA Daisy Chain Relays Gateway Vault #4 - Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Using twisted pair cable connect relays in a "daisy chain" fashion. Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Project#900642-5000	PD-Preventive
09-036127-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2009		8/26/2009 12:15:35 PM	10/05/09	8	5.25	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
08-019611-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2008	4	4/24/2008 6:49:59 AM	06/23/08	8	6	CBD:Test, inspect, repair if necessary, and perform maintenance on network protector. 121696-8220	PD-Preventive

Show All IVARA Data in One Page | Numeric data is available to chart. Click here to see charts.

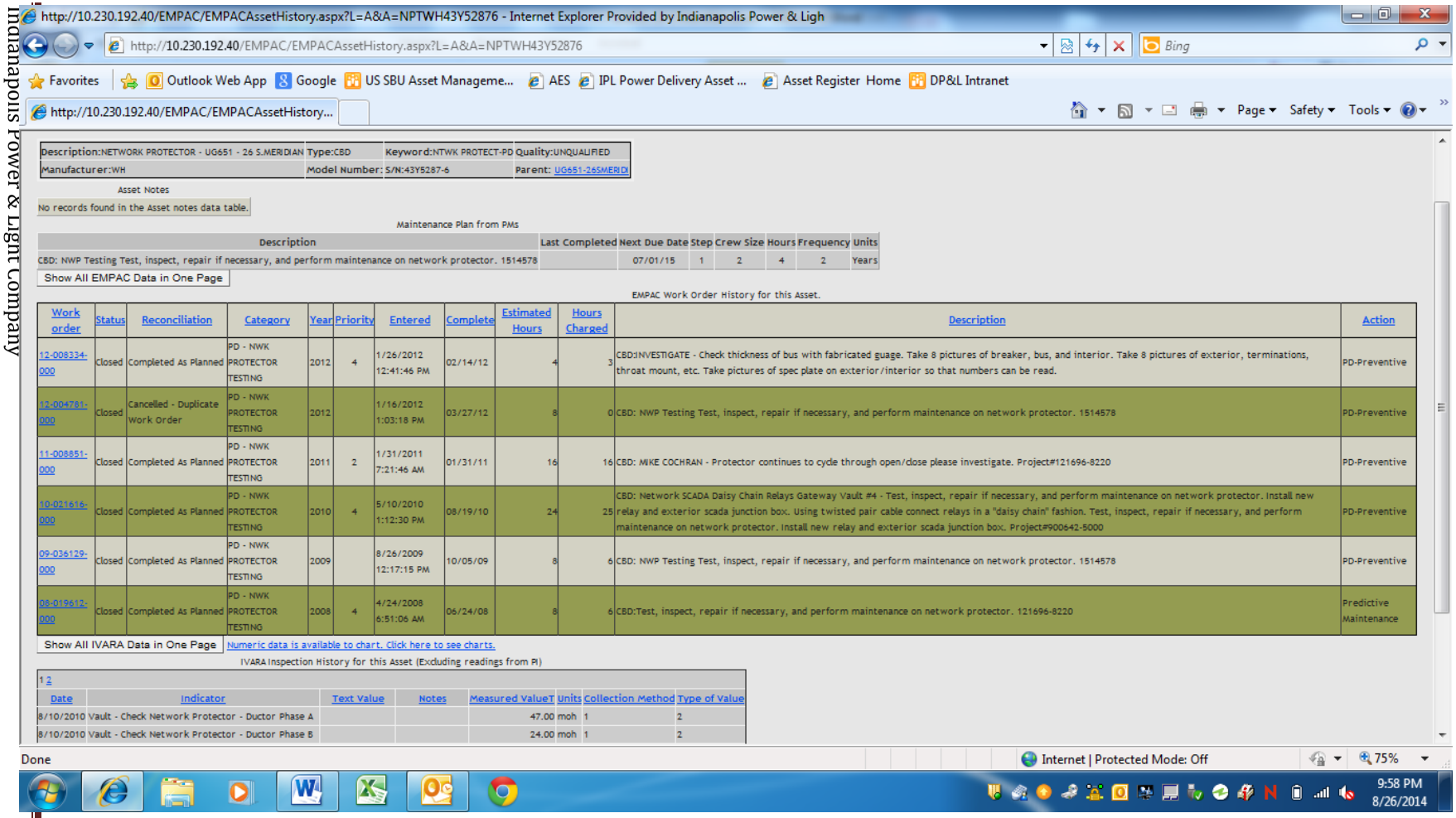
IVARA Inspection History for this Asset (Excluding readings from PI)

