Missouri Public Service Commission

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January 18, 2002

Mr. Dale Hardy Roberts
Secretary/Chief Regulatory Law Judge
Missouri Public Service Commission
P. O. Box 360
Jefferson City, MO 65102

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Missouri Public
Service Commission

RE: Case No. ES-2001-359

Dear Mr. Roberts:

Enclosed for filing in the above-captioned case are an original and eight (8) conformed copies of the Staff's Electric Incident Report, which was originally filed on April 25, 2001. This filing is being made to clearly show which information is now public information and which is highly confidential as provided in the Commission's July 24, 2001 order adopting the staff recommendation and modifying protective order. Both the Office of the Public Counsel and counsel for Ameren Services Company have been contacted and they do not have any objection to this filing.

This filing has been mailed or hand-delivered this date to the Office of the Public Counsel and James J. Cook, attorney for Ameren Services Company.

Thank you for your attention to this matter.

Sincerely yours,

Eric William Anderson
Assistant General Counsel
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EWA:ccl
Enclosure
cc: Counsel of Record

THE PUBLIC SERVICE COMMISSION OF THE STATE OF MISSOURI

Electric Incident Report

AmerenUE
Case No. ES-2001-359

Venice Plant
Turbine #1 Fire
Venice, Illinois
August 10, 2000

Operations Division...Electric Department...Engineering Section

Jefferson City, Missouri
April 25, 2001

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SYNOPSIS

On Thursday evening, August 10, 2000 at 5:55 PM, a hydraulic oil line on turbine #1 at AmerenUE's Venice Power Plant (Venice) located in Venice, Illinois ruptured, spilling approximately 3150 gallons of oil. There are six (6) units at Venice that are fired by oil or natural gas. Unit #1 has a generation capacity of approximately 40 megawatts (MW). Steam lines in the vicinity ignited the oil and the ensuing fire caused significant damage in and around the plant. Efforts to contain the blaze by plant personnel were not successful due to the intensity of the fire and the smoke in the plant, and consequently the plant was evacuated. AmerenUE personnel successfully tripped the other generating units offline as they evacuated, which protected these units from possible damage.

With the loss of the 125-volt direct current (D.C.) bus, due to damaged D.C. circuits within the plant, AmerenUE was unable to operate breakers to disconnect from (isolate) the adjoining substation to de-energize the 138 kV connection. Consequently, the electrical fault within the plant was sustained as it was fed from the 138 kV Ameren system. Transformers experienced catastrophic failure (rupture and fire) or internal failure from the electrical fault. The fault was isolated at approximately 8:00 PM when the connections to other system substations were manually opened. When the electrical fault was cleared, firemen were able to extinguish the fire.

The hydraulic oil line that failed is a ¾ inch line. The 60 pounds per square inch (psi) hydraulic system is used in part to control steam valves, and at a reduced pressure the oil is used to lubricate moving parts. The hydraulic line in question was previously repaired about ten (10) years ago and again in July 2000. Welding over the previous cracks created a stress point that provided the initiation site for the failure.

AmerenUE expects to retire Unit #1 and Unit #2. Unit #3 and Unit #4 were found serviceable, but damage to the electrical connection to the substation and damage to step-up transformers leave the units out of service. These units are expected back in service by June 2001. Unit #5 and Unit #6 were restored to service on August 30, 2000. These last two

units are connected to the 138 kV system by transformers that were not damaged in the incident. Insurance settlement is still pending.

Approximately 8100 AmerenUE electric customers, served by three distribution substations, located in the northern portion of St. Louis were affected by the disruption of the electrical supply on Thursday night and Friday as a result of the fire at Venice. Normal supply sources were altered to allow restoration of electric service to these customers. Many customers were restored early Friday morning by switching to alternate sources; the last circuit was restored at approximately 4:16 PM on Friday, August 11, 2000. Other outages occurred later as changes were made in the alternate power sources.

FACTS

Purpose

The scope of Staff's investigation is to report the events of the incident at the Venice Plant on August 10, 2000, to evaluate the cause and to provide recommendations that would reduce and/or eliminate the possibility of a similar incident in the future.

Staff Investigation

At the direction of the Assistant Manager of Staff's Electric Department, three (3) members of the Electric Department were sent to investigate the incident on August 16, 2000. The plant manager and other AmerenUE employees provided an overview of the events at the plant on the day of the fire and a tour of the plant and the substation. Much of the plant was dark because the normal lighting circuits had not been re-energized. A portable transformer was brought to the substation to provide electrical power in the plant, but much of the plant was still without electric service. Cleanup was underway and assessment of the damage to equipment in the plant continued.

The Staff made additional visits to Venice on September 8, 2000 to inspect the facilities and again on March 19, 2001 to review information provided in data requests with plant personnel. Staff also reviewed the progress of the work to return Unit #3 and Unit #4 to service, completion of which is expected by June 2001.

Facility Description

The Venice Power Plant is located north of downtown St. Louis, Missouri, on the Mississippi River in Venice, Illinois and is owned and operated by AmerenUE. The plant consists of six (6) generating units whose eight (8) boilers are fueled by oil or natural gas.

Unit #1, the first unit of this plant, was completed in 1942 and Unit #6, the last unit, was completed in 1950. Unit #1 and Unit #2 have a capacity of approximately 40 MW each and Units #s 3 through 6 are approximately 90 MW each. This plant has been used as needed to supply electricity during peak periods to meet electric load. A simplified electrical diagram is included in Appendix A; photographs of the plant and substation are in Appendix B.

Timeline of Events 08/10/00

Approx 17:30	St. Louis Dispatch Center informs Venice Plant to take all units off line for the evening; unit output was reduced in preparation of shutting down all six units at Venice.	
17:55	Hydraulic line on Unit #1 ruptures, spilling oil which ignites.	
18:00:13	Generator #1 breaker opens.	
18:11:00	Generator #2 breaker opens.	
18:12:08	Generator #3 breaker opens.	
18:13:16	Generator #6 breaker opens.	*Generator breakers #1 - #6 were operated from within the plant.*
18:14:24	Generator #4 breaker opens.	
18:14:50	Generator #5 breaker opens.	
18:48:19	Campbell Substation 138 kV to Venice is opened.	
18:48:19	Ridge Substation 138 kV to Venice is opened.	
18:48:21	Ashley Substation 138 kV to Venice is opened.	

