Missouri Public Service Commission

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December 6, 2000

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

RE: Case No. ES-2001-28 – In the Matter of an Incident at St. Joseph Light & Power Company's Lake Road Power Plant on June 7, 2000.

Dear Mr. Roberts:

Enclosed for filing in the above-captioned case are an original and eight (8) conformed copies of a **NOTICE OF FILING OF STAFF'S FINAL INCIDENT REPORT AND MOTION TO REQUIRE FILING OF RESPONSE TO STAFF'S RECOMMENDATIONS.**

This filing has been mailed or hand-delivered this date to all counsel of record.

Thank you for your attention to this matter.

Sincerely yours,

Nathan Williams

Nathan Williams
Assistant General Counsel
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Enclosure
cc: Counsel of Record

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of an Incident at St. Joseph Light & Power Company's Lake Road Power Plant on June 7, 2000.	)))	Case No. ES-2001-28

NOTICE OF FILING OF STAFF'S FINAL INCIDENT REPORT AND MOTION TO REQUIRE FILING OF RESPONSE TO STAFF'S RECOMMENDATIONS

COMES NOW the Staff of the Missouri Public Service Commission (Staff) and for its Notice of Filing of Staff's Final Incident Report and Motion to Require Filing of Response to Staff's Recommendations states:

1. The Missouri Public Service Commission (Commission) has the authority to establish a case for the purpose of receiving information from public utilities under its jurisdiction. §§ 393.130.1 and 393.140(1), (2), (3), (5), (9) and (10), RSMo. 1994. St. Joseph Light & Power Company (SJLP) is an electrical corporation as defined in section § 386.020 (15) RSMo. Supp. 1999, and, as such, is a public utility subject to the Commission's jurisdiction pursuant to Chapters 386 and 393 RSMo.

2. On July 12, 2000, the Staff of the Missouri Public Service Commission (Staff) filed a motion requesting that the Missouri Public Service Commission (Commission) establish a case for the purpose of receiving an incident report from the Staff regarding a June 7, 2000, incident at SJLP's Lake Road Power Plant that caused extensive damage to Turbine/Generator #4.

3. On July 27, 2000, the Commission issued its order establishing Case No. ES-2001-28 for the purposes of receiving (1) an incident report from the Staff pertaining to the June 7, 2000, incident at SJLP's Lake Road Power Plant and (2) the response of SJLP to the

Staff's incident report. Additionally, the Commission directed the Staff to file on December 6, 2000, either the Staff's final incident report or an interim incident report.

4. In the attached final incident report, which is labeled Attachment A, the Staff presents information that it obtained through discovery and other means during its investigation, the Staff's analysis of that information and the Staff's recommendations. The Staff's recommendations are for actions to be taken by SJLP to reduce the likelihood of recurrence of incidents such as that which occurred on June 7, 2000 at SJLP's Lake Road Power Plant. Because the Staff is recommending that SJLP take particular actions, it is appropriate that SJLP file in this case a response to the Staff's recommendations.

WHEREFORE, the Staff notifies the Commission of the filing, in this case, of Staff's Final Incident Report and moves the Commission to issue an order directing St Joseph Light & Power Company to file, within thirty (30) days of the date of said order, St Joseph Light & Power Company's response to the recommendations made by the Staff in the Staff's Final Incident Report.

Respectfully submitted,

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Certificate of Service

I hereby certify that copies of the foregoing have been mailed or hand-delivered to all counsel of record as shown on the service list below this 6th day of December, 2000.

Dana Williams

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MISSOURI PUBLIC SERVICE COMMISSION

STAFF FINAL ELECTRIC INCIDENT REPORT

St. Joseph Light & Power Company
Case No. ES-2001-28

Lake Road Power Plant

St. Joseph, Missouri

June 7, 2000

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

December 6, 2000 - Jefferson City, MO

ATTACHMENT A

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SYNOPSIS

On Wednesday, June 7, 2000, five days after returning to operation from a scheduled spring outage, St. Joseph Light & Power Company's (SJLP) Lake Road Power Plant #4 turbine (Unit 4) in St. Joseph, Missouri tripped. Generally when a turbine trips, there is no damage to the unit. However, this trip ended in severe damage to the turbine and generator bearings and seals.

Usually when the #4 turbine/generator trips, the Alternating Current (AC) oil pumps that supply oil to lubricate the turbine and generator bearings are de-energized and the backup Direct Current (DC) oil pump will start to supply the oil used to lubricate the bearings at a pressure necessary to allow the turbine/generator to decelerate to a stop without incident. However, following this trip, the DC oil pump did not start. Lack of oil supply to the turbine/generator bearings resulted in rapid overheating of the bearing surfaces and loss of sealing oil to the generator hydrogen seals. Loss of sealing oil to the generator hydrogen seals allowed pressurized hydrogen gas to escape to the atmosphere. The hydrogen gas then exploded when mixed with the atmosphere. The explosion was followed by fire because the remaining hydrogen continued to leak out and ignite. When the AC oil pumps were re-powered, oil pressure was restored causing oil to be sprayed out the seals, and vaporize. The hydrogen flames ignited the vaporized oil causing a second explosion and fire.

SJLP personnel quickly shut off the supply of hydrogen but the oil continued to burn. SJLP personnel shut down the AC oil pumps which stopped the fire, but due to a loss of bearing lubricant, brought the turbine to a sudden stop. No injuries associated

with the incident were reported. The local fire department was called but the fires were out by the time it arrived. The surrounding structures suffered minimal damage; however, the turbine/generator bearings and rotor suffered extensive damage. SJLP completed the necessary repairs, and took actions to avoid future occurrences. On August 8, 2000 SJLP placed Unit 4 back on line. Unit 4 continued to register high vibrations after these repairs and on August 16, 2000 the unit again tripped, but this time without damage. After SJLP made adjustments to seal clearances the high vibrations abated.