Date	Indicator	Text Value	Notes	Measured Value	Units	Collection Method	Type of Value
10/11/2010	Vault - Check Network Protector - Ductor Phase A			21.00	moh	1	2
10/11/2010	Vault - Check Network Protector - Ductor Phase B			21.00	moh	1	2
10/11/2010	Vault - Check Network Protector - Ductor Phase C			21.00	moh	1	2
10/11/2010	Vault - Check Network Protector - Relay Close Volts			1.80	vlt	1	2
10/11/2010	Vault - Check Network Protector - Relay Trip Amps			6.30	amp	1	2
2/14/2012	Vault - Check Network Protector - Evaluation	Normal				1	3
2/14/2012	Vault - Check Network Protector - Rust	Normal				1	3
2/14/2012	Vault - Check Network Protector Bus Type	Normal - Copper				1	3
3/22/2012	Vault - Check Network Protector - Ductor Phase A				moh	1	2
3/22/2012	Vault - Check Network Protector - Ductor Phase B				moh	1	2
3/22/2012	Vault - Check Network Protector - Ductor Phase C				moh	1	2
3/22/2012	Vault - Check Network Protector - Relay Close Volts				vlt	1	2
3/22/2012	Vault - Check Network Protector - Relay Trip Amps				amp	1	2
9/7/2012	Vault - Criticality Secondary 500MCM	Yes				1	3
9/11/2012	Vault - Criticality High Traffic Area	Yes				1	3
8/18/2014	Vault - Check Network Protector - Evaluation	Normal				1	3
8/18/2014	Vault - Check Network Protector - Rust	Normal				1	3
8/18/2014	Vault - Check Network Protector Bus Type	Normal - Copper				1	3
8/19/2014	Vault - Check Network Protector - Ductor Phase A			21.00	moh	1	2
8/19/2014	Vault - Check Network Protector - Ductor Phase B			21.00	moh	1	2
8/19/2014	Vault - Check Network Protector - Ductor Phase C			21.00	moh	1	2
8/19/2014	Vault - Check Network Protector - Relay Close Volts			1.80	vlt	1	2
8/19/2014	Vault - Check Network Protector - Relay Trip Amps			6.30	amp	1	2

Done | Internet | Protected Mode: Off | 75% | 9:54 PM 8/26/2014

Screen Shot of Vault Inspection Data for UG 651 Bay at 26 S. Meridian Street

The UG 651 network protector underwent a scheduled inspection in 2008 and 2009. In 2010 the new Network SCADA relay was installed and the protector went through another inspection. It required maintenance in 2011 because it was cycling open and closed and was repaired. It was inspected in 2012 to see if it had aluminum bus work. It was found to have copper bus work.



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Description:NETWORK PROTECTOR - UG651 - 26 S.MERIDIAN	Type:CBD	Keyword:NTWK PROTECT-PD	Quality:UNQUALIFIED
Manufacturer:WH	Model Number:	S/N:43Y5287-6	Parent: UG651-26SMERID

Asset Notes

No records found in the Asset notes data table.

Maintenance Plan from PMs

Description	Last Completed	Next Due Date	Step	Crew Size	Hours	Frequency	Units
CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578		07/01/15	1	2	4	2	Years

Show All EMPAC Data in One Page

EMPAC Work Order History for this Asset.