19:51:33 Hall Street Substation 138 kV to Venice is opened, fault is isolated.
Substations disconnected manually at each site.

08/11/00

02:00 Fire is extinguished.

(Breaker operations at Venice and at substations were recorded remotely at the dispatch center. Generator breakers were operated from within the plant while D.C. control was still functioning. Isolation of the electrical fault at Venice required manual operation of breakers at other substations.)

Events at the Plant

All six (6) of the units at Venice were online the afternoon of August 10, 2000. The dispatch center directed the plant to take the units offline at approximately 17:30. Plant personnel were reducing the load on the units when the hydraulic line ruptured.

The oil line is located under the floor and covered by a tread grate. It appears that the oil migrated to the steam driven oil pump where the temperature was high enough to ignite the oil. Operators observed that the oil had pooled on the floor and they thought the oil reservoir was overflowing, not realizing that the line had ruptured. When the oil flashed into a ball of fire, it was determined that the fire could not be controlled and the plant was evacuated. As operators left the building, the other units were tripped offline and they coasted down without damage. Lubrication to bearings from the steam driven system provided sufficient oil to effect a safe shutdown.

Local firefighting units responded to the fire but were unable to fight the fire until the electrical fault was isolated. The 138 kV connections to other transmission substations

continued to feed the electrical ground fault[1] at Venice. AmerenUE personnel were unable to trip breakers at Venice because the D.C. control system also experienced an electrical ground fault and the batteries were quickly discharged. The timeline of events shows that the last substation was manually disconnected from the 138 kV system at 19:51:33. Following this breaker operation at the Hall Street Substation to isolate the fault, firefighters were able to extinguish the fire by 02:00 on August 11, 2000.

Personnel

On the afternoon of August 10, 2000 there were twenty-four (24) AmerenUE employees at the plant when the fire started. There were two lost time injuries as a result of the fire, but none of the injuries were serious. The flames, fueled by the oil from the ruptured hydraulic line, and the ensuing smoke necessitated the evacuation of the plant.

Property Damage

Unit #1 sustained extensive damage in the area of the fire. Damage to structural steel supporting the turbine floor was evident as the floor dropped approximately ten (10) to twelve (12) inches. The fire caused damage to electrical cables and ensuing electrical faults caused extensive damage to the 480-volt electrical bus[2] and to the 2400-volt internal station bus. The fire damaged the 125-volt D.C. circuits and the storage batteries quickly discharged, leaving no power to operate the breakers or to activate the fire control systems.

Station service transformers (13.8 / 2.4 kV) 1A and 1B plus a 480-volt transformer (2.4 kV / 480 V) were damaged by the electrical fault and fire, as were step-up transformers #1, #2 (13.8 / 69 kV), #3 (13.8 / 138 kV) and #4 (69 / 138 kV). (See diagram in

[1] A ground fault is an electrical short circuit from an energized source to a grounded component
[2] A bus is a conductor, or group of conductors, that serve as a common connection for two or more circuits.

Appendix A) Electrical buses and switches between the plant and the substation were also damaged. Most of the damaged equipment in and around the plant was original equipment.

Electric Service Outages In St. Louis

The fire at Venice affected the supply of electricity to distribution substations in the northern portion of St. Louis. The normal supply to Cass Substation (3900 customers), Vandeventer Substation (3100 customers) and Cole Substation (1100 customers) was interrupted. The customers served from Vandeventer were restored starting at 21:37 on Thursday evening by switching to other substations. Switching to alternate sources restored customers served from Cass. All customers served from these two substations were restored at 01:43 early Friday morning, August 11, more than seven (7) hours after the incident began.

The Cole Substation had no alternate supply source and extensive work was necessary to restore power to customers served by this substation. The first portion of the load from the Cole Substation was restored at 15:32 on the afternoon of August 11 and all customers were restored at 16:14. Some of these customers were without electric service for more than twenty-two (22) hours.

Work continued to provide a second supply to the Cole Substation. On Saturday there was an outage on one of the new circuits to Cole that also served the Mullanphy Substation (1300 customers). Customers served from the Mullanphy Substation were without electric service from 12:37 to 17:32, approximately five (5) hours Saturday afternoon.

Damage Repair

Initially, the plant was secured as air-monitoring equipment was installed to ensure that the environment was safe for workers. As previously stated, a portable transformer was brought in to provide station power and to facilitate cleanup.

Structural repair of the turbine floor has been completed. Damaged cabinets and equipment have been removed. The batteries for the 125-volt D.C. system have been replaced. Installation of new cable to the substation, transformer repair and replacement are underway.

Listed below are the anticipated expenditures for Venice restoration. Insurance settlement is still pending.

Unit # 1 Operation

The generation units at Venice are dispatched as needed, normally for a few hours daily during periods of peak demand. Maintenance records indicate that on the day before the incident Unit #1 had experienced trouble with the governor linkage. The governor is a mechanical device used to maintain constant speed of the generator by increasing or decreasing the steam flow to the turbine to maintain 60 cycles per second. A linkage in this control system was sticking, which would not allow the governor to operate properly. Operators had to manually free the linkage to allow the governor to operate. When the stuck linkage was freed, there was a surge in the hydraulic system. This was reported by AmerenUE as the dynamic event that caused the hydraulic line to break.

Previous Hydraulic Line Repairs

The 60 psi hydraulic system is used in part to control steam valves, and at a reduced pressure the oil is used to lubricate moving parts. The ruptured hydraulic line is a ¾ inch pipe of carbon steel and is part of the original piping installed in 1942. The ¾ inch pipe tees off a main four (4) inch supply pipe at 45 degrees. Photographs and diagrams are in Appendix C.

Approximately ten (10) years ago, the same line failed at the weld onto the four (4) inch line. In July 2000, the line failed about one (1) inch from the previous weld failure. The AmerenUE metallurgical report concludes that the pipe failed due to fatigue. Welding over the previous cracks apparently created a stress riser (point) that provided the initiation site for the last failure. These stress risers or points of stress in the pipe are approximately one (1) inch down the pipe from the previous weld. The two previous failures were not repaired, i.e. the crack ground out and re-welded. They were welded over and the cracks continued to grow. The laboratory report found that the original crack grew .003 inches in the ten years since the repair; but the second repair was close to failing again.

