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

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

Pursuant to the requirements of 10CFR21, Houston Lighting & Power (HL&P) submits the attached report regarding feedwater isolation valve solenoid dump valve failure to energize due to thermal incompatibility of hydraulic fluid. A telephone notification of this item was made to NRC Region IV on April 6, 1990.

If you should have any questions on this matter, please contact Mr. C. A. Ayala at (512) 972-8628 or myself at (512) 972-7138.

S. L. Rosen
Vice President
Nuclear Engineering

CAA/eg

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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 will be 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 maximum steady state service rating of the fluid is 150°F. Based on Valcor's qualification test data and HL&P's engineering evaluations, the continuous energization of the solenoid coil results in an estimated maximum fluid temperature of 250°F to 280°F. The temperature of the fluid at the pilot assembly, a critical location, is estimated to be approximately 180°F. The dump valve manufacturer, Valcor, failed to take into account that the normal operating environment steady state service conditions created within the dump valve, as a result of continuous energization of the solenoid coil, exceeded the fluid manufacturer's recommendation.

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 overfill. Note, that no adverse affects 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:

Unit 2

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 Akzo's steady state service rating for the GT fluid is also 150°F.

4) Each solenoid dump valve was replaced.

5) A 90% MFIV stroke test will be performed at a maximum of every seven days when the MFIVs are open and the Unit is at power. The performance of this normally quarterly Technical Specification required surveillance test will assure MFIV operability more frequently, and will recycle hydraulic fluid from the 125 gallon fluid reservoir to the critically hot pilot area of the valve minimizing any local fluid decomposition potential. This action will be continued until the next refueling outage when we expect a longer term corrective measure to be available.

VI. Corrective Actions Being Taken:

Unit 2 (Cont.)

6) Chemical samples will be taken monthly from each MFIV actuator reservoir during Unit operation. These samples will be analyzed and trended to determine if any action is needed. This action will be continued until the next refueling outage when we expect a longer term corrective measure to be available.

Unit 1

Unit 1 remained shutdown following the March 29th trip and has entered its second refueling outage. The Unit is scheduled to resume operation in the beginning of June, 1990. The actions identified in items 1) through 4) above will be implemented in Unit 1 prior to power operation after the outage. Actions 5) and 6) will also be applicable to Unit 1 and will be continued until the third refueling outage of Unit 1.

HL&P is evaluating longer term corrective measures which are being considered for the next refueling outages in each STPEGS unit.