Work order	Status	Reconciliation	Category	Year	Priority	Entered	Complete	Estimated Hours	Hours Charged	Description	Action
12-008334-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2012	4	1/26/2012 12:41:46 PM	02/14/12	4	3	CBD:INVESTIGATE - Check thickness of bus with fabricated guage. Take 8 pictures of breaker, bus, and interior. Take 8 pictures of exterior, terminations, throat mount, etc. Take pictures of spec plate on exterior/interior so that numbers can be read.	PD-Preventive
12-004781-000	Closed	Cancelled - Duplicate Work Order	PD - NWK PROTECTOR TESTING	2012		1/16/2012 1:03:18 PM	03/27/12	8	0	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
11-008851-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2011	2	1/31/2011 7:21:46 AM	01/31/11	16	16	CBD: MIKE COCHRAN - Protector continues to cycle through open/close please investigate. Project#121696-8220	PD-Preventive
10-021616-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2010	4	5/10/2010 1:12:30 PM	08/19/10	24	25	CBD: Network SCADA Daisy Chain Relays Gateway Vault #4 - Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Using twisted pair cable connect relays in a "daisy chain" fashion. Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Project#900642-5000	PD-Preventive
09-036129-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2009		8/26/2009 12:17:15 PM	10/05/09	8	6	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
08-019612-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2008	4	4/24/2008 6:51:06 AM	06/24/08	8	6	CBD:Test, inspect, repair if necessary, and perform maintenance on network protector. 121696-8220	Predictive Maintenance

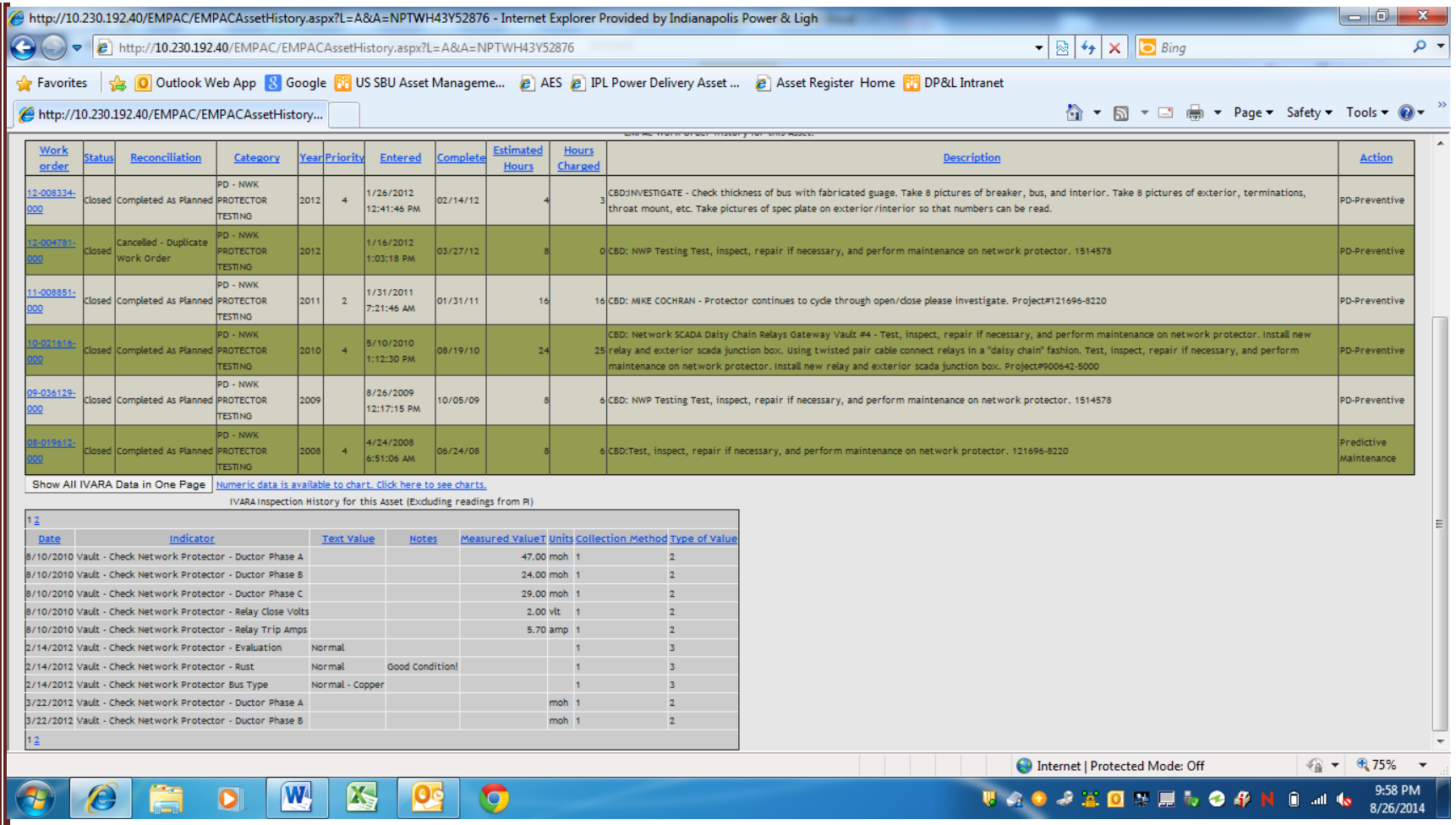
Show All IVARA Data in One Page | Numeric data is available to chart. Click here to see charts.

