

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-315/93003; 50-316/93003

Docket No. 50-315; 50-316

License No. DPR-58; DPR-74

Licensee: Indiana Michigan Power Company
1 Riverside Plaza
Columbus, OH 43216

Meeting Conducted: January 8, 1993

Meeting At: Region III Office, Glen Ellyn, Illinois

Type of Meeting: Enforcement Conference

Inspection Conducted: Onsite at D. C. Cook Nuclear Plant, December 3
through 18, 1992.

Inspectors:	<i>WDS for</i> J. A. Esom Senior Resident Inspector	<u>1-15-93</u> Date
	<i>WDS for</i> D. J. Hartland Resident Inspector	_____ Date
Reviewed By:	<i>WDS for</i> B. L. Jorgensen, Chief Reactor Projects Section 2A	_____ Date
Approved By:	<i>WDS for</i> W. D. Shafer, Chief Reactor Projects Branch 2	<u>1-15-93</u> Date

Meeting Summary

Enforcement Conference on January 8, 1993, (Report No. 50-315/93003;
50-316/93003)

Areas Discussed: A review of the apparent violations and areas of concern identified during the inspection, and corrective actions taken or planned by the licensee. The enforcement options pertaining to the apparent violations were also discussed with the licensee.

DETAILS

1. Persons Present at Conference

E. E. Fitzpatrick, Vice President, Nuclear Operations
A. A. Blind, Plant Manager
G. A. Weber, Plant Engineering Superintendent
J. S. Wiebe, Safety and Assessment Superintendent
J. R. Sampson, Operations Superintendent
S. A. Richardson, Production Supervisor
R. J. Sieber, Shift Supervisor
P. G. Schoepf, Project Engineering Superintendent
S. J. Brewer, Nuclear Safety and Licensing Manager
D. Malin, Nuclear Licensing Manager
R. Rickman, Outage Manager
W. G. Smith, Jr., Chief Nuclear Engineer
M. Ackerman, Nuclear Licensing Engineer
K. J. Newell, System Engineer
R. B. Bennett, Senior Engineer

U.S. Nuclear Regulatory Commission, Region III

A. B. Davis, Regional Administrator, RIII
W. L. Forney, Deputy Director, Division of Reactor Projects, RIII
W. D. Shafer, Chief, Reactor Projects Branch 2, RIII
E. R. Schweibinz, Senior Project Engineer, RIII
J. Luehman, Office of Enforcement (via telephone)
W. M. Dean, Licensing Project Manager, NRR (via telephone)
J. A. Isom, Senior Resident Inspector, RIII
D. J. Hartland, Resident Inspector, RIII
R. L. Bywater, Reactor Engineer, RIII
B. A. Berson, Regional Counsel, RIII
R. W. DeFayette, Chief, Enforcement and Investigations
Coordination Staff, RIII
G. M. Smith, Enforcement Specialist, RIII
D. M. O'Neal, General Engineer (Intern)

2. Enforcement Conference

An enforcement conference was held in the NRC Region III office on January 8, 1993. This conference was conducted as a result of the preliminary findings of the inspection conducted on December 3 through 18, 1992, in which apparent violations of NRC regulations and license conditions were identified. Inspection findings are documented in Inspection Report No. 50-315/92022; 50-316/92022, transmitted to the licensee by letter dated December 31, 1992.

The purpose of this conference was to (1) discuss the apparent violations, causes, and the licensee's corrective actions; (2) discuss

several areas of concern; (3) determine if there were any escalating or mitigating circumstances; and (4) obtain any information which would help determine the appropriate enforcement action.

The licensee's representatives did not contest any of the apparent violations and were in agreement with the NRC's understanding of the areas of concern. However, with regard to Violation 50-316/92022-03, the licensee's representatives and the NRC agreed that failure to identify and correct the adverse trend of lube oil inventory for the Unit 2 "AB" emergency diesel generator (EDG) was a root cause of the EDG lube oil trip. Failure to correct the before and after pump seal leakage was a contributing cause. Therefore, the NRC will utilize the failure to correct the adverse trend of lube oil inventory as its basis for consideration of enforcement action for this apparent violation.

The licensee's representatives described the events which led to the apparent violations, including root causes and corrective actions taken and planned. A summary of the licensee's corrective actions is included in pages 41 through 43 of the attached handout that the licensee provided at the conference. Included among these were immediate actions to restore operability of the 2 "AB" EDG and verify operability of the other EDGs. Also included were longer-term actions to review/revise procedures, provide additional guidance to personnel for performance of tours, review the work request process, perform an engineering review of the lube oil gauge design adequacy, review other level gauge installations, and increase the frequency and scope of level alarm operational checks. The licensee also addressed the safety significance of the EDG inoperability.

At the conclusion of the meeting, the licensee was informed that they would be notified in the near future of the final enforcement action.

Attachment: As stated



NRC ENFORCEMENT CONFERENCE

**DIESEL GENERATOR
LUBE OIL TRIP**

JANUARY 8, 1993



MANAGEMENT CONCERN

ISSUE RECEIVED HIGH LEVEL OF UPPER MANAGEMENT ATTENTION

- Thorough Immediate Actions
 - Included Inspection of Bearings
 - Notification to Operating Shifts
 - Checking of Other Lube Oil Tanks
 - Established Interface With Resident Inspector
- Multidisciplinary Task Force
 - Investigate Event
 - Determine Root and Contributing Causes
- Operations Task Force
 - Review Tour Practices
 - Review Data Sheet Practices

AGENDA

I. INTRODUCTORY REMARKS

II. BACKGROUND

- A. System Description
- B. Chronology

III. ROOT AND CONTRIBUTING CAUSES

IV. ISSUES AND CORRECTIVE ACTIONS

- A. Process Related Issues
- B. Equipment Related Issues
- C. Work Scheduling Issues