As a result of its investigation, the Staff of the Missouri Public Service Commission (Staff), developed recommendations for SJLP to prevent recurrence of this type of incident. These are recommendations presented in the Recommendations Section of this report.

FACTS

This report was prepared following a Staff investigation that included on-site visits, information gathered from interviews of St. Joseph Light & Power Company employees, from Data Request responses from SJLP, and evidence presented in Case No. EO-2000-845 *In the Matter of Application of St. Joseph Light & Power Company for the Issuance of an Accounting Authority Order Relating to it's Electric Operations.*

History

Unit 4 is a 97 megawatt base load steam turbine/generator supplied by steam from the coal-fired Boiler No. 6. During the summer months of June, July, and August of the years 1997, 1998, 1999, Unit 4 provided 27.2% , 29.0%, and 29.1% of the electric system requirements for SJLP during each of those periods. Thus, loss of Unit 4 during the summer months has a significant impact upon SJLP's ability to supply its electrical customers from its own generation sources.

In the original design in 1966, Unit 4 had two AC oil pumps powered from the Unit 4 main auxiliary transformer and one DC oil pump powered by station batteries. When the Unit 4 generator trips, power is lost to the Unit 4 main auxiliary transformer, and therefore, to the AC oil pumps. Many power plants have an automatic bus transfer (ABT) that transfers the AC power from the main auxiliary transformer to an independent power source. However, Unit 4 was not equipped with an ABT. Instead, it has relied upon a battery powered DC oil pump until an operator manually closed the breaker to

connect to the independent power source. Thus, when the turbine trips, power is lost to the main AC oil pumps, and the DC oil pump starts to supply oil to the turbine/generator bearings and seals until the operator can re-energize the AC oil pumps from the reserve auxiliary transformer. In the original 1966 design, the operator controlled the DC oil pump by a single manual switch. In 1995, SJLP contracted through SEGA, Inc. to modify existing controls systems, including the AC and DC oil pump controls, to include control through a Bailey Digital Control System (DCS). With this modification, the DC oil pump had redundant means for operation, through the manual switch, or through the DCS. However, SJLP's operators continued to almost exclusively rely upon the manual switch to operate the DC oil pump and rarely ever used the DCS for that purpose.

In January of 2000, SJLP contracted with General Electric Co. (GE) to install the MARK V turbine control system and install new vibration monitoring equipment during the spring outage of 2000 (May 3- June 2). The existing turbine controls were aging and replacement parts were no longer readily available. During installation of the Mark V, SJLP agreed to allow GE to remove the manual switch that controls the operation of the DC oil pump to make room for the new Mark V control cabinet. After the removal of the manual switch, the SJLP operators had to rely upon the DCS system installed in 1995 to control the DC oil pump.

Events Prior to Incident

Between May 3 and June 2, 2000, Unit 4 underwent a general overhaul and inspection. During this period, GE was testing the installation of the Mark V turbine/controls and the turbine supervisory system. The turbine supervisory system measures the vibrations of each of the bearings and alarms or trips the unit when the

vibrations are too high. Since initial startup on June 2, 2000, the operators noticed that the turbine vibration supervisory system was not showing a credible value for bearing No. 5. SJLP personnel discussed the problem with the GE and the manufacturer of the monitoring equipment, Bently Nevada Corp. GE and SJLP personnel were troubleshooting the turbine supervisory system when the trip occurred on June 7, 2000.

Details of the Incident

On June 7, 2000, Unit 4 had been following load since startup on June 2nd and increased its load to 102MW at 12:00 p.m. Vibrations readings on the turbine/generator had been normal since startup with the exception of the number 5 bearing y-axis probe that was reading zero. SJLP and GE decided to troubleshoot the probe wiring. Precautions were taken to reduce the chance of a vibration trip by bypassing the trip circuit of the turbine supervisory equipment and perform the work at the probe end of the wiring rather than at the Mark V end. While working at the probe end at 2:07 p.m., the SJLP technician noticed a discernable difference in the sound of the turbine and went into the control room where he discovered that the turbine had tripped. Within seconds after the trip, the hydrogen gas escaped from the generator, exploded and a fire occurred. SJLP personnel shut off the hydrogen supply valve to the generator, cutting off the source of fuel for the flames. SJLP made announcements to evacuate the plant and called the fire department. Because it was time for the normal work force shift to change, there were additional qualified personnel in the control room to help in the response to the incident.

When the Unit 4 turbine/generator tripped, the main AC oil pumps lost power because they receive their power from the main auxiliary transformer of the Unit 4

generator. The DC oil pump, powered by station batteries, is supposed to start upon low oil pressure, but did not start in this instance. The loss of oil pressure to the Unit 4 turbine/generator bearings caused the bearings to overheat. The loss of sealing oil to the hydrogen seals allowed hydrogen to escape through the seals and explode once it mixed with the atmosphere. When the operator restored power to the AC oil pump by closing its breaker to the reserve auxiliary transformer, oil pressure to Unit 4 turbine/generator bearings and seals was restored. Once oil pressure was restored, oil escaped through the damaged seals, and was ignited by the existing fire. This caused a second explosion. SJLP personnel decided to shut off the oil supply in order to extinguish the fires. Their decision to shut off the oil supply was based on the assumption that damage had already occurred and it was a necessary action to put out the fire. Without lubricating oil, the bearings seized and the rotor came to a sudden stop. The turning gear used to turn the rotor after shutdown to ensure even cool down of the rotor, was unable to operate due to the damage. This resulted in uneven cooling, which resulted in a bowed turbine rotor.

Personal Injuries

No personal injuries were reported as a result of this incident.

