

The Light company

Houston Lighting & Power South Texas Project Electric Generating Station P. O. Box 289 Wadsworth, Texas 77483

October 15, 1990

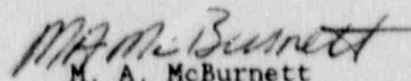
ST-HL-AE-3568
File No. G12.449
10CFR21

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

South Texas Project Electric Generating Station
Units 1 and 2
Docket Nos. STN 50-498/50-499
Revised 10CFR21 Report Regarding Feedwater Isolation Valve
Solenoid Dump Valve Failure to Energize due to
Thermal Incompatibility of Hydraulic Fluid

A 10CFR21 Report regarding the above subject was previously submitted to the NRC in letter ST-HL-AE-3430 dated April 11, 1990. Additional evaluations of the circumstances of the event and subsequent experience with the affected equipment has caused us to revise our corrective actions. An explanation of this is provided in the attached revised report. Change bars indicate areas where revisions have been made.

If you should have any questions on this matter, please contact Mr. G. A. Ayala at (512) 972-8628 or myself at (512) 972-8530.



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Attachment: Revised 10CFR21 Report Regarding Feedwater Isolation Valve
Solenoid Dump Valve Failure to Energize due to
Thermal Incompatibility of Hydraulic Fluid

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South Texas Project Electric Generating Station

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South Texas Project Electric Generating Station
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I. Facility and Basic Component Containing Defect:

South Texas Project Electric Generating Station (STPEGS), Units 1 and 2
18" Main Feedwater Isolation Valves containing solenoid-actuated
pilot-operated dump valves with FYRQUEL 150 hydraulic fluid

II. Firm Supplying Basic Component Containing Defect:

Main Feedwater Isolation Valves were provided directly to STPEGS by:

WKM
P.O. Box 2117
Houston Texas 77252.

Solenoid-actuated pilot-operated dump valves were supplied to WKM by
subcontract via:

Valcor
#2 Lawrance Road
Springfield, New Jersey 07081.

FYRQUEL 150 hydraulic fluid is manufactured by:

Akzo
300 South Riverside Plaza
Chicago, IL 60606

III. Nature of Defect and Safety Hazard:

Each STPEGS unit uses four (4) 18" Main Feedwater Isolation Valves (MFIVs) which were purchased from and provided directly to STPEGS by WKM during initial plant construction. Each MFIV is designed to hydraulically open and use pressurized nitrogen to close. Closure of the valve is accomplished by deenergization of either of two (2) Valcor pilot-actuated solenoid dump valves which relieve hydraulic fluid from the actuator, allowing nitrogen pressure to close the MFIV. The opening of the dump valve is critical to successful closure of the MFIV. Note that the solenoid coil is continuously energized to hold open the MFIV during normal plant operations.

The MFIVs at the STPEGS are the containment isolation valves, one per feedwater line, required for 10CFR50 Appendix A General Design Criterion 57. The MFIVs are designed to isolate feedwater flow to prevent containment overpressurization following a postulated main steam line break accident and to prevent excessive reactor coolant system cooldown. They also isolate to prevent steam generator overfill. An MFIV closure signal is initiated upon safety injection actuation, steam generator water level Hi-Hi, and low Tavg coincident with reactor trip. The required response time is 12 seconds which includes 10 seconds for MFIV closure.

On March 29, 1990 STPEGS Unit 1 experienced a plant trip from 100% power followed by main feedwater isolation signal. The event was initiated by loss of a feedwater booster pump and was described in LER 90-005. Two of the four MFIVs failed to close upon receipt of an automatic closure signal. One valve, A1FW-FV-7144, failed to close until approximately five (5) minutes following the event, while the other, A1FW-FV-7141 moved to an intermediate position and subsequently closed approximately two (2) minutes following the event.