V. SAFETY AND LICENSING SIGNIFICANCE

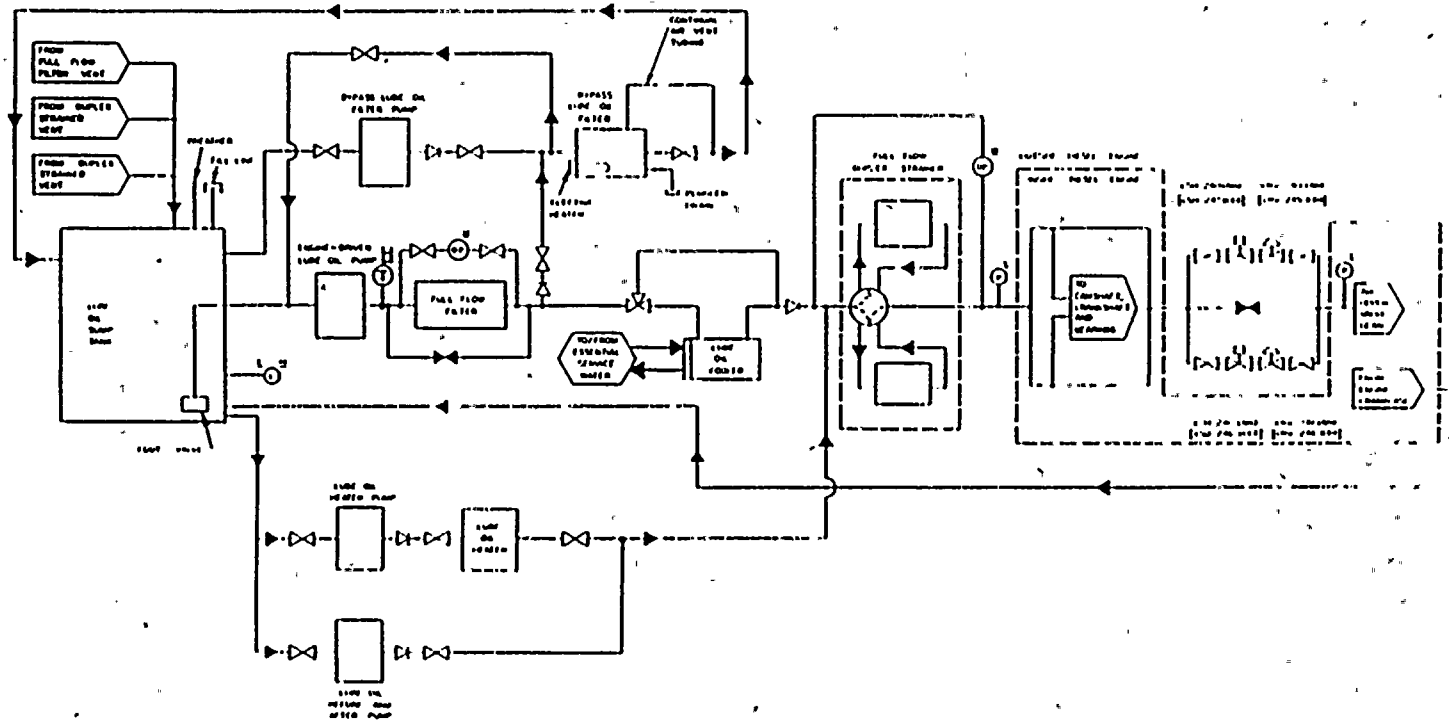
- A. Time of Inoperability
- B. Safety Significance
- C. Factors for Consideration

VI. CONCLUDING REMARKS

Diesel Generator Lube Oil System

Function

- To provide clean, warm lube oil to the Emergency Diesel Generator bearings and valve gear during operation and while in standby service.



EMERGENCY DIESEL GENERATOR LUBE OIL SYSTEM

Diesel Generator Lube Oil System Instrumentation

Sump Tank Level Gauge (LLI-210)

- Local level Indication (200 to 700 Gallon)
- Pressure Guage

Sump Tank Level Alarm (LLA-110)

- Control Room annunciator on low (395 Gal.) or high (650 Gal.) level
- Magnetrol Displacement Level Alarm System

Pressure Indicator (LPI-220)

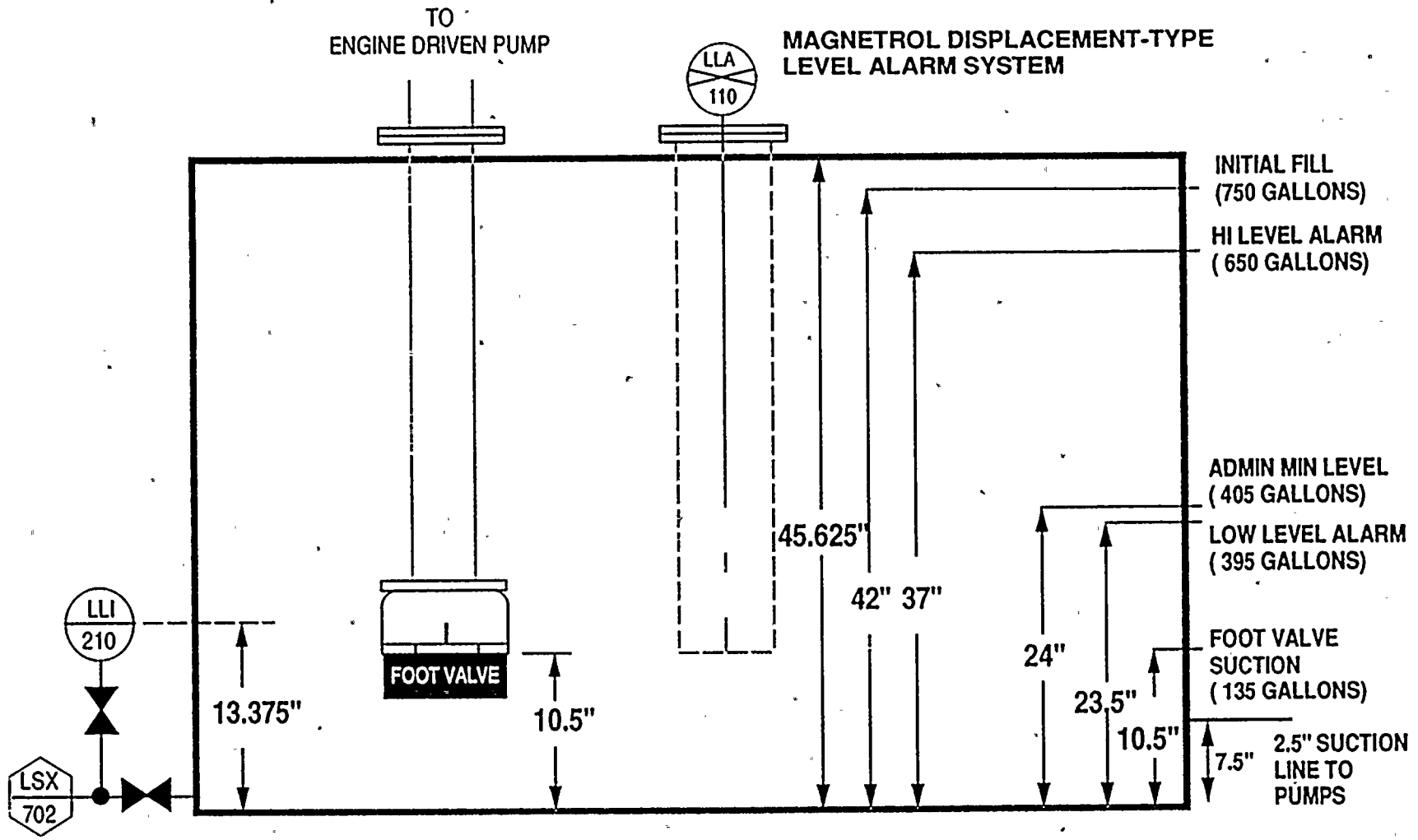
- Local Pressure Indicator (0-100 PSIG)