Company Notification and Actions

The Staff received its first notification of the incident by telephone at 3:30 p.m. on June 7, 2000, only one hour and 23 minutes following the turbine trip. SJLP was required to report to the Staff by Commission Rule 4 CSR 240-20.080 because Unit 4 supplies greater than 20% of SJLP's total power generation and it was apparent that the outage would last more than three days. SJLP immediately began damage assessment of the turbine/generator and to search for replacement power. On June 22, 2000, SJLP and

the Staff met in Jefferson City. SJLP explained details of the incident and announced SJLP's intention to file an application for an Accounting Authority Order (AAO). SJLP filed its application for an AAO the very next day on June 23, 2000. Repairs to Unit 4 were completed by August 8, 2000, and on August 11, 2000, SJLP notified the Staff by telephone that the repairs and testing were complete, and that Unit 4 was available for dispatch up to 100% load.

PSC Staff Investigation

One member of Staff's Electric Department visited the Lake Road Plant on the morning of June 9, 2000. Very little damage could be observed. The Staff observed scorched paint at the turbine/generator bearings seals location. No disassembly work had yet begun so Staff interviewed SJLP personnel and took photographs (see Appendix A). Three other members of the Staff's Electric Department and one member of the Staff's Accounting Department returned on June 16, 2000, to observe the damage and the repairs underway. The turbine bonnet and upper casing had been removed and the turbine/generator rotor was removed from the lower casing. Staff observed the damage to the turbine shaft bearings and generator rotor bearings and took photographs. Staff also interviewed SJLP personnel and toured the control room. On July 5, 2000, the Staff requested the Commission open a docket to investigate the incident. The Staff began to issue Data Requests (DRs) on July 13, 2000. On July 27, 2000, the Commission Order establishing Case No. ES-2001-28 was issued. Three members of the Staff's Electric Department again visited the Lake Road Plant on July 28, 2000, to interview SJLP personnel and observe the progress of repairs. In addition, the Staff gathered information

from DRs in this case and in Case No. EO-2000-845. Repairs were complete and Unit 4 was placed back on line on August 8, 2000.

ANALYSIS

Mechanical Analysis

Timeline of Events

6/07/00	11:00:00	a.m.	Turbine/generator output at 94 MW
6/07/00	11:??:00	a.m.	Troubleshooting of vibration probes begins
6/07/00	12:00:00	p.m.	Turbine/generator output at 102 MW
6/07/00	2:06:26:000	p.m.	High vibration alarms on bearings #1, 2, 3, and 5
6/07/00	2:06:26:312	p.m.	Mark V trips turbine/generator
6/07/00	2:06:26:812	p.m.	Main auxiliary transformer breaker trips
6/07/00	2:06:26:812	p.m.	AC oil pumps lose power
6/07/00	2:06:27:625	p.m.	Oil pressure falls to low pressure alarm set point
6/07/00	2:06:27:625	p.m.	DC oil pump fails to start upon low oil pressure
6/07/00	2:06:27:625	p.m.	Loss of oil sealing pressure to the hydrogen seals and bearings
6/07/00	2:06:30:???	p.m.	Bearings overheat, cause alarm, high vibrations and damage shaft seals
6/07/00	2:07:49:???	p.m.	Low generator hydrogen pressure, hydrogen escapes and explodes
6/07/00	2:09:34:???	p.m.	AC oil pump re-energized
6/07/00	2:09:36:000	p.m.	Oil pressure returns and alarm clears
6/07/00	2:09:36:???	p.m.	Oil escapes from damaged seals catches on fire and explodes

6/07/00	2:31:18:???	p.m.	Operators stop the AC oil pump
6/07/00	2:31:28:???	p.m.	Oil pressure is lost to bearings and stops fire
6/07/00	2:31:28:???	p.m.	Additional damage to bearings and shaft occur due to friction and over heating.
6/07/00	2:31:28:???	p.m.	Bearings overheat and seize, stopping turbine rotation
6/07/00	2:42:38:???	p.m.	Turning gear motor fails to rotate turbine shaft because of damage

Discussion

The troubleshooting being performed on the vibration monitoring equipment at the time of the trip most likely caused the trip; however, this has not been confirmed, despite testing done by SJLP and the contractors SJLP hired to investigate the cause of the trip. Regardless of the cause of the trip, the damage to Unit 4 was caused by the loss of lubricating oil to the bearings following the trip. The explosions and fires were caused by the loss of seal oil pressure and the escape of hydrogen and oil to the atmosphere. Damage from the fire was limited to scorched paint. However, damage due to loss of lubricating oil was extensive. All five bearings were damaged both on the shaft and on the casing. Damage to the seals can be attributed to the vibration caused when the turbine shaft began rubbing against the bearings without any lubricating oil. The vibration and speed sensors were destroyed when the shaft contacted them. The turning gear was also damaged by contact with the shaft. Failure of the turning gear caused the turbine rotor to bow from the weight of the shaft. Other than the bearings, the generator rotor was not damaged by this incident.

Operational Analysis

Timeline of Events

?/??/1966	Manual control switch for the DC oil pump installed as part of original system
5/01/1995	Digital Control System (DCS) installed
1/11/2000	GE contracted to install Mark V turbine generator controls
1-2/??/2000	Decision made to remove manual DC oil pump switch
5/06/2000	Unit 4 originally scheduled to shutdown for spring outage
5/02/2000	Unit 4 shut down early due to forced outage
5/??/2000	Manual switch for DC oil pump removed during the installation of Mark V
5/24/2000	Last time DC oil pump tested with DCS; DCS set to auto, the AC oil pump breaker tripped and the DC oil pump starts. DC oil pump stopped. **Operator does not return control to auto**
6/02/2000	Startup of Unit 4 commenced
6/02/2000	DC oil pump not tested **as required by startup procedure** (see Schedule 2, Appendix B)
6/05/2000	**DC oil pump not tested during weekly operational checks**
6/07/2000	Unit 4 Turbine /Generator trips, DC oil pump does not start and extensive damage occurs

Discussion

The loss of the oil pressure and the failure of the hydrogen seals, and thus the damage to the turbine occurred as a result of the failure of the DC oil pump to start after the trip. The DC oil pump failed to start because SJLP operators did not understand the operation of the DC oil pump from the DCS and thus failed to place the DCS control for the DC oil pump in the automatic mode.