IVARA Inspection History for this Asset (Excluding readings from PI)

1 2

Date	Indicator	Text Value	Notes	Measured ValueT	Units	Collection Method	Type of Value
8/10/2010	Vault - Check Network Protector - Ductor Phase A			47.00	moh	1	2
8/10/2010	Vault - Check Network Protector - Ductor Phase B			24.00	moh	1	2

Done | Internet | Protected Mode: Off | 75% | 9:58 PM 8/26/2014



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http://10.230.192.40/EMPAC/EMPACAssetHistory...

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Work order	Status	Reconciliation	Category	Year	Priority	Entered	Complete	Estimated Hours	Hours Charged	Description	Action
12-008334-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2012	4	1/26/2012 12:41:46 PM	02/14/12	4	3	CBD:INVESTIGATE - Check thickness of bus with fabricated guage. Take 8 pictures of breaker, bus, and interior. Take 8 pictures of exterior, terminations, throat mount, etc. Take pictures of spec plate on exterior/interior so that numbers can be read.	PD-Preventive
12-004781-000	Closed	Cancelled - Duplicate Work Order	PD - NWK PROTECTOR TESTING	2012		1/16/2012 1:03:18 PM	03/27/12	8	0	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
11-008851-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2011	2	1/31/2011 7:21:46 AM	01/31/11	16	16	CBD: MIKE COCHRAN - Protector continues to cycle through open/close please investigate. Project#121696-8220	PD-Preventive
10-021616-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2010	4	5/10/2010 1:12:30 PM	08/19/10	24	25	CBD: Network SCADA Daisy Chain Relays Gateway Vault #4 - Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Using twisted pair cable connect relays in a "daisy chain" fashion. Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Project#900642-5000	PD-Preventive
09-036129-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2009		8/26/2009 12:17:15 PM	10/05/09	8	6	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
08-019612-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2008	4	4/24/2008 6:51:06 AM	06/24/08	8	6	CBD:Test, inspect, repair if necessary, and perform maintenance on network protector. 121696-8220	Predictive Maintenance

Show All IVARA Data in One Page | Numeric data is available to chart. Click here to see charts.