Low Pressure Alarm (LPA-220)

- Control Room annunciator if oil pressure drops to 35 PSIG

Low Pressure Shutdown (LPS-220)

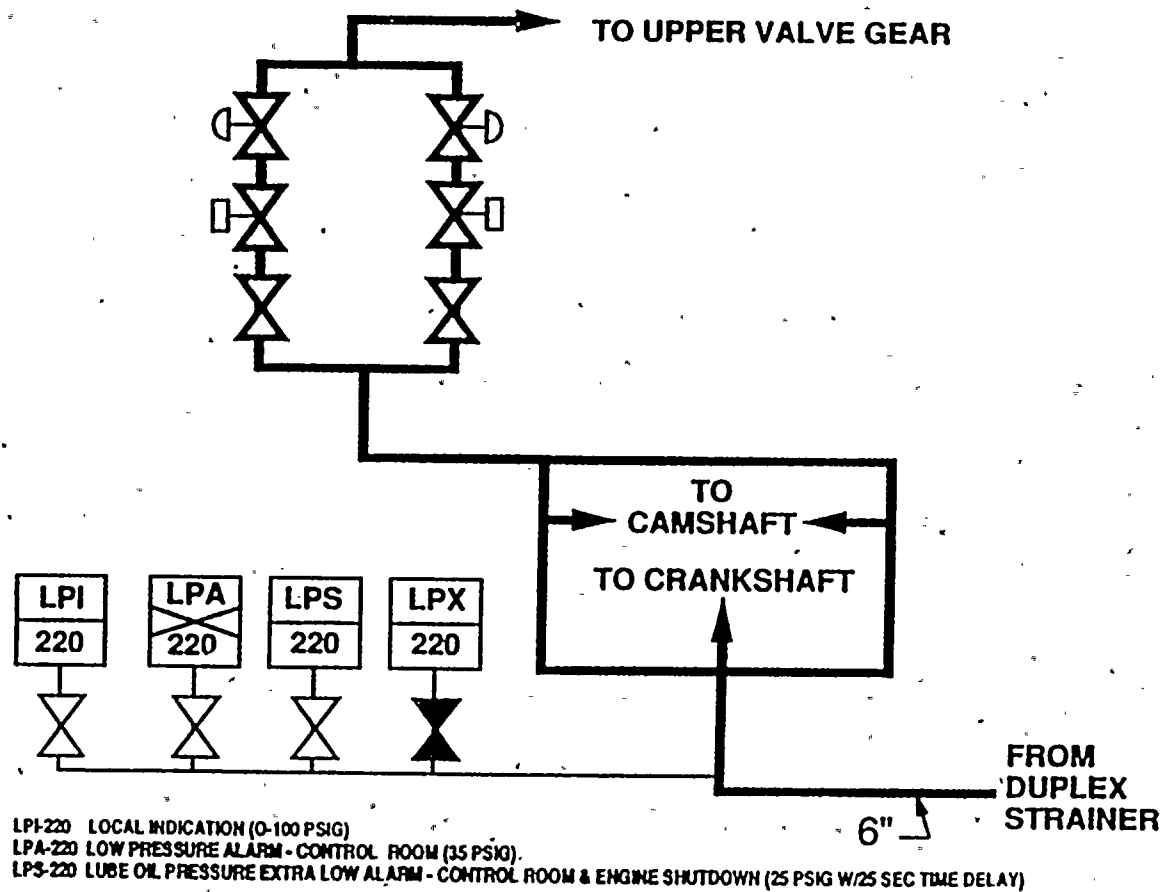
- Control Room annunciator (Oil Pressure Extreme Low) and engine trip (during non-safety related operation) if oil pressure drops to 25 PSIG for 25 seconds.



DIESEL GENERATOR LUBE OIL SUMP TANK



Instrumentation Taps



LPI-220 LOCAL INDICATION (0-100 PSIG)
LPA-220 LOW PRESSURE ALARM - CONTROL ROOM (35 PSIG)
LPS-220 LUBE OIL PRESSURE EXTRA LOW ALARM - CONTROL ROOM & ENGINE SHUTDOWN (25 PSIG W/25 SEC TIME DELAY)

Event Description

DG2AB Lo-Lo Lube Oil Pressure Trip

- **September 28, 1992**
- **Routine Operations Department Surveillance**
- **Engine Start**
- **Lo-Lo Lube Oil Pressure Trip Due To Low Lube Oil Sump Tank Level**
- **Engine Declared Inoperable**