In the direct testimony given by Dwight V. Svuba in Case No. EO-2000-845, Mr. Svuba explains:

> "... Prior to May 2000, the primary control interface for the DC lube oil pump was a pistol grip control switch with indicating lights, located on the north wall of the control room. The position of the switch and the status of the lights provided a clear indication of the pump's status to the operator. The secondary control interface was an electronic control station on the unit's distributed control system (DCS), i.e. on a computer screen. This electronic control station was only visible to the operator when that particular screen was displayed on one of the operating consoles. During the replacement project, the wall switch (along with several others) was removed to allow the installation of the Mark V turbine control system cabinet. **After the switch was removed, the operators had to use the DCS console display to control the pump and determine its status** (emphasis added)..." (Exhibit 5, page 7, lines15 through 22, and page 8, lines1 through 2.)
>
> "...It was generally believed by plant personnel (not only operators, but also engineers and supervisors) that the DC oil pump returned to the automatic mode after the pump was stopped by the operator..." (Exhibit 5, page 8, lines 9 through 11.)
>
> "... The manual control switch (that was removed) returned to the automatic position after a stop command. Similarly, the DCS controls for the two AC lube oil pumps each had the return to auto feature. Since the operators operate the AC oil pumps much more often than the DC pump, they became accustomed to this feature with oil pumps..."(Exhibit 5, page 8, lines17 through 20.)

SJLP plant personnel had over 5 years, from May 1995 through May 2000, to learn and understand the operation of the DC oil pump from the DCS. In addition, according to company procedures, the DC oil pump's operation is routinely checked on a weekly basis and also upon startup of the unit (see Appendix B, Schedules 1 and 2). It should have been checked by SJLP on June 2, 2000 and again on June 5, 2000. SJLP's startup procedure requires the operator to test the operation of the DC oil pump by pushing a test button and observing that the DC oil pump has started. The operator is then

instructed, by the test procedure, to stop the DC oil pump, and return the DC oil pump control to 'Auto' (see Schedule 1, Appendix B).

The fact that SJLP had removed the familiar return-to-auto manual switch did not remove the ability of the operator to return the DC oil pump control to auto. SJLP contracted with SEGA, Inc., to review and test the logic of the DCS. SEGA, Inc. found that the DC oil pump would work when placed in auto (see schedule 3 Appendix B). The operator could have used the DCS to return the DC oil pump to auto, but did not. Therefore, the DC oil pump control was still in the stop position when the AC oil pumps lost power. SJLP personnel's lack of understanding of the operation of the DCS was the major contributing factor to this incident.

Actions Taken to Prevent Recurrence

SJLP took actions to prevent a recurrence of this type of incident before Unit 4 was restarted on August 8, 2000. SJLP modified the electrical supply for one of the AC bearing and seal oil pumps so that it is supplied power from a source independent of the Unit 4 main auxiliary transformer. This modification allows at least one AC oil pump to run even after a Unit 4 trip. SJLP also reinstalled the manual DC oil pump control switch, which the operators were familiar with. It is hard-wired independent of the DCS. SJLP also provided additional control room alarms for the lube oil system through the DCS. SJLP changed operating procedures to reflect these changes and provided operator training on these changes. SJLP personnel also are provided additional training on the Mark V system.

CONCLUSIONS

1. On June 7, 2000 at 14:07 p.m., Unit 4 tripped. The cause of the trip is unknown, but was most likely due to the troubleshooting efforts on the turbine vibration monitoring system.
2. The damage which occurred to the #4 turbine/generator resulted in an outage from June 7 to August 8, 2000.
3. The first explosion and fire were caused by the ignition of escaping hydrogen gas due to loss of oil pressure to the hydrogen seals.
4. The second explosion was due to the ignition of pressurized hot oil spray after oil pressure was restored.
5. The initial loss of oil pressure was due to the failure of the DC oil pump to start after Unit 4 tripped.
6. The DC oil pump failed to start because a SJLP operator had placed the control for it in the stop position during an operational check and no one returned the control to automatic prior to the June 7, 2000 trip.
7. The damage to Unit 4 turbine/generator was due to the loss of lubricating oil to the turbine bearings after failure of the DC oil pump to start automatically and the operator shutting off the AC oil pumps to end the fire.
8. SJLP did not change its DC oil pump test procedure after removing the manual DC oil pump switch. The procedure still reads as follows: "6. Head Operator should stop DC oil pump and verify that control switch returns to 'Auto' position." The procedure does not tell the operator what action to take with regards to the DCS.

9. The Unit 4 procedures require the operator to check the operation of the DC oil pump weekly and before startup.

10. The DC oil pump will start and maintain oil pressure when placed in 'Auto' mode in the DCS.

RECOMMENDATIONS

Based on the Staff's investigation and review of this incident, the Staff recommends that SJLP:

1. Modify the DC oil pump test procedure to read: "6. Head Operator should stop the DC oil pump and verify that the control switch returns to the 'Auto' position or place DCS control for the pump in Auto."
2. Provide operator training on the above procedure.
3. On-site refresher training, for operators and shift supervisors, for both the DCS and the Mark V controls, should be conducted periodically and documented.
4. Any system maintenance or troubleshooting that has the potential to trip the turbine should be scheduled and performed only during periods of shutdown or low load demand.
5. Develop procedure to include at least one shift supervisor in early planning stages of any modification to the plant.
6. Within 180 days, SJLP should:
    1) Identify and review, with supporting documentation, all of the critical control systems used in the operation of its power plants to assure that appropriate redundancies and fail-safe designs are in place;

2) Document that appropriate personnel are properly trained on the operation of these critical control systems, including backup (i.e. redundant) systems; and