IVARA Inspection History for this Asset (Excluding readings from PI)

1 2

Date	Indicator	Text Value	Notes	Measured ValueT	Units	Collection Method	Type of Value
8/10/2010	Vault - Check Network Protector - Ductor Phase A			47.00	moh	1	2
8/10/2010	Vault - Check Network Protector - Ductor Phase B			24.00	moh	1	2
8/10/2010	Vault - Check Network Protector - Ductor Phase C			29.00	moh	1	2
8/10/2010	Vault - Check Network Protector - Relay Close Volts			2.00	vlt	1	2
8/10/2010	Vault - Check Network Protector - Relay Trip Amps			5.70	amp	1	2
2/14/2012	Vault - Check Network Protector - Evaluation	Normal				1	3
2/14/2012	Vault - Check Network Protector - Rust	Normal	Good Condition!			1	3
2/14/2012	Vault - Check Network Protector Bus Type	Normal - Copper				1	3
3/22/2012	Vault - Check Network Protector - Ductor Phase A				moh	1	2
3/22/2012	Vault - Check Network Protector - Ductor Phase B				moh	1	2

1 2

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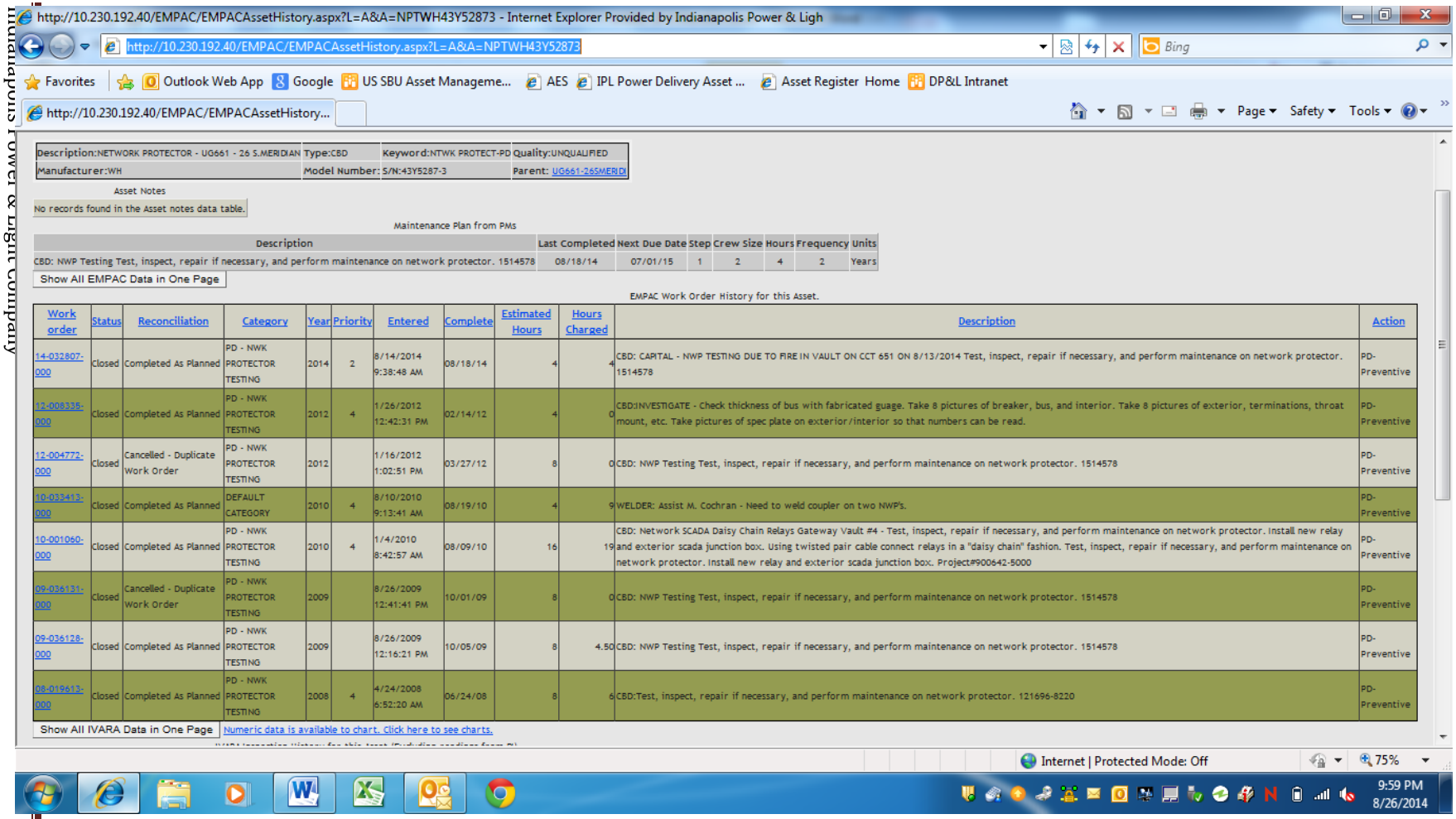
Screen Shot of Vault Inspection Data for UG 661 Bay at 26 S. Meridian Street