As a result of laboratory analysis by Ameren, it was recommended that future repairs should involve pipe replacement, or a defect repair should be made instead of only welding over the crack. The welding provided a point of initiation one (1) inch down the pipe that could lead to failure. It appears from laboratory analysis that several individual cracks connected together, resulting in the failure on August 10, 2000. Photographs in Appendix C show results from the metallurgical report.

Preventative Action Taken

AmerenUE expects to complete upgrades to the fire protection system by October 1, 2001. Improvements include storage tank, new pumps, monitors, piping and a building to house the equipment. The estimated cost for this project is $3,461,000. This is a cost in addition to the cost listed previously to restore the electrical and mechanical components damaged by the fire.

Reconfiguring the D.C. Control System at Venice will include battery chargers with alternate electrical sources to augment the existing motor/generators. The new D.C. cables will be routed to avoid possible hazards and installed in multiple locations in an effort to minimize the risk of a total system failure. This change will help ensure power for control of breakers and fire control systems.

Upgrades in the substation will include new high-side breakers on the 138 kV transformers to allow disconnection from the transmission system. Dispatch center control for these breakers is being considered.

Meteorological Data

The National Oceanic and Atmospheric Administration (NOAA) weather station at the St. Louis International Airport reported that the maximum temperature for August 10,

2000 was 86 degrees Fahrenheit and at 18:00 the temperature was 83 degrees Fahrenheit. No precipitation was recorded that day. The airport is approximately eleven (11) miles west of the Venice Plant and would be representative of the weather in the metropolitan area that day. The temperatures recorded on August 10, 2000 reflect a typical summer day in which the peaking capacity of Venice was needed to supply a portion of the electrical demand.

Notification

Missouri Public Service Commission rule 4 CSR 240-20.080 requires that any accident at a power plant involving property damage in excess of $50,000 be reported by telephone by the end of the first business day following discovery. Also, a written report is required within five (5) business days following discovery.

The incident was reported by telephone to the Staff on August 11, 2000 and AmerenUE provided updates as additional information was available from the Venice Plant. In addition, information on the status of the restoration effort for portions of the northern area of downtown St. Louis, affected by the damage at the Venice Plant, was provided to the Staff. The written report was received on September 5, 2000.

Violations Found By Other Government Agencies

The Illinois Environmental Protection Agency issued a Violation Notice due to the oil released with the rupture of the hydraulic line. Approximately 3150 gallons of oil were consumed in the fire.

A Citation and Notification of Penalty was issued by the Occupational Safety and Health Administration (OSHA) because the water supply for standpipe and hose systems were not sufficient to provide 100 gallons per minute for a period of at least 30 minutes. With the loss of D.C. power in the plant, the fire control systems could not be activated.

AmerenUE was fined $1875 for this citation and expects to complete an upgrade of the fire protection system by October 1, 2001. Improvements will include new storage tanks, underground fire main system and diesel powered water pumps.

CONCLUSIONS

From the investigation conducted by Staff of the events surrounding the incident at the Venice Power Plant on August 10, 2000, the Staff draws the following conclusions:

1. Welds performed on cracks in the hydraulic line, both ten years ago and in July 2000, proved to be inadequate repairs. Welds served to create a new stress point approximately one inch from the crack that was previously repaired.

2. Mechanical problems with the governor on Unit #1 was the apparent dynamic event that caused the hydraulic line to fail. The surge on the hydraulic system when the governor linkage was freed caused the weakened hydraulic line to fail.

3. The ruptured hydraulic line spilled oil near steam lines that ignited the oil. The intensity of the flames and the smoke inside the plant necessitated the evacuation of the plant.

4. D. C. cables that were routed through the area under turbine #1 were damaged by the flames and caused the D. C. system to experience a ground fault and consequently, loss of control of electrical breakers and fire control systems.

5. The fire on Unit #1 damaged electrical cables that caused a ground fault on the 2.4 kV bus that was fed through the substation from the 138 kV transmission system, which caused major damage to electric facilities.

6. Loss of D.C. and the inability to operate breakers to separate the plant from the substation, necessitated the manual disconnect from substations

interconnected with the Venice Substation. The uncontrolled fault current destroyed equipment and delayed the fire fighting effort.

7. AmerenUE failed to provide a written report within five (5) business days following discovery. AmerenUE did provide updates to the Staff of the events at the plant and the restoration of electric service in St. Louis. Subsequent reporting by AmerenUE of power plant events has been timely.

RECOMMENDATIONS

Based on the Staff's investigation and review of the incident, Staff recommends the Commission direct that:

1. AmerenUE review maintenance records and inspect hydraulic lines to identify repair welds on the hydraulic systems of Units' #3, #4, #5 and #6 at Venice.

2. AmerenUE perform a defect repair of previous welds completed to repair hydraulic leaks or replace portions of pipe on the units at Venice.