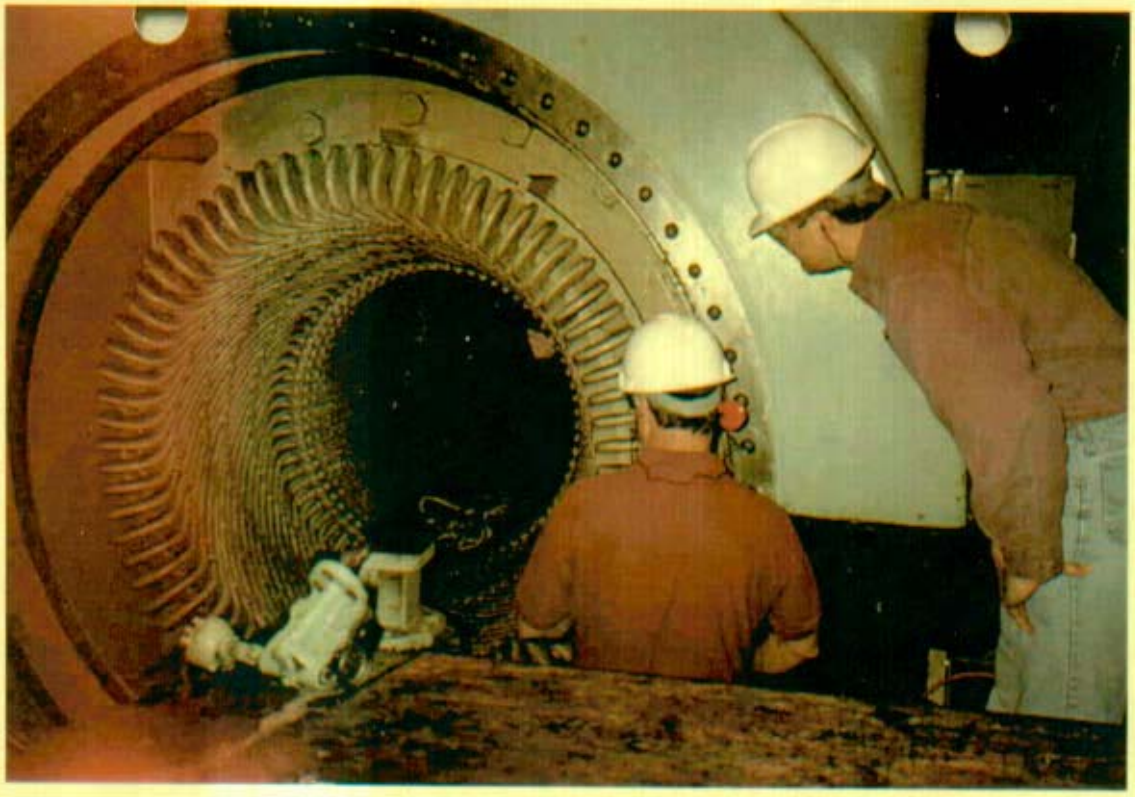
3) Report, in writing, its activities regarding items 1) and 2) to the Commission's Electric Department, Engineering Section.