The UG 661 network protector underwent a scheduled inspection in 2008 and 2009. In 2010 the new Network SCADA relay was installed and the protector went through another inspection. In 2010 repair work was done to the door mechanism. It was inspected in 2012 to see if it had aluminum bus work. It was found to have copper bus work. It was inspected in 2014 the week after the event in the UG 651 bay.



http://10.230.192.40/EMPAC/EMPACAssetHistory.aspx?L=A&A=NPTWH43Y52873 - Internet Explorer Provided by Indianapolis Power & Ligh

http://10.230.192.40/EMPAC/EMPACAssetHistory.aspx?L=A&A=NPTWH43Y52873

Favorites | Outlook Web App | Google | US SBU Asset Manageme... | AES | IPL Power Delivery Asset ... | Asset Register Home | DP&L Intranet

http://10.230.192.40/EMPAC/EMPACAssetHistory...

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Description:NETWORK PROTECTOR - UG661 - 26 S.MERIDIAN	Type:CBD	Keyword:NTWK PROTECT-PD	Quality:UNQUALIFIED
Manufacturer:WH	Model Number:	S/N:43Y5287-3	Parent: UG661-26SMERIDI

Asset Notes

No records found in the Asset notes data table.

Maintenance Plan from PMs

Description	Last Completed	Next Due Date	Step	Crew Size	Hours	Frequency	Units
CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	08/18/14	07/01/15	1	2	4	2	Years

Show All EMPAC Data in One Page

EMPAC Work Order History for this Asset.

Work order	Status	Reconciliation	Category	Year	Priority	Entered	Complete	Estimated Hours	Hours Charged	Description	Action
14-032807-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2014	2	8/14/2014 9:38:48 AM	08/18/14	4	4	CBD: CAPITAL - NWP TESTING DUE TO FIRE IN VAULT ON CCT 651 ON 8/13/2014 Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
12-008335-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2012	4	1/26/2012 12:42:31 PM	02/14/12	4	0	CBD:INVESTIGATE - Check thickness of bus with fabricated guage. Take 8 pictures of breaker, bus, and interior. Take 8 pictures of exterior, terminations, throat mount, etc. Take pictures of spec plate on exterior/interior so that numbers can be read.	PD-Preventive
12-004772-000	Closed	Cancelled - Duplicate Work Order	PD - NWK PROTECTOR TESTING	2012		1/16/2012 1:02:51 PM	03/27/12	8	0	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
10-033413-000	Closed	Completed As Planned	DEFAULT CATEGORY	2010	4	8/10/2010 9:13:41 AM	08/19/10	4	9	WELDER: Assist M. Cochran - Need to weld coupler on two NWP's.	PD-Preventive
10-001060-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2010	4	1/4/2010 8:42:57 AM	08/09/10	16	19	CBD: Network SCADA Daisy Chain Relays Gateway Vault #4 - Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Using twisted pair cable connect relays in a "daisy chain" fashion. Test, inspect, repair if necessary, and perform maintenance on network protector. Install new relay and exterior scada junction box. Project#900642-5000	PD-Preventive
09-036131-000	Closed	Cancelled - Duplicate Work Order	PD - NWK PROTECTOR TESTING	2009		8/26/2009 12:41:41 PM	10/01/09	8	0	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
09-036128-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2009		8/26/2009 12:16:21 PM	10/05/09	8	4.50	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
08-019613-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2008	4	4/24/2008 6:52:20 AM	06/24/08	8	6	CBD:Test, inspect, repair if necessary, and perform maintenance on network protector. 121696-8220	PD-Preventive