Immediate Corrective Actions

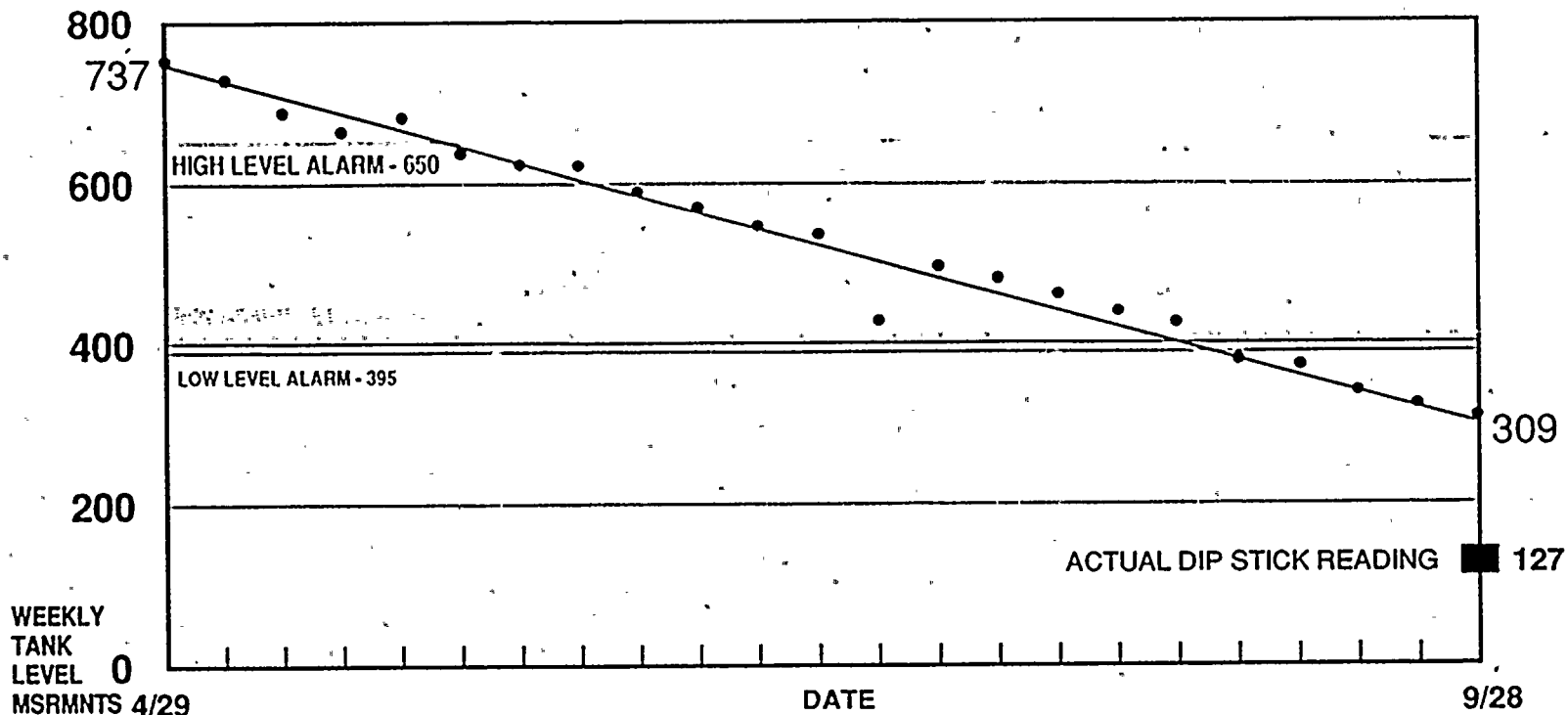
- Oil Level Check
- Replenished Oil Supply
- Repaired B&A Pump Leak
- Verified Oil Supply on
Other Engines
- Checked Bearing
Clearances
- Inspected #4 Bearing
- Initiated Root Cause
Investigation

Root Cause Investigation

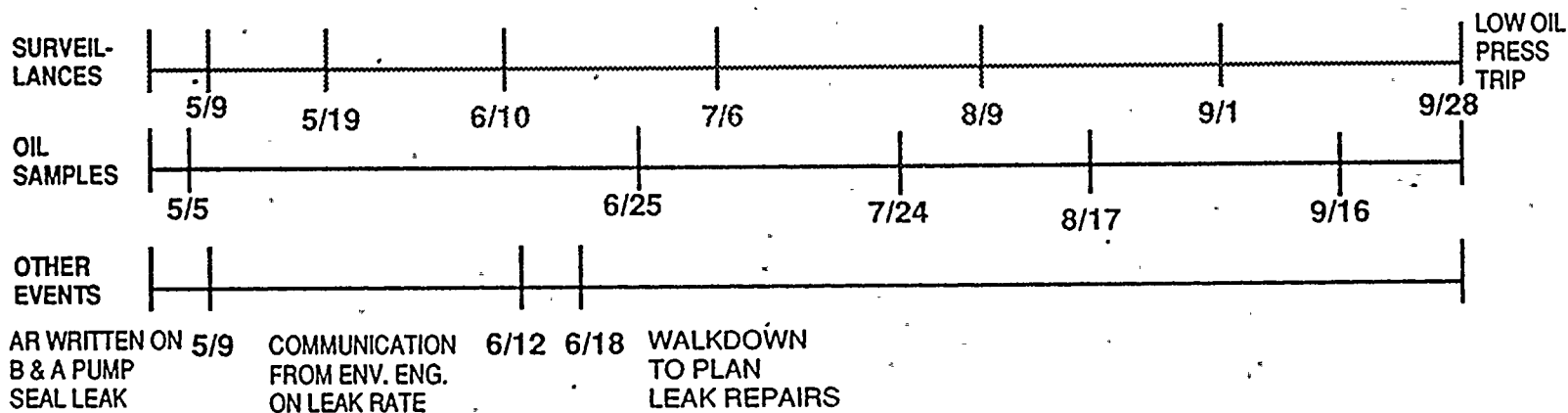
DG2AB Lo-Lo Lube Oil Pressure Trip

- Investigation Team
 - System Engineer
 - Safety & Assessment
 - Operations
 - I&C Engineer
 - Project Engineering
- Actions Taken
 - Reviewed Operations Tour Data
 - Reviewed Surveillance History
 - Reviewed Maintenance History
 - Reviewed Level Gauge Design Change Package
 - Interviews with Operations, Maintenance, Environmental
 - Field Observations

GAL 2 AB LUBE OIL TANK INDICATED LEVEL ● INDICATOR LEVEL



WEEKLY TANK LEVEL 0 MSRMNTS 4/29





Root Cause

Failure to Identify Adverse Lube Oil Level Trend

The Effect...