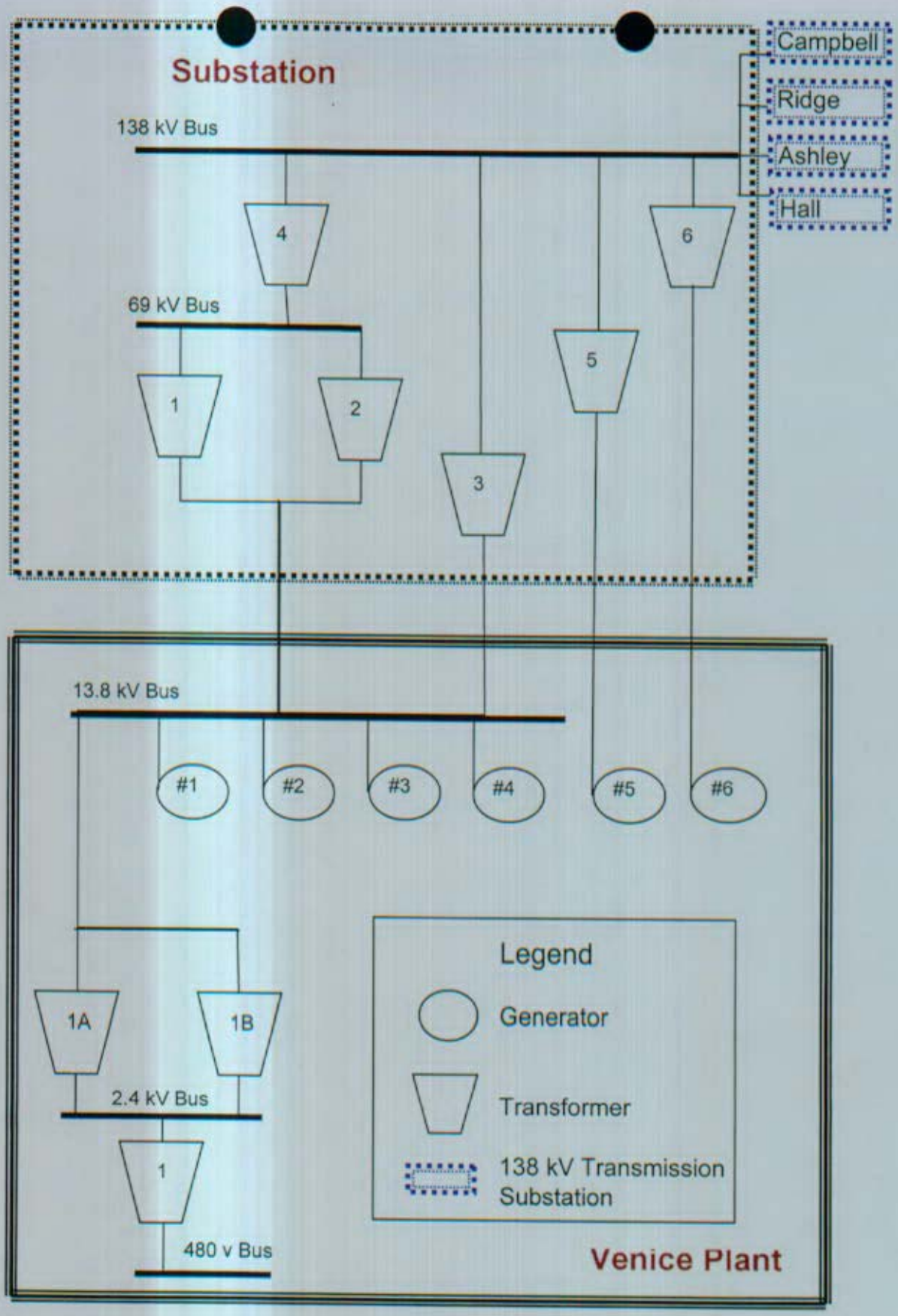
3. Report to Staff completion of:
   a. Review of maintenance records and inspection of hydraulic lines;
   b. Weld repairs or pipe replaced;
   c. Substation upgrades including transformer replacement/repair, breaker upgrades/replacement and replacement of 13.8 kV bus between generators and substation;
   d. D.C. system upgrades for backup and reliability, including addition of battery chargers and re-routing of cables;
   e. Fire control upgrades.

4. AmerenUE file a response to this Electric Incident Report in this case within 30 days.

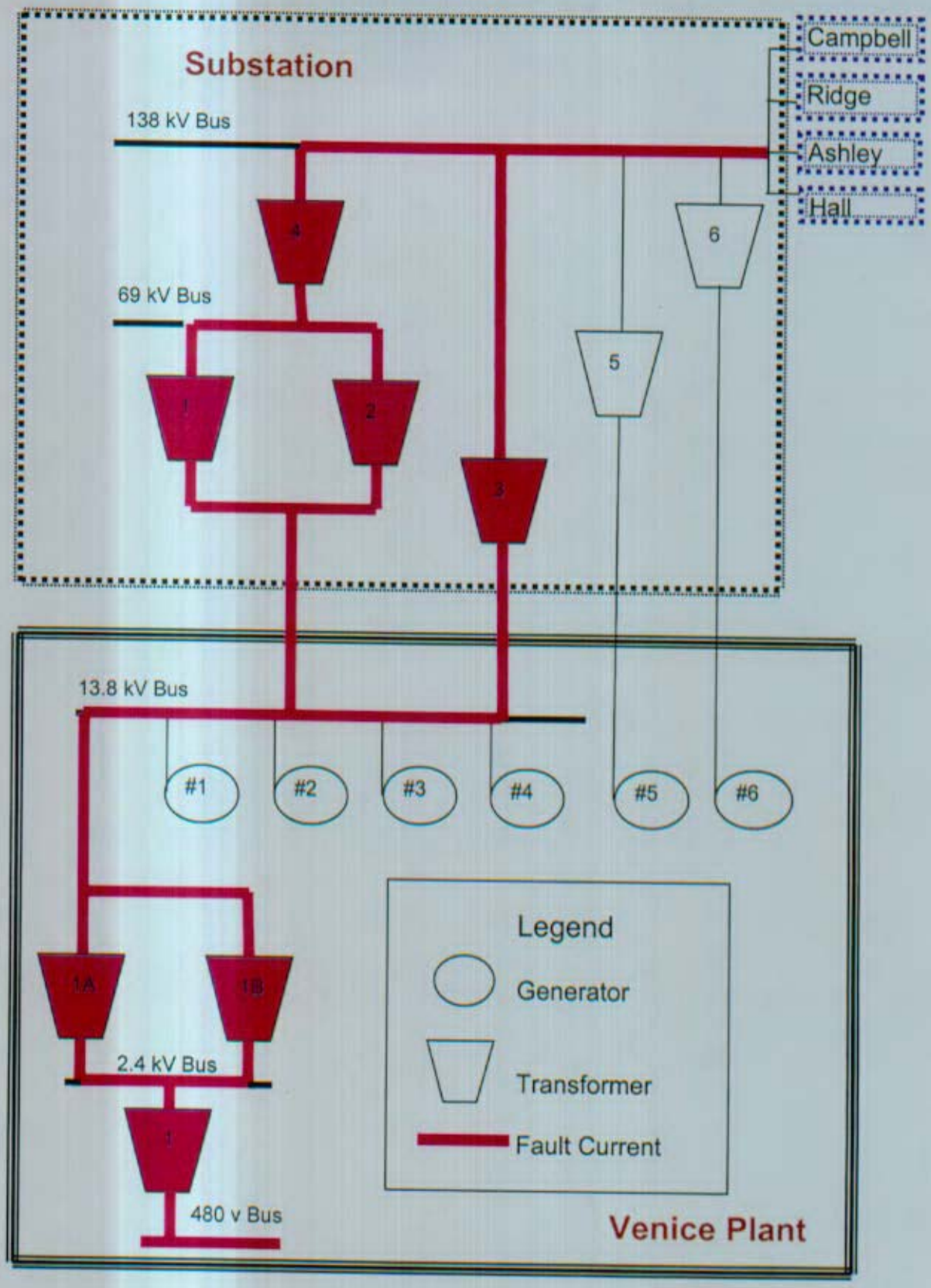
APPENDIX A

Electrical Diagram

Venice Plant and Substation



Simple electrical diagram of Venice Plant and Venice Substation.