An evaluation of the failure of the two MFIVs to close was immediately initiated. Engineering evaluations concluded that the MFIVs did not close due to the failure of the dump valves to operate successfully as a result of hydraulic fluid thermal degradation. The pilots in the two pilot-actuated solenoid dump valves were found blocked by decomposed hydraulic fluid. Green gelatinous and green crystalline materials were found in the dump valves. Chemical analysis and discussions with an Akzo chemist established that the materials were products of thermal decomposition of FYRQUEL 150, accelerated by moisture and contamination. (Degradation is affected by time at high temperature.) The chemist stated that decomposition is evidenced initially by a thickening of the fluid, following by formation of a gelatinous material, then green crystals and hard carbon-like material.

The FYRQUEL hydraulic fluid literature states that the fluid is stable at temperatures below 150 °F and that in the absence of moisture, the fluid is stable to much higher temperatures. Based on Valcor's qualification test data and initial HL&P engineering evaluations, it was calculated that the continuous energization of the solenoid coil resulted in a maximum fluid temperature of 250 °F to 280 °F. Subsequent heat flow calculations and measurements conducted indicate that the expected temperature of the fluid is much lower. The maximum temperatures of the fluid are now estimated to be approximately 175 °F near the solenoid coil and 153 °F at the orifice. The recalculated temperatures agree with the Akzo requirements when moisture is not present. Consequently, it is considered that VALCOR adequately accounted for the use of FYRQUEL hydraulic fluid within their scope of the system design.

A modification to limit moisture as a potential source of hydraulic fluid contamination was performed. Following implementation of the modification, samples were taken which confirmed low moisture content in the hydraulic fluid. Additional samples with controlled levels of contaminants added have been aged at an elevated temperature for a duration that corresponds to three months service at the solenoid orifice. These samples showed predictable degradation and little viscosity change.

There have been no MFIV failures associated with polymerized FYRQUEL since the March 29th event. As a result of that event the 90% MFIV stroke tests were conducted at a maximum period of every seven days when the MFIV's were open and the Unit was at power. Based on the reduced temperature expected at the orifice and low moisture content in the hydraulic fluid, the period of stroke testing will be revised to one month intervals. The MFIV stroke tests will be conducted on a monthly basis (extended by not more than 25% of the interval).

The consequence of failure of both dump valves to reposition and dump fluid is failure of an MFIV to perform its intended safety functions. This could lead to containment overpressurization in the event of a postulated steam line break, a potential excessive reactor coolant system cooldown, or steam generator overflow. Note, that no adverse effects occurred in the March 29th event since feedwater flow was cutoff by automatic closure of the feedwater regulating valves and main feedwater pump trip which occurred at the time of the MFIV closure signal.

IV. Date on which Information of the Defect was Obtained:

Houston Lighting & Power (HL&P) completed its evaluation and determined that this item was reportable pursuant to 10CFR21 on April 6, 1990.

V. Number and Location of all such Components:

STPEGS, Unit 1: 4 MFIVs with 2 (each) Valcor dump valves
STPEGS, Unit 2: 4 MFIVs with 2 (each) Valcor dump valves

Additionally, HL&P evaluated other hydraulic systems at the units and has determined that no other locations exist where FYRQUEL fluid is utilized wherein normal service conditions exceed the specified limitations of the fluid.

VI. Corrective Actions Being Taken for Both Units:

- 1) The hydraulic fluid systems were flushed clean.
- 2) A modification to help limit moisture as a potential source of hydraulic fluid contamination was performed.
- 3) Per recommendations from Akzo, FYRQUEL GT fluid was used to replace the FYRQUEL 150. Per discussions with the Akzo chemist, the FYRQUEL GT is a more temperature stable version of the fluid, although both are rated at 150°F in a closed environment.
- 4) Each solenoid dump valve was replaced or rebuilt.
- 5) 90% MFIV stroke test will be performed on a monthly basis (will be extended by not more than 25% of the monthly interval).
- 6) Chemical samples will be taken monthly from each MFIV actuator reservoir during Unit operation. When high total acid number or moisture content is indicated by these test results additional samples will be aged at an elevated temperature for a period equivalent to three months of continuous service in the solenoid valve orifice to predict fluid performance. The samples will be analyzed and trended to determine if any additional action is needed.
- 7) HL&P is evaluating longer term corrective measures which are being considered for implementation during the fourth refueling outage for Unit 1 and the second refueling outage for Unit 2.