Precluded Timely Response

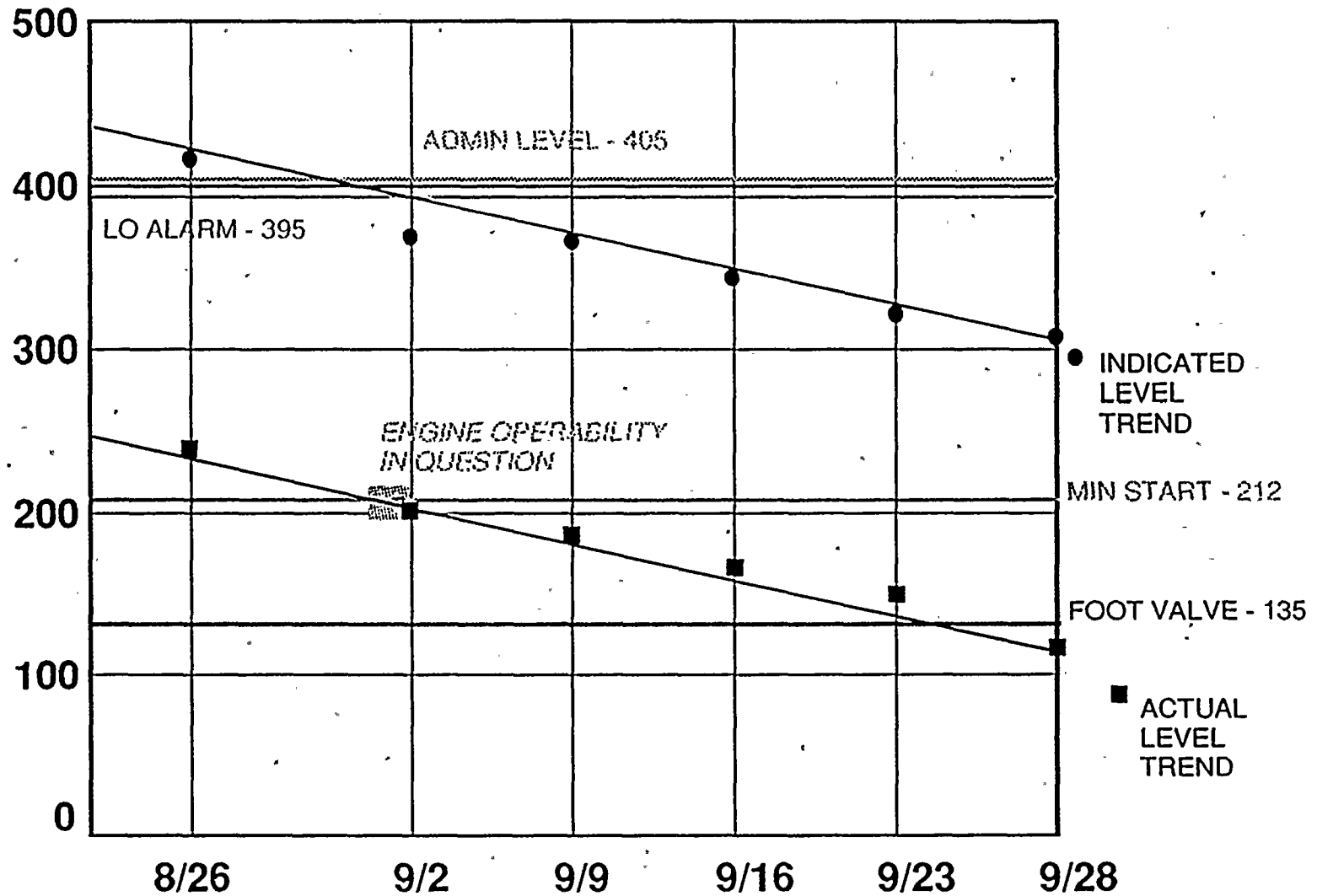
- Oil Supply Not Replenished
- Oil Leak Not Investigated/Corrected
- Eventual Loss of Adequate Oil Supply

Contributing Causes

- **Failure To Recognize Parameter Outside Acceptance Criteria**
- **Pump Seal Leakage**
- **Level Alarm Failure**
- **Level Indicator Problems**

ESTIMATED TIME OF INOPERABILITY

9/2 THROUGH 9/28



Assumes constant 9.5" level difference

PROCESS RELATED ISSUES

- **FAILURE TO IDENTIFY ADVERSE LUBE OIL LEVEL TREND**
- **FAILURE TO RECOGNIZE PARAMETER OUTSIDE ACCEPTANCE CRITERIA**
- **FOLLOW-UP PREVENTIVE ACTION**

DATA COLLECTION/TRENDING PROCESS OVERVIEW

DATA COLLECTION/TRENDING

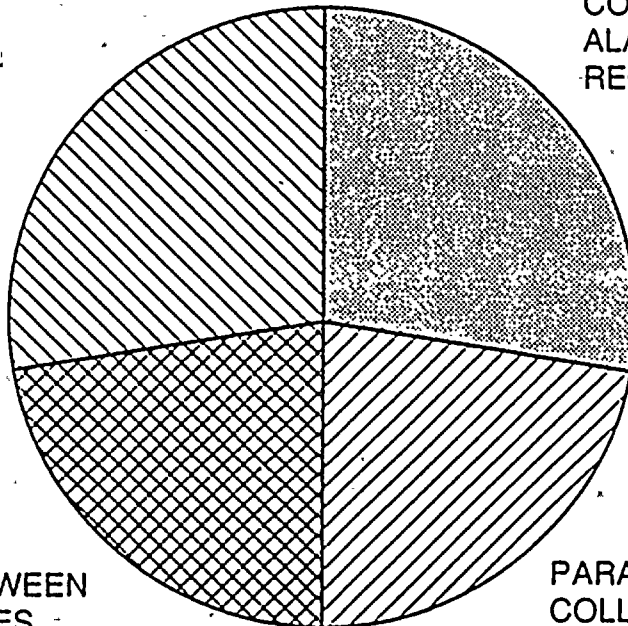
- **OPERATIONS PROCEDURES
- 4030 AND 5030 SERIES**
- **OPERATOR TOURS**

DATA COLLECTION/TRENDING PROCESS OVERVIEW

TOTAL PLANT PARAMETERS AVAILABLE

PARAMETERS WHICH ARE COLLECTED, MONITORED, AND TRENDED IN PLANT PROCEDURES (e.g., 4030 AND 5030 TEST PROCEDURES)