Electrical current available from the 138 kV system sought the ground fault in the plant

APPENDIX B

Photographs

Plant and Substation

Venice Power Plant, Facing West, Substation In Foreground

Venice Plant: Unit One Turbine

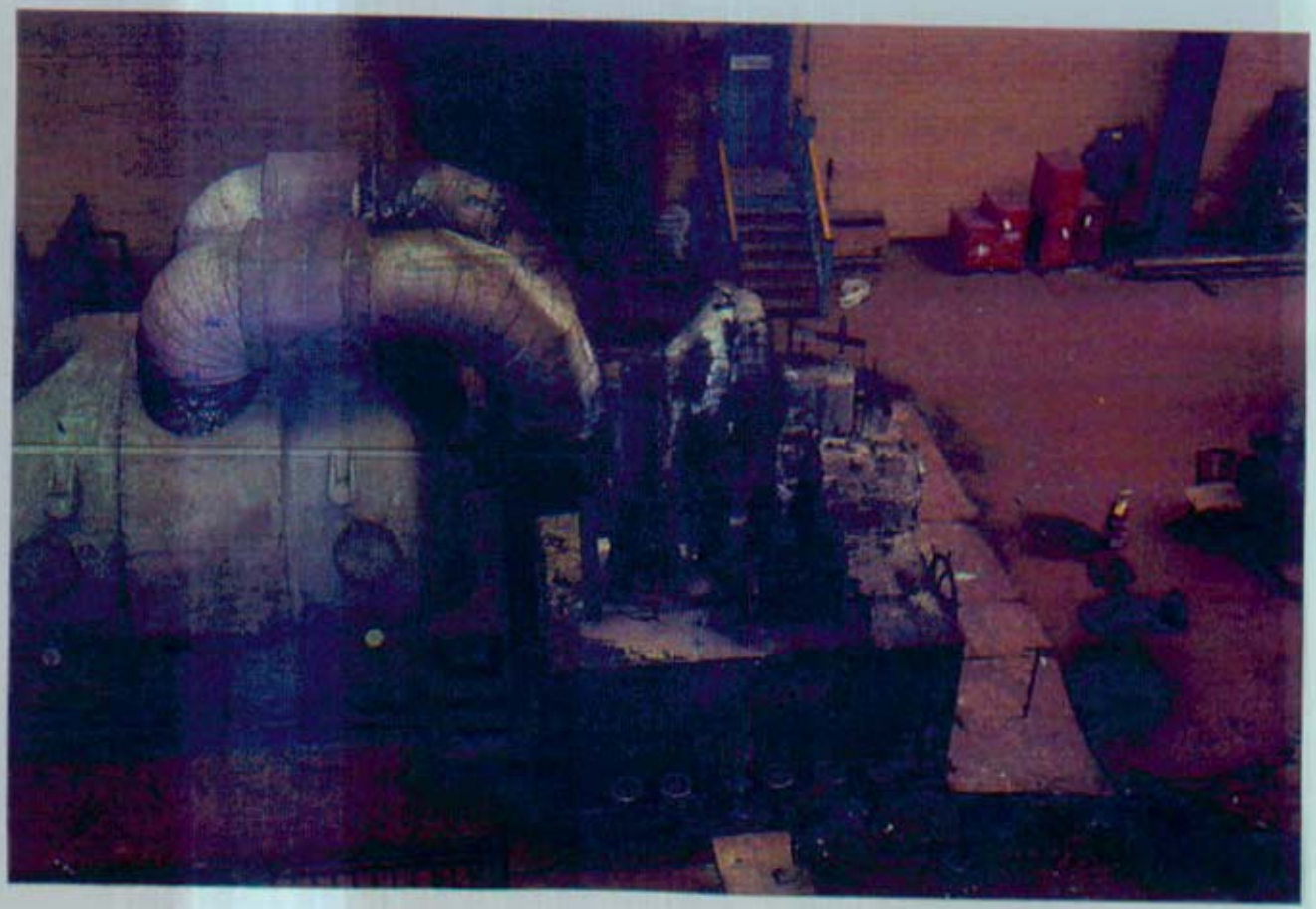
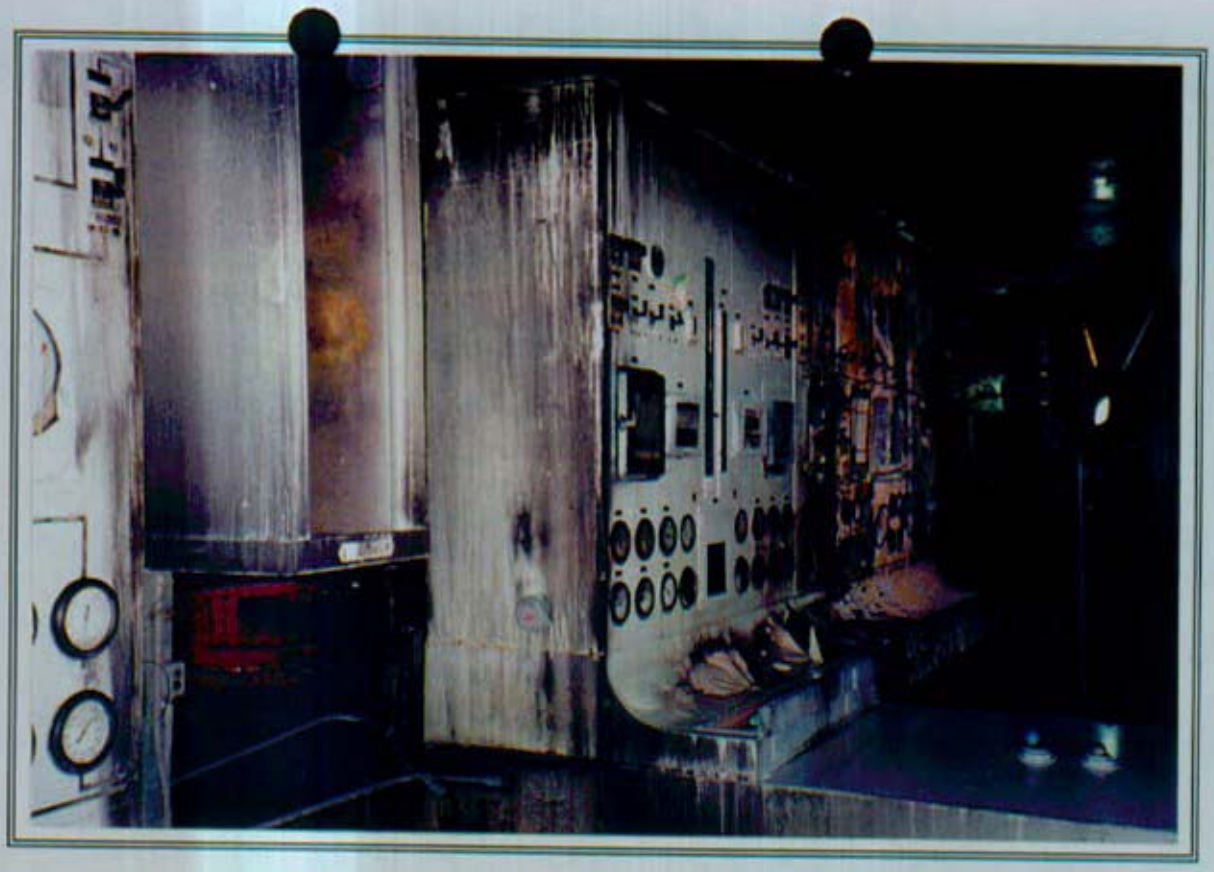