Show All IVARA Data in One Page | Numeric data is available to chart. Click here to see charts.

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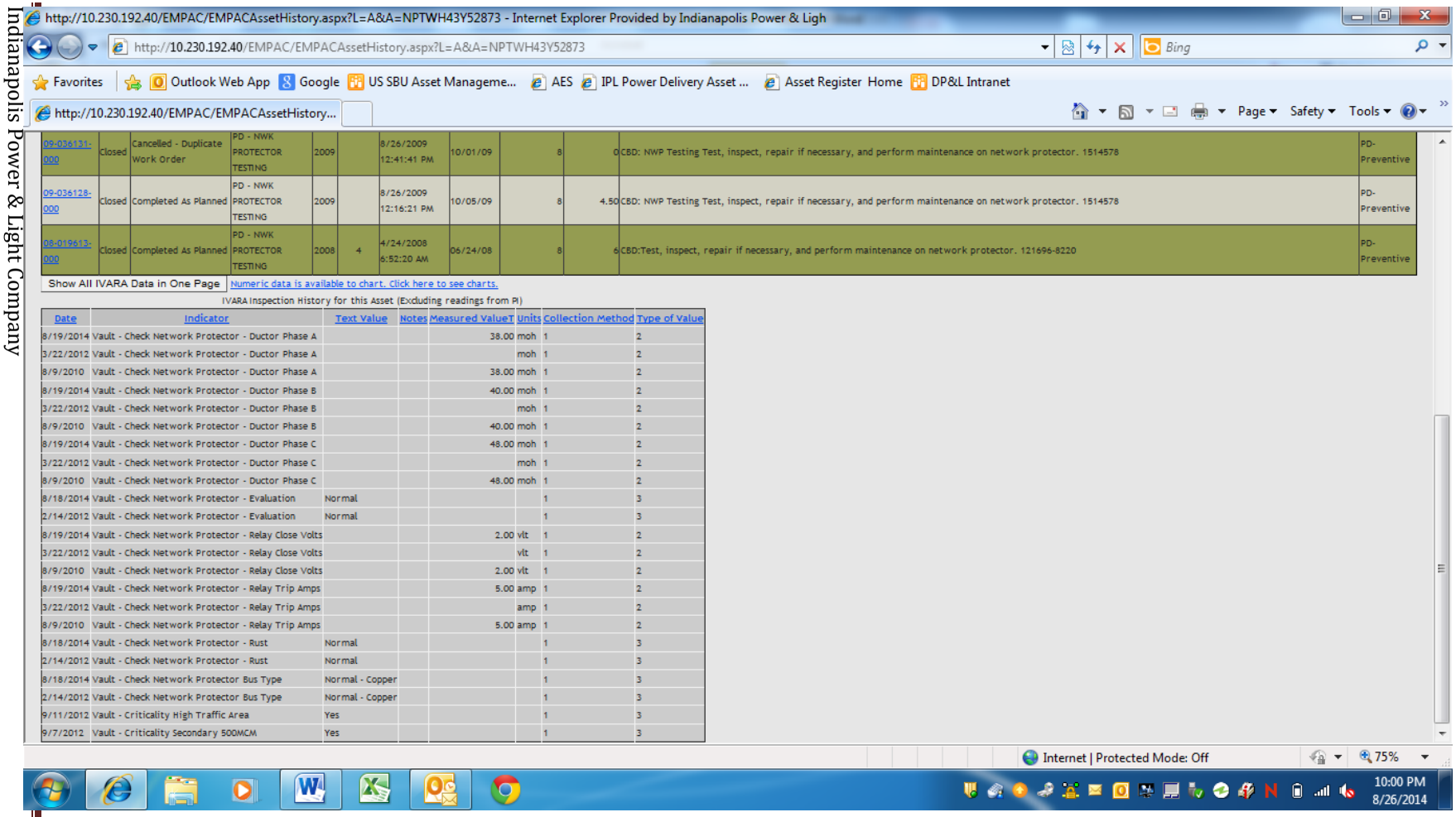