PARAMETERS COLLECTED, MONITORED, AND TRENDED BY CONTROL ROOM ALARMS, AND RECORDERS



OVERLAP BETWEEN SURVEILLANCES AND TOURS

PARAMETERS COLLECTED, MONITORED, AND TRENDED DURING THE PERFORMANCE OF ROUTINE PLANT TOURS

FAILURE TO IDENTIFY ADVERSE TREND

CONTRIBUTING FACTORS

- **INSUFFICIENT TREND DATA
AVAILABLE TO UNIT
SUPERVISOR**
- **ACCEPTANCE CRITERIA NOT
STATED IN DATA SHEET**

SHORT TERM CORRECTIVE ACTIONS

- **DATA SHEET REVISED**
- **INCREASED FREQUENCY OF
DATA COLLECTION**

OHI-5030
ATTACHMENT #2

UNIT 2 LUBE OIL AND EHC TANK LEVEL

Test # 073
ATTACHMENT #1

DAY/DATE:	SUN/6/14	MON/7/15	TUE/8/16	WED/9/17	THU/10/18	FRI/11/19	SAT/12/20	CS-5.8
MAIN TURBINE L.O. TK.	3	3	2.8	2.5	7.8	3.5	7.5	
EAST F.P.T. L.O. TK.	11	2	3.0	4.0	3.0	3.0	3.0	
WEST F.P.T. L.O. TK.	15	15	17.5	14.0	16.0	8.5	13.0	
EAST F.P.T. CONTROL FLUID TK	22	20	21	20	21	20	20	
WEST F.P.T. CONTROL FLUID TK	9	9	9	9	9.0	9.0	9.0	
MAIN CONTROL FLUID TK.	9	9	7.5	7.5	7.5	10.0	25	
LUBE OIL HOLDING TK.	23	23	23	23	23	23	23	
NEW L.O. TK.	54	54	54.5	54.5	43	23	23	
AB DIESEL L.O. TK.	N/A	N/A	N/A	624	N/A	N/A	N/A	CS-5
CD DIESEL L.O. TK.	N/A	N/A	N/A	490	N/A	N/A	N/A	

COMMENTS

6-17 Transferred oil from New L.O TK to M.O. TK. 50
6-20 Added 19 barrels to New L.O. TK

DAY/DATE	SUN/6/14	MON/7/15	TUE/8/16	WED/9/17	THU/10/18	FRI/11/19	SAT/12/20	CS-5.8.1
U.S. REVIEW	AP	AP	BC	BC	BC	AP	AP	

FORWARD TO OPERATIONS ACC ONE WEEK AFTER LAST ENTRY

CS-5



OHI-5030
ATTACHMENT #1

UNIT 1 LUBE OIL AND EHC TANK LEVELS

Test # 73
ATTACHMENT #1

Minimum Level*	Day Date	SUN 12/27/92	MON 12/28/92	TUE 12/29/92	WED 12/30/92	THU 12/31/92	FRI 1/1/93	SAT 1/2/93
- 4"	Main Turbine L.O. Tank	3	3	2.9	2.9	2.9	2.9	2.9
- 2.5"	East FPT L.O. Tank	-1.5	-1.5	-1.3	-1.3	-1.3	-1.5	-1.5
- 2.5"	West FPT L.O. Tank	-1.2	-1.0	-1	-1	-1	-1	-1
- 4"	Main Control Fluid Tank	+2.5	+ .7	.8	.8	.6	.6	.6
N/A	Lube Oil Holding Tank	3	3	3	3	3	3	3
N/A	New L.O. Tank	91	91	91	91	91	91	91
400 gal. 2ft=405gal	AB Diesel L.O. Tank	2'5" 507.4	2'5" 507.4	2'5" 507.4	2'5" 507.4	2'5" 507.4	2'6" 508.275	2'6" 527.5
400 gal. 2ft=405gal	CD Diesel L.O. Tank	2'11" 623	2'11" 623	2'11" 623	2'11" 623	2'9" 586.1	2'9" 615.4	2'10" 604.8
Operator's	Initials	BG	BG	[Signature]	[Signature]	[Signature]	[Signature]	[Signature]

CS-5, E

CS-5

*Minimum Level pertains to normal operations.

Comments Section:

* Relevel 2" change due to visual run, previous night. PD

CS-30

Day Date	SUN 12/27/92	MON 12/28/92	TUE 12/29/92	WED 12/30/92	THU 12/31/92	FRI 1/1/93	SAT 1/2/93
U.S. Review	[Signature]	[Signature]	[Signature]	[Signature]	[Signature]	[Signature]	[Signature]

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FORWARD TO OPERATIONS ACC ONE WEEK AFTER LAST ENTRY

CS-5



FAILURE TO RECOGNIZE PARAMETER OUTSIDE ACCEPTANCE CRITERIA

CONTRIBUTING FACTORS

- **OPERATORS NOT FULLY
AWARE OF ACCEPTANCE
CRITERIA**
- **ACCEPTANCE CRITERIA NOT
EFFECTIVELY COMMUNICATED**

FAILURE TO RECOGNIZE PARAMETER OUTSIDE ACCEPTANCE CRITERIA

SHORT TERM CORRECTIVE ACTIONS

- **OPERATIONS MEMORANDUM**
- **ESTABLISHED SHIFT REVIEW TEAM**
 - **ASSISTANT SHIFT SUPERVISOR**
 - **TOUR OPERATORS**
- **DAILY "DIP STICK" READINGS**
- **DATA SHEET REVISED TO SHOW
ACCEPTANCE CRITERIA**



FOLLOW UP PREVENTIVE ACTIONS

TOUR PROCEDURE WALKDOWN

- **NON-LICENSED OPERATORS, LICENSED OPERATORS, SUPERVISORS**

REVIEW OF TOUR PROCEDURES

- **CRITICAL PARAMETERS**
- **ACCEPTANCE CRITERIA AND COMMUNICATION METHOD**
- **TRENDING**

"POCKET" VERSION OF TOUR PROCEDURES

OPERATIONS POLICY ON TOUR ROTATION

PROCESS RELATED ISSUES

SUMMARY

- EXISTING PROCESS FOR DATA COLLECTION, MONITORING, AND TRENDING EFFECTIVE
- SYSTEM ENGINEER PROGRAM HAS ENHANCED TRENDING PROCESS
- SHORT TERM CORRECTIVE ACTIONS PREVENT SPECIFIC EVENT
- BROAD-BASED FOLLOW-UP ACTIONS