Photo Courtesy of AmerenUE

Appendix B



Equipment below Turbine #1 damaged by the fire

Equipment damaged by electrical ground fault

View Of Turbine Floor, Looking South
Unit #1 on Immediate Left

Overhead 13.8 kV Bus Outside
Of Plant That Was Damaged
By The Fault Current

Venice Transformer #3 (13.8 / 138 kV)

Substation towers in background

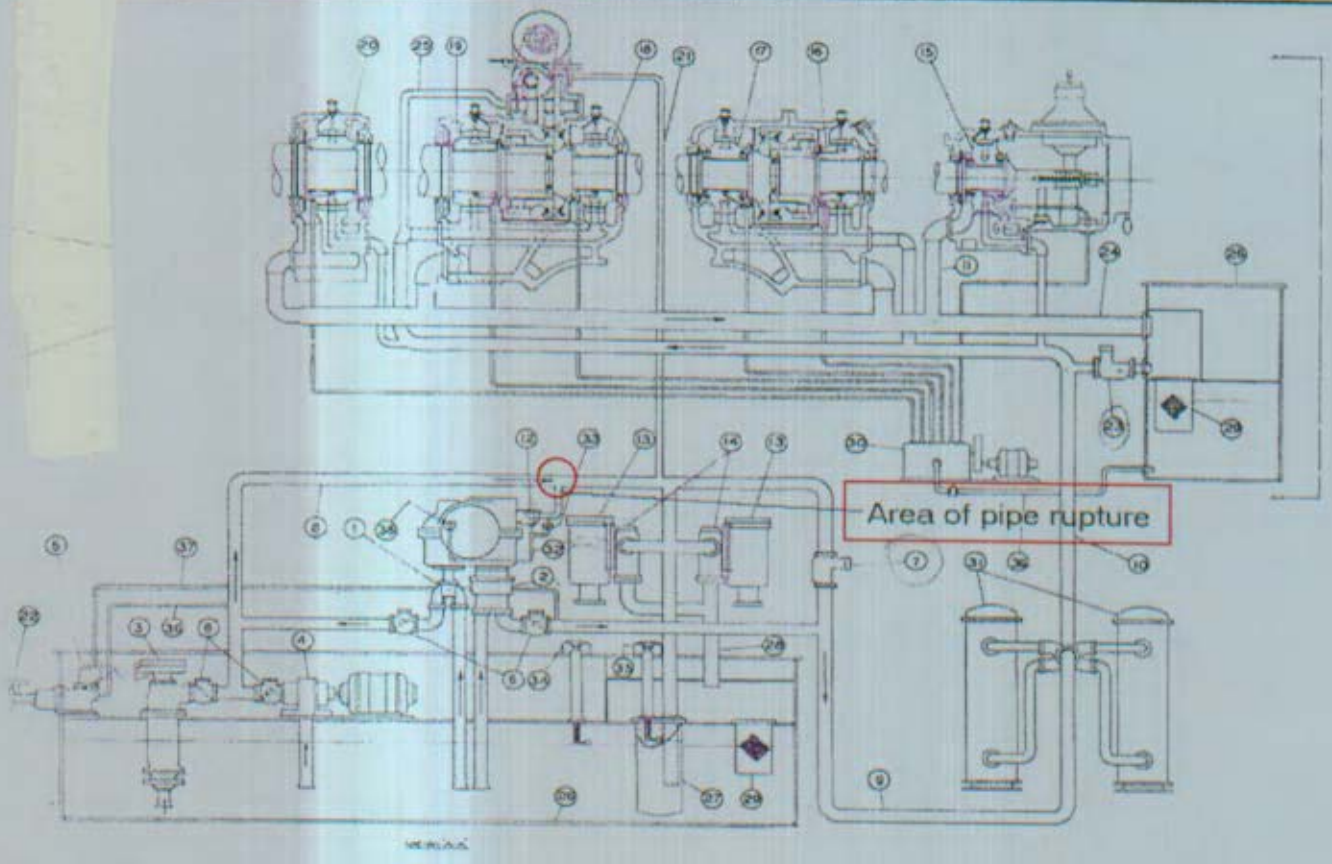
Vennice Plant in background

APPENDIX C

Turbine Oiling System

Appendix C is Deemed Highly Confidential in its Entirety.