APPENDIX A

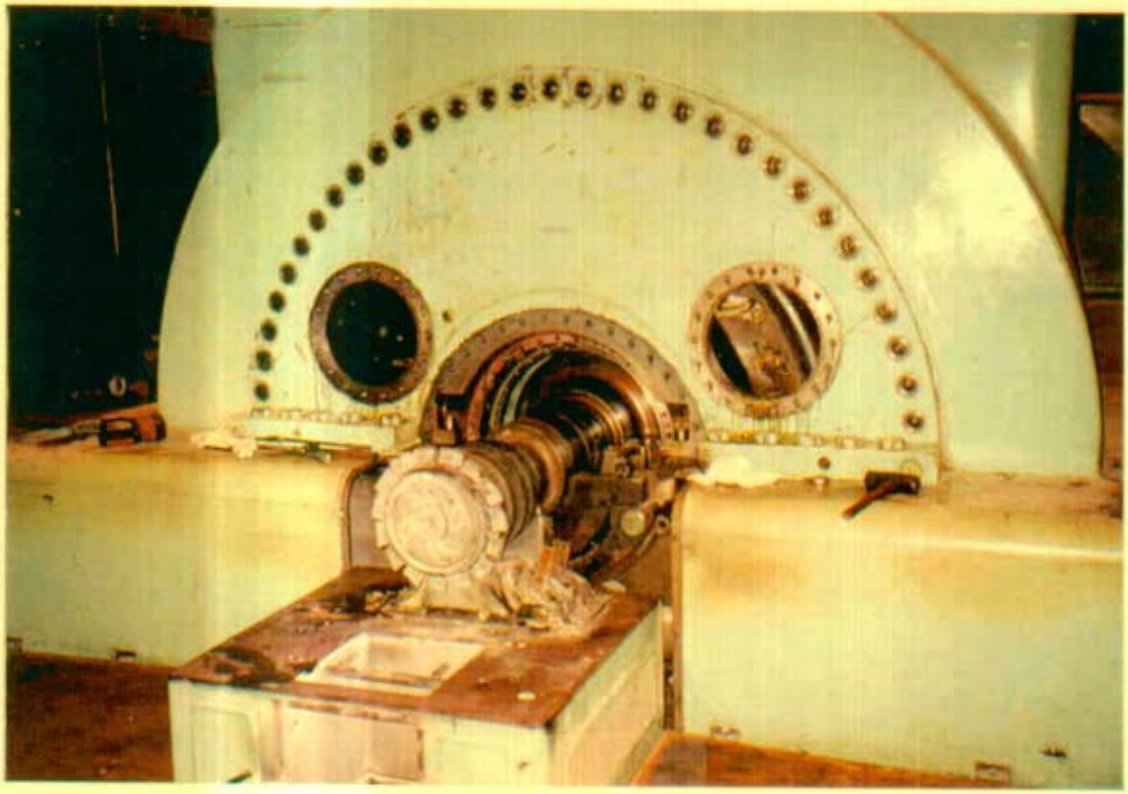
Photographs

Photograph 1. Scorched paint on generator and No. 5 bearing damage

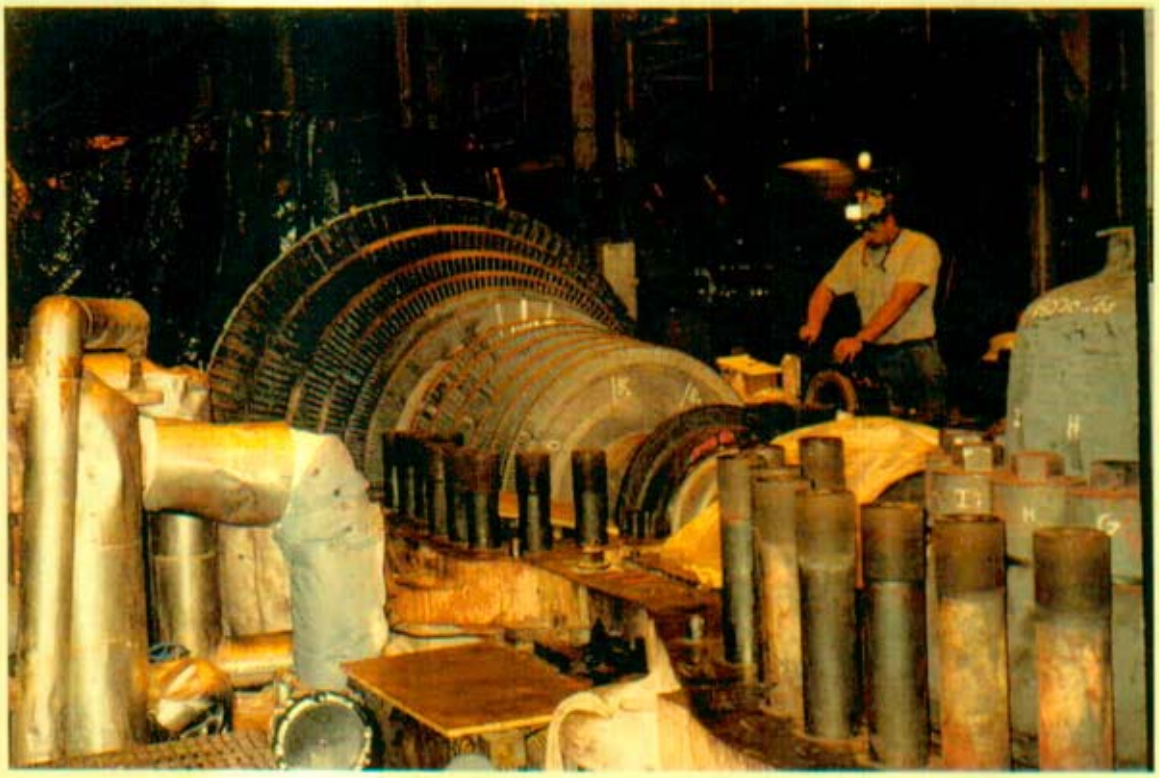
Photograph 2. No. 3 & 4 bearings



Photograph 3. Generator stator with rotor removed.



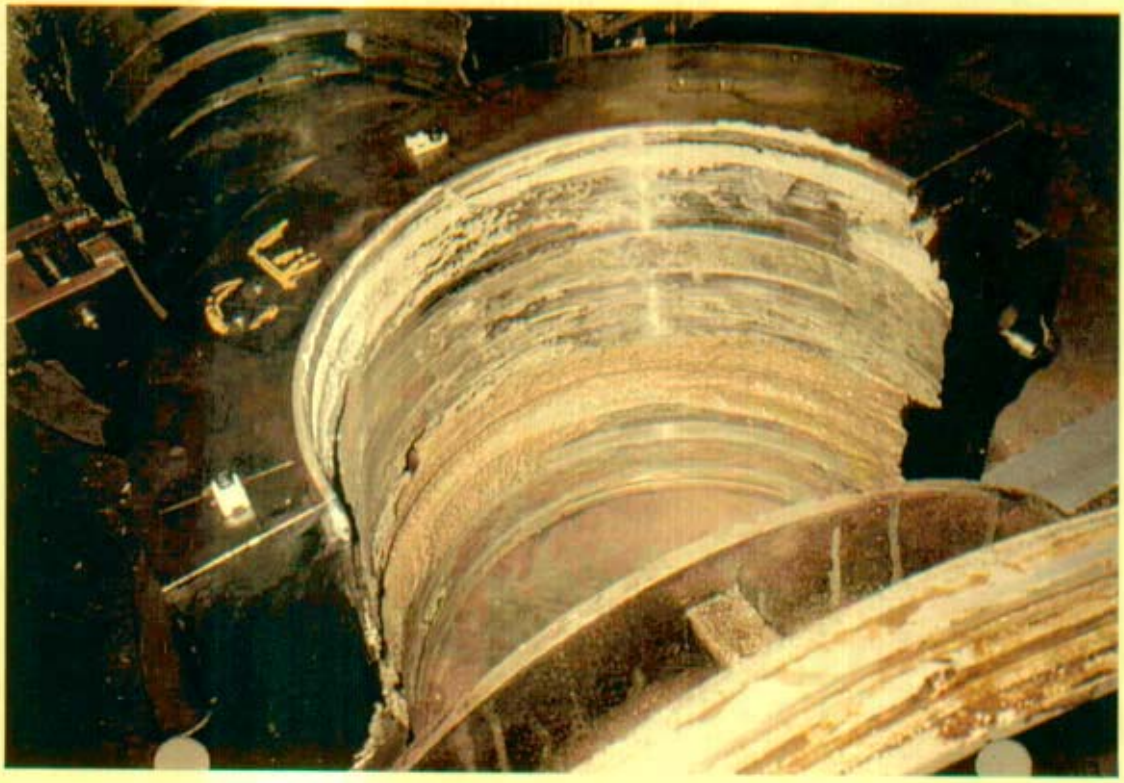
Photograph 4. No. 5 bearing on generator end