AEP

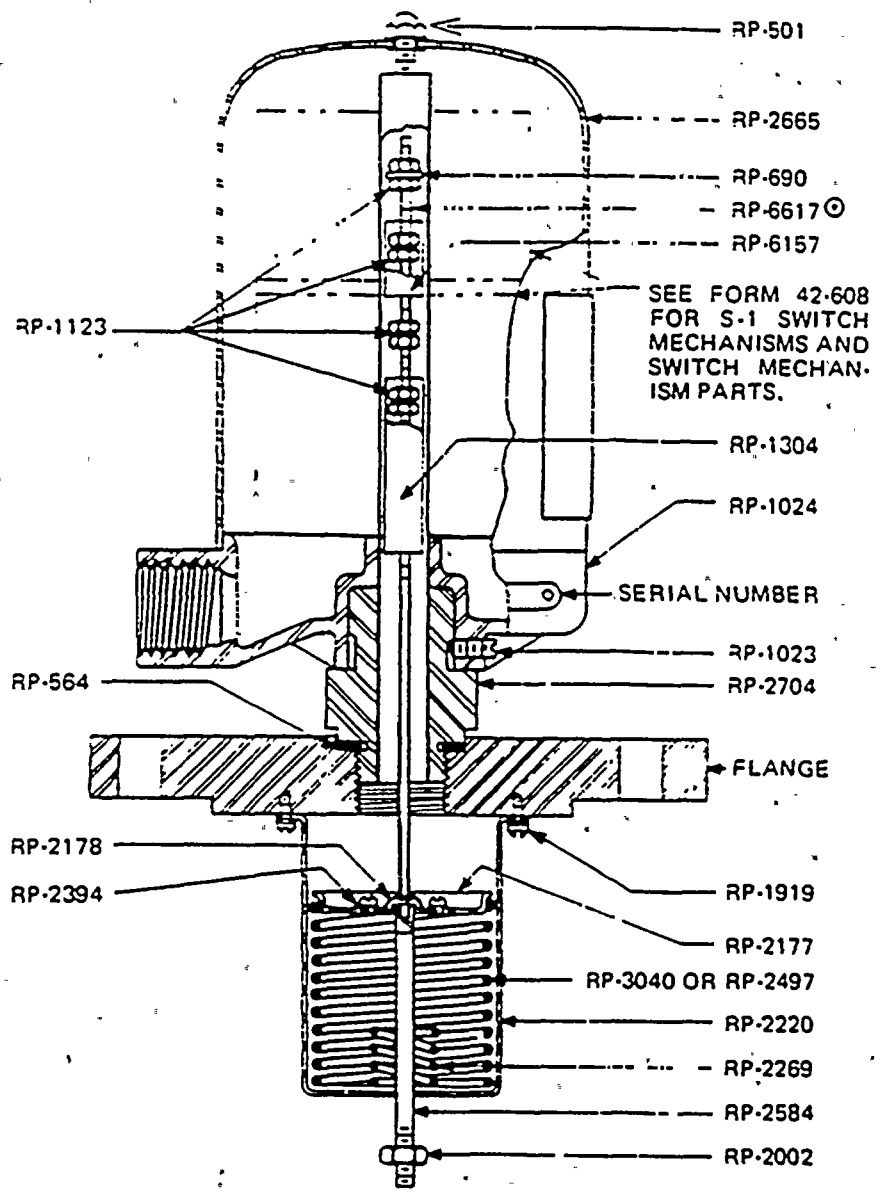
EQUIPMENT

RELATED

ISSUES



MAGNETROL MODEL 153 TANDEM SWITCH HOUSING



Level Alarm Failure

Investigation

- Disassembly and Inspection
- Maintenance History Search
- Industry OE (NPRDS) Search
- Preventive Maintenance Practice

Conclusion

- Available Information Indicated No Deficiencies In Level Alarm Maintenance Program

Actions

- Verify Operation of Level Alarms on Other 3 Engines
- Increase Frequency of Operational Checks From 2RO to 1RO
- Full Operational Check

Level Indicator Problems

Investigation

- Design
 - Non-standard Installation/Sample Tap
 - Final Design Raised Gauge Elevation Above Tank Penetration
 - Appropriate Reviews/Approvals Obtained
- Post Modification Test
 - Bench Calibration
 - Post Installation Leak Inspection
- Field Observations
 - Sampling Operation Introduced Air into Sensing Line
 - Positive Bias on Indicated Level

Level Indicator Problems (Continued)

Corrective Actions

- **Gauges Taken Out of Service on All Engines**
- **Daily Dipstick Readings Being Performed/Trended**

Preventive Action

- **Level Indicating System Re-Design Under Evaluation**

Other Actions

- **Review Other Level Gauge Installations for Similar Deficiencies**
 - **Shared Sensing Line**
 - **Gauge Elevation**
 - **Low Pressure Systems**
- **Consider Programmatic Actions Based on Outcome of This Review**



IDENTIFICATION, PRIORITIZATION AND SCHEDULING OF B&A PUMP SEAL LEAK

- **Material Condition Deficiency Identified on May 9, 1992 and Action Request Generated to Correct**
- **Action Request Reviewed and Prioritized for Next Scheduled AB Diesel Generator Outage**
- **Action Request Planned and Scheduled for October 19, 1992 Train Outage**

WORK CONTROL PROCESS CONCLUSIONS

- **Material Condition Deficiency Properly Identified And Processed**
- **Action Request Promptly Reviewed And Properly Prioritized**
- **Corrective Maintenance Appropriately Scheduled For Next Diesel Generator Outage**

ON-GOING ENHANCEMENTS TO THE WORK CONTROL PROCESS

- **Implementation of a Plant Wide
12-Week Work Schedule Cycle**
- **Creation of a Work
Classification Organization**
- **System Engineer Involvement
in the Work Control Process**

TIME OF INOPERABILITY

**DIESEL ESTIMATED TO BE INOPERABLE
SEPTEMBER 2, 1992**

- Average Oil Leak Rate
- Uncovering of Foot Valve
- Measured Drawdown

**TECHNICAL SPECIFICATION
REQUIREMENTS**

- 2 Diesels Required, Modes 1-4
- 1 Diesel Required, Mode 5

**UNIT IN MODE 5 AT TIME OF DISCOVERY
(9/28)**

- Mode 5 Entered September 25
- Diesel Inoperable 23 Required Days
- 2CD Diesel Operable