TURBINE OILING SYSTEM



1. Main oil pump for governor
2. Main oil pump for bearings
3. Auxiliary oil pump, steam driven
4. Auxiliary oil pump, motor driven
5. Automatic pressure regulator
6. Check valves
7. Relay oil relief valve
8. Relay oil supply pipe
9. Bearing oil supply pipe to cooler
10. Bearing oil supply pipe from cooler
11. Thrust end oil drain
12. Power oil relay
13. Power cylinder
14. Power cylinder oil relay
15. Combined No. 1 journal and Kingsbury thrust bearing
16. No. 2 journal bearing
17. Combined No. 3 journal and Kingsbury thrust bearing
18. No. 4 journal bearing
19. No. 5 journal bearing
20. No. 6 journal bearing
21. Relay oil supply to turning gear
22. Pressure regulator steam connection
23. Bearing oil relief valve
24. Bearing oil drain system
25. Turning gear lubricating oil supply
26. Oil reservoir
27. Accumulator
28. Relay oil drain pipe
29. Oil strainer
30. H.P. lubricating system
31. Oil coolers
32. Line to trip valve
33. Orifice
34. Oil level indicator float
35. Accumulator oil level indicator
36. Pressure regulator connection to relay pressure
37. Pressure regulator connection to bearing pressure
38. Trip valve
39. Oil supply to H.P. oil pump

STEAM TURBINE
Dwg. 613-00151

ALLIS-CHALMERS MANUFACTURING COMPANY
MILWAUKEE, WISCONSIN

Inst. Sheet 2284

Figure 1 – Schematic showing the Venice turbine oiling system and the location of the failure.

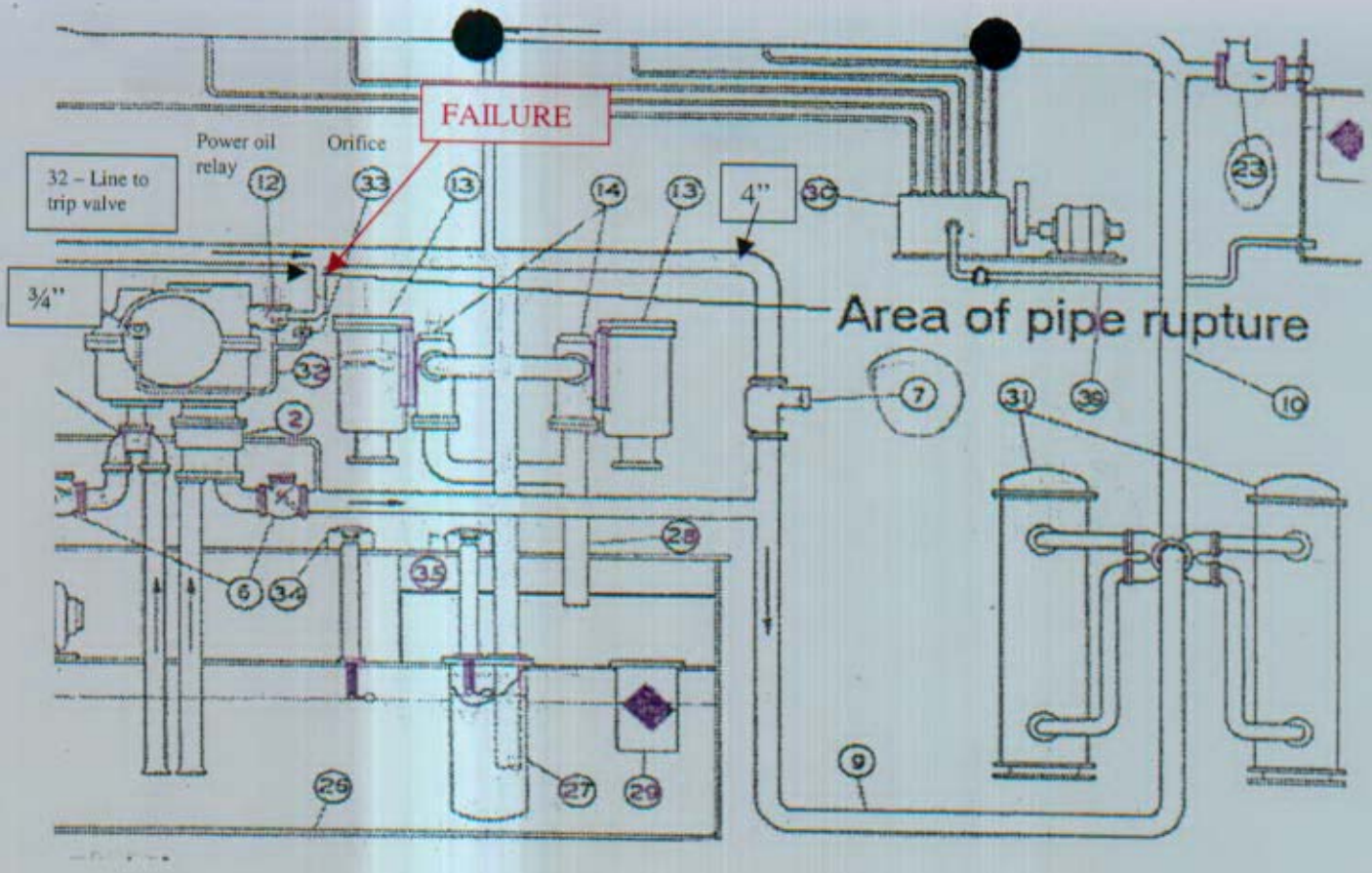


Figure 2 – Enlarged section of the turbine oiling system showing the failure location in greater detail. The pipe failed at the location shown by the arrow. The ¾" line that failed tees off of the main 4" supply line and goes to the power oil relay (12). This line tees off at about a 45° and the pipe failed about 2-1/2" from the socket weld to the 4" line.

Figure 3 - This photograph shows the ¾" line that failed and the 4" main supply line. The bolted flange at the top of the photograph connects to the power oil relay.