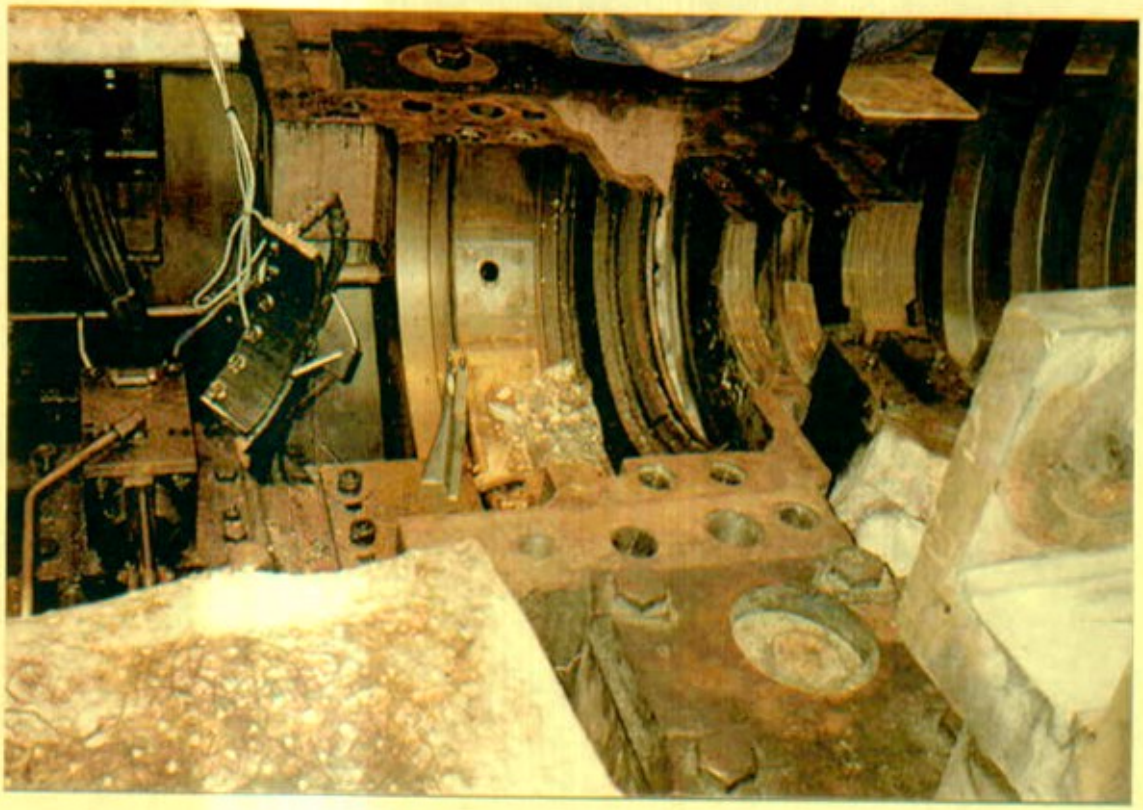
Photograph 5. Turbine rotor and blades with upper casing removed

Photograph 6. Turbine rotor with work in progress

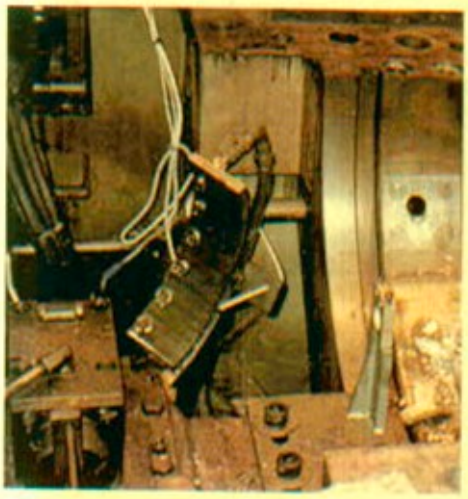
Photograph 7. Turbine lower casing and seals



Photograph 8. No. 2 bearing damage



Photograph 9. No. 2 & 3 bearing housing and seal damage



Photograph 10. Instrumentation damage

Photograph 11. DCS operator interface located in control room

Photograph 12. Newly reinstalled DC oil pump control switch in control room (extreme left with red tag)

Photograph 13. Mark V operator interface and display in control room.

APPENDIX B

Attachments

PROCEDURE: TURBINE 4 – DC OIL PUMP TEST

1. NOTIFY HEAD OPERATOR YOU ARE GOING TO TEST DC OIL PUMP.
2 DEPRESS "DC PUMP TEST" BUTTON.
3 VERIFY THAT DC PUMP STARTS.
4 VERIFY THAT "EMERG. BEARING OIL PUMP – RUN" RED LIGHT LIGHTS.
5 NOTIFY HEAD OPERATOR THAT TEST IS COMPLETE.
6 HEAD OPERATOR SHOULD STOP DC OIL PUMP AND VERIFY THAT CONTROL SWITCH RETURNS TO "AUTO" POSITION.

START UP #4 TURBINE

March 29, 1982
Rev. #2 May, 3, 1983

See Back of 3rd Page

1. Check turning gear, should be on at least 3 hours.
2. Check bearing oil flows at bearings.
3. Check bearing oil pressure, 23 lbs., min.
4. Check bearing and seal oil pumps for operation, (3).
5. Check hydraulic pumps for operation (2) 1600 lbs., min., fluid temp. should be 90°(F) min.
6. Check lubeoil tank level.
7. Check lube oil tank vapor extractor.
8. Check bearing drain enlargement exhauster.
9. Check electrical trip device.
10. Check oil trip at front standard.
11. Check reheat and intercept valves.
12. Check stop valve.
13. Check control valves.
14. Start circulating water pump and fill condenser.
15. Start water box vacuum pump.
16. Set turbine drains to boiler raising pressure setting.
17. Light #6 boiler following light off and pressure raising procedure.
18. Due to modifications to the turbine at the last overhaul, there should be no more cold starts.
19. If the turbine metal temperatures are above 300°(F), proceed with a warm start.
20. If the turbine metal temperatures are below 300°(F), proce with turbine prewarm instructions when #6 boiler pressure reaches 200 lbs or 2 hours.
21. * Proceed with warm start. See note on Back of 2nd page
22. Close vacuum breaker.
23. Put on steam seal at 3 lbs.
24. Start gland exhauster.