09-036131-000	Closed	Cancelled - Duplicate Work Order	PD - NWK PROTECTOR TESTING	2009		8/26/2009 12:41:41 PM	10/01/09	8	0	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
09-036128-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2009		8/26/2009 12:16:21 PM	10/05/09	8	4.50	CBD: NWP Testing Test, inspect, repair if necessary, and perform maintenance on network protector. 1514578	PD-Preventive
08-019613-000	Closed	Completed As Planned	PD - NWK PROTECTOR TESTING	2008	4	4/24/2008 6:52:20 AM	06/24/08	8	6	CBD:Test, inspect, repair if necessary, and perform maintenance on network protector. 121696-8220	PD-Preventive

Date	Indicator	Text Value	Notes	Measured ValueT	Units	Collection Method	Type of Value
8/19/2014	Vault - Check Network Protector - Ductor Phase A			38.00	moh	1	2
3/22/2012	Vault - Check Network Protector - Ductor Phase A				moh	1	2
8/9/2010	Vault - Check Network Protector - Ductor Phase A			38.00	moh	1	2
8/19/2014	Vault - Check Network Protector - Ductor Phase B			40.00	moh	1	2
3/22/2012	Vault - Check Network Protector - Ductor Phase B				moh	1	2
8/9/2010	Vault - Check Network Protector - Ductor Phase B			40.00	moh	1	2
8/19/2014	Vault - Check Network Protector - Ductor Phase C			48.00	moh	1	2
3/22/2012	Vault - Check Network Protector - Ductor Phase C				moh	1	2
8/9/2010	Vault - Check Network Protector - Ductor Phase C			48.00	moh	1	2
8/18/2014	Vault - Check Network Protector - Evaluation	Normal				1	3
2/14/2012	Vault - Check Network Protector - Evaluation	Normal				1	3
8/19/2014	Vault - Check Network Protector - Relay Close Volts			2.00	vlt	1	2
3/22/2012	Vault - Check Network Protector - Relay Close Volts				vlt	1	2
8/9/2010	Vault - Check Network Protector - Relay Close Volts			2.00	vlt	1	2
8/19/2014	Vault - Check Network Protector - Relay Trip Amps			5.00	amp	1	2
3/22/2012	Vault - Check Network Protector - Relay Trip Amps				amp	1	2
8/9/2010	Vault - Check Network Protector - Relay Trip Amps			5.00	amp	1	2
8/18/2014	Vault - Check Network Protector - Rust	Normal				1	3
2/14/2012	Vault - Check Network Protector - Rust	Normal				1	3
8/18/2014	Vault - Check Network Protector Bus Type	Normal - Copper				1	3
2/14/2012	Vault - Check Network Protector Bus Type	Normal - Copper				1	3
9/11/2012	Vault - Criticality High Traffic Area	Yes				1	3
9/7/2012	Vault - Criticality Secondary 500MCM	Yes				1	3