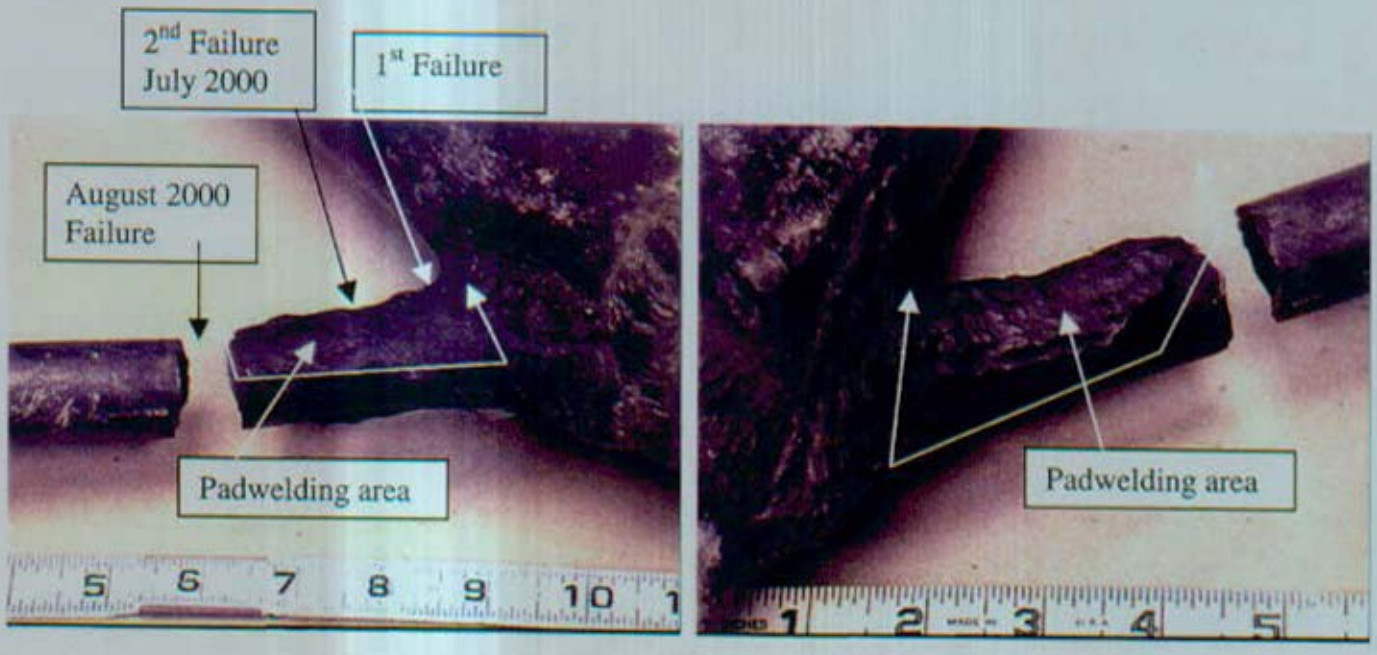


Figure 4 – These photographs show the two sides of the failure. Extensive padwelding on the top half of the pipe had been done with the two past failures. The first failure occurred about 10 years ago at the toe of the socket weld on the ¾" side of the weld. The second failure occurred about 1" away from this. All of the padwelding was on the side of the tube between the ¾" line and the 4" line.

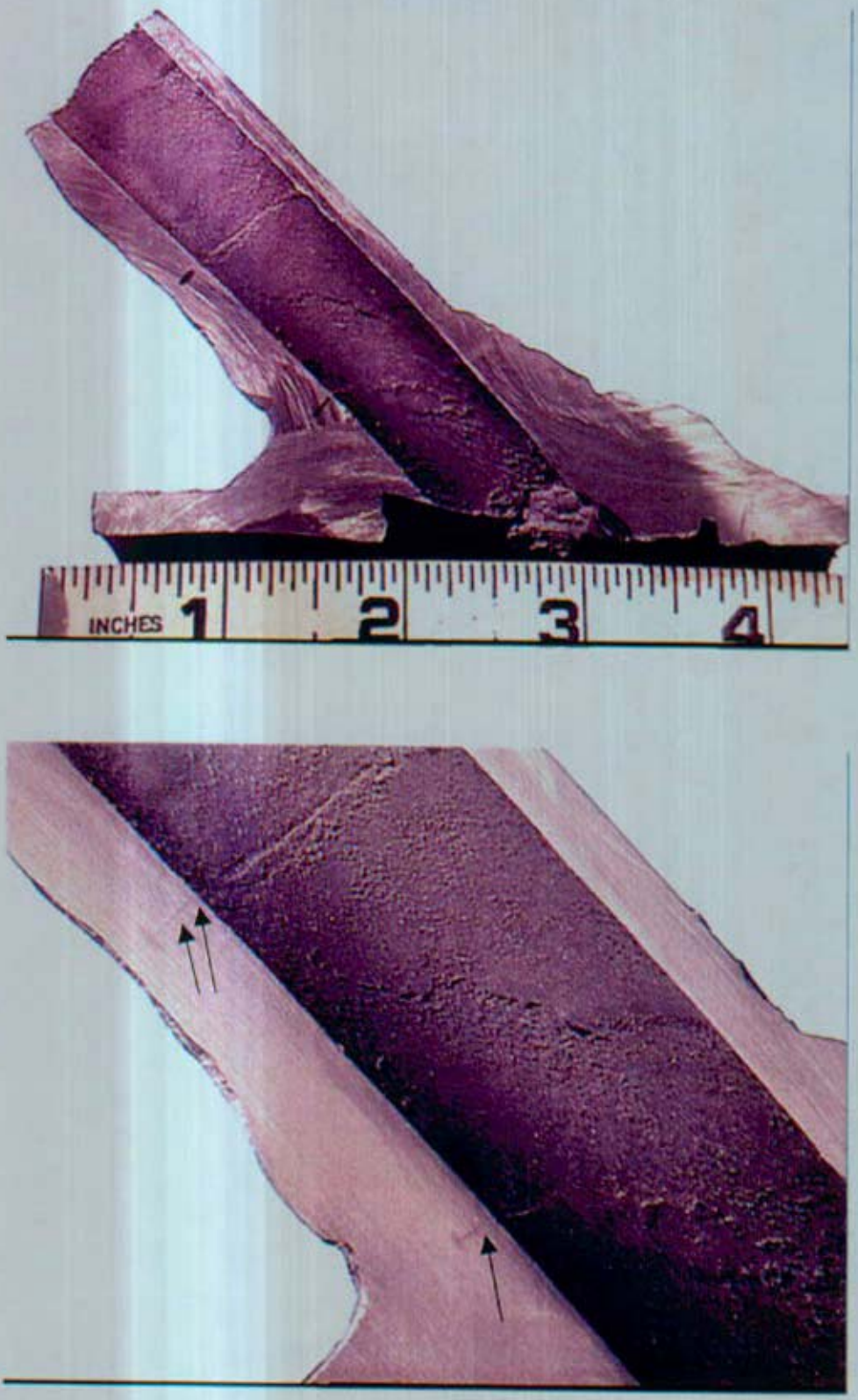


Figure 7 – These photographs show the ¾" line split in half. The lower photograph shows the original crack (arrow) and the July 2000 crack (double arrow).