Sega®

CONFIDENTIAL

July 6, 2000

St. Joseph Light & Power Company
Lake Road Plant
P.O. Box 998
St. Joseph, MO 64502-0998

Attention: Mr. John Modlin

Re: St. Joseph Light & Power Company
Lake Road Plant
Turbine 4 Engineering Analysis
Sega Project No. 00-194

SUBJECT: DC EMERGENCY BEARING AND SEAL OIL PUMP ENGINEERING ANALYSIS

Dear Mr. Modlin:

Sega was asked to perform two (2) tasks by St. Joseph Light & Power Company (SJL&P). Task 1 was to determine if the wiring and function of the DC emergency bearing and seal oil pump for Turbine 4 are as shown on marked Drawings K-1 and K-1A, Rev. 0, as provided by SJL&P. These drawings were part of a set marked "Mark V Retrofit, Engineering Services, GE Co." Task 2 was to describe the distributed control system (DCS) logic for the pump as shown on Drawing B6MCSA3A as provided by SJL&P. Copies of these drawings are attached with this letter.

Task 1

On June 15, 2000, Sega observed SJL&P personnel perform continuity checks on all wiring shown on Drawing K-1A. Sega believes that Drawing K-1A accurately represents the wiring of the pump.

With the pump motor leads disconnected, Sega observed SJL&P personnel place the pump in the automatic state with the DCS. With the pump in automatic, the motor starter contactor was energized.

Sega then observed SJL&P personnel put the pump in the off state with the DCS. With the pump in the off state, the motor starter contactor was de-energized.

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Sega Inc.
16041 FOSTER
P.O. BOX 1000
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PHONE [illegible]

Sega next observed SJL&P personnel put the pump in the on state with the DCS. With the pump in the on state, the motor starter contactor was energized.

Sega lastly observed SJL&P personnel return the pump to the off state with the DCS. With the pump returned to the off state, the motor starter contactor was de-energized.

Sega believes that Drawing K-1 accurately represents the electrical and control function of the pump.

Sega also observed that input 6-ZSO-1160 (Pump Not Running) was present at termination Unit 3-3A, but not present at the module level. This was found while observing the I/O with monitor/tuning at the engineering work station. The impact of the absence of this signal at the module level is described later in this letter.

Task 2

On June 19, 2000, Sega reviewed the DCS logic. The following paragraphs describe the DCS logic including the multi-state device driver (MSDD) and all supporting control logic.

The MSDD is designed for manual mode only, requiring the control room operator (operator) to select the desired output. There is no other means of manipulating the outputs of the MSDD other than the override logic described later.

The three outputs associated with the MSDD are start, auto, and stop. When the operator selects a particular output, it is set (memorized) in logic, and the other two outputs are reset to logic zero. This is done using set/reset latches. Any output may be selected at any time by the operator. The only way to reset a selected output is for the operator to select a different output, or for the module to be taken out of execute mode which will reset all outputs to logic zero.

The override logic of the MSDD is executed when either the operator depresses the Auto/Man key on the keyboard or when the MSDD feedback masks do not match the corresponding output mask within 60 seconds. If either of these conditions occur, the MSDD will be overridden, remain in the manual mode, and all MSDD outputs will be set to the default output mask. The default output mask is logic zero for all three MSDD outputs. The following feedback/output mask conditions will activate the override logic:

1. A stop has been requested by the operator, and the running signal does not go to a logic zero and/or the not running signal does not go to a logic one.

2. A start has been requested by the operator, and the running signal does not go to a logic one and/or the not running signal does not go to a logic zero.

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The start output is sent through a five-second time delay before going through an AND block along with the not running signal to generate a "TRIPPED" alarm. This will alarm the operator that the pump has tripped only after a start from the DCS was given.

6-ZSO-1160

Sega was also asked to investigate the function of input 6-ZSO-1160 by SJL&P on June 23, 2000. Sega reviewed graphic TURBINE.DR and the exception reports from logic sheet B6MCSA3A and determined that the absence of 6-ZSO-1160 at the module level would have generated an MSDD alarm sixty seconds after a pump-stop command was given by the control room operator. Sega also determined that the absence of 6-ZSO-1160 would not affect the starting/stopping of the pump, or the indication of running/not running at the console.

If you have any questions or comments, please call.

Sincerely,

SEGA INC.

Frederick R. Tolman, P.E.

Homer Clark, P.E.

FRT/sc

Enc. 3

c: Dick Sands
Jorge Carballeira
Bob Tolman

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BEFORE THE PUBLIC SERVICE COMMISSION

OF THE STATE OF MISSOURI

IN THE MATTER OF AN INCIDENT AT ST JOSEPH LIGHT & POWER COMPANY'S LAKE ROAD POWER PLANT ON JUNE 7, 2000.	))))	ES-2001-28

AFFIDAVIT OF LEON C. BENDER

STATE OF MISSOURI)
) **ss**
COUNTY OF COLE)

Leon C. Bender, of lawful age, on his oath states: that he has participated in the preparation of the foregoing incident report consisting of 29 pages; that he has knowledge of the matters set forth in the report; and that such matters are true to the best of his knowledge and belief.

Leon C. Bender

Subscribed and sworn to before me this 6th day of December, 2000.

Joyce C. Neuner
Notary Public, State of Missouri
County of Osage
My Commission Exp. 06/18/2001

Notary Public

My commission expires