SAFETY SIGNIFICANCE

EVENT HAD LOW SAFETY SIGNIFICANCE

- **Offsite Power Continuously Available**
 - **Offsite Sources**
 - **Alternate 69 KV Source**
- **Redundant Diesel Operable**
- **Procedures for Repowering Equipment from Unit 1**
- **Decay Heat Load Low**
 - **Following Refueling Outage**

PROBABILISTIC RISK ASSESSMENT

MINIMAL INCREASE IN CORE DAMAGE FREQUENCY

- 6.26 E-05 Per Reactor Year Baseline
- 6.46 E-05 per Reactor Year w/23 Days Diesel Inoperability
- Increase of only 3%
- Minimal Impact Due to:
 - 3 Offsite Power Sources
 - Reliability of Redundant EDG

FACTORS FOR CONSIDERATION

MANAGEMENT INITIATIVE IN IDENTIFYING ROOT CAUSE OF EVENT AND TAKING CORRECTIVE ACTIONS

- **Thorough Immediate Actions**
- **Multidisciplinary Task Force**
- **Operations Task Force**
- **Enhancements to Work Control
Practices Already Underway**

FACTORS FOR CONSIDERATION (Continued)

CORRECTIVE ACTION PROMPT AND EXTENSIVE

- **Immediate Actions to Restore Operability**
- **Short Term Changes to Lube Oil Data Collection**
- **Changes to Operations Tour and Data Review Practices**
- **Level Gauges Removed From Service**
- **Review of Other Level Gauge Installations for Similar Deficiencies**
- **Increased Frequency and Scope of Level Alarm Operational Checks**



FACTORS FOR CONSIDERATION (Continued)

EVENT HAD LOW SAFETY SIGNIFICANCE

- Availability of Offsite Power
- Redundant Diesel
- Minimal Increase in Core Melt Frequency

ALL REPORTING REQUIREMENTS SATISFIED

- Resident Kept Informed of Developments
- LER Complete and Thorough

ABILITY TO RECOGNIZE LOW LUBE OIL CONDITION HAMPERED BY EQUIPMENT PROBLEMS

- Low Level Alarm
- Level Gauge

SUMMARY OF CORRECTIVE ACTIONS

EDG INOPERABLE LONGER THAN TECH ALLOWABLE OUTAGE TIME

ACTION	STATUS
Check Lube Oil Level in All Diesels	Completed (September 28)
Lube Oil Tank Level Restored to Normal Operating Range	Completed prior to return to operable status
Lift Check Performed on EDG Bearings	Completed prior to return to operable status
Inspection of All Visible Bearing Surfaces for Abnormal Wear	Completed prior to return to operable status
Bearing #4 Pulled and Inspected	Completed prior to return to operable status
Replacement of Defective Before and After Pump Seal	Completed prior to return to operable status
Repair of Level Alarm	Completed prior to return to operable status
Revision of surveillance test procedures for monthly EDG operability test to include recording of lube oil level	Completed



SUMMARY OF CORRECTIVE ACTIONS

FAILURE TO PROMPTLY IDENTIFY AND CORRECT OIL LEAK

ACTION	STATUS
Initiate Daily Dipstick Readings of Lube Oil Tank	Complete
Engineering Review of Lube Oil Gauge Design Adequacy (Gauges Tagged Out)	Complete
Review of Work Request Process for Possible Enhancements to Ensure Detailed Information, Required for Proper Work Prioritization, is Provided	Complete
Issue Memo to Shifts	Complete
Increase Frequency and Scope of Level Alarm Operational Checks to Refueling Outage Frequency	Next Refueling Outage
Verify Operation Of Level Alarms On Other 3 Diesels	During Next Scheduled Outages
Review Other Level Gauge Installations for Similar Deficiencies	March 15, 1993

SUMMARY OF CORRECTIVE ACTIONS

FAILURE TO INCLUDE ACCEPTANCE CRITERIA FOR EDG LUBE OIL LEVEL

ACTION	STATUS
Revise Lube Oil Inventory Log Sheet to Include Minimum Allowed Level and Require Recording of 7 Consecutive Readings	Complete
Establish a Tour Assignment Policy to Require, Whenever Possible, an Operator to be Assigned a Plant Tour for a Long Enough Period to Establish Personal Ownership of that Tour	January 31, 1993
Review Tour Procedures for Appropriate Critical Parameters, Acceptance Criteria, Communication Method, and Trending Method	June 30, 1993
All Tour Operators will Complete a Review of the Tour Procedures, Including Walkthroughs	March 31, 1993
Issue a Tour Guide, Sized to Fit in a Pocket, to be Used for Reference Only by the Tour Operators	March 31, 1993

APPENDIX



Major Components

Sump Tank

- 754 Gallon Capacity

Engine Driven Pump

- Positive Displacement, Gear-type, 441 GPM at 514 RPM and 140°F lube oil, casing relief set at 75 PSIG

Full-flow Filter

- Single steel vessel containing 34 individual, disposable 10 micron filtering cartridges

3-way Bypass Valve

- 9 individual thermostatic elements operating in parallel

Cooler

- Shell and tube, two pass tube side (ESW), single pass shell side (oil)

Duplex Strainer

- 2 individual steel vessels with a manual transfer valve. Each vessel contains 3-100 mesh screens and is capable of handling full system flow.

B&A Pump

- Positive Displacement, Gear-type, 90 GPM at 75 PSIG, runs continuously

Major Components (Continued)

Heater Pump

- Positive Displacement, Gear-type, 6 GPM, runs only when engine is in standby

Heater

- 7.5 KW, 5.6 GPM capacity

Bypass Filter Pump

- Positive Displacement, Gear-type, 39 GPM, runs only when engine is in standby

Bypass Filter

- Single steel vessel containing 18 individual disposable 3 micron filtering cartridges

Upper Valve Gear Oil Control

- Two independent flowpaths, each containing a solenoid valve and a pressure regulating valve, that control the flow of oil to the upper valve gear. While the engine is in standby, oil is supplied to the valve gear for 2 minutes every 4 hours. Oil is supplied to the valve gear continuously while the engine is running.