UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE INSERVICE TESTING PROGRAM

HOUSTON LIGHTING & POWER COMPANY

CITY PUBLIC SERVICE BOARD OF SAN ANTONIO

CENTRAL POWER AND LIGHT COMPANY

CITY OF AUSTIN, TEXAS

SOUTH TEXAS PROJECT, UNITS 1 AND 2

DOCKET NOS. 50-498 AND 50-499

1.0 INTRODUCTION

The Code of Federal Regulations, 10 CFR 50.55a, requires that inservice testing (IST) of certain American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 pumps and valves be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code (the Code) and applicable addenda, except where alternatives have been authorized or relief has been requested by the licensee and granted by the Commission pursuant to Sections (a)(3)(i), (a)(3)(ii), or (f)(6)(i) of 10 CFR 50.55a. In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety; (2) compliance with the Code would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) compliance with the Code is impractical for its facility. Section 50.55a authorizes the Commission to approve alternatives and to grant relief from ASME Code requirements upon making the necessary findings.

The NRC staff's findings with respect to authorizing alternatives and granting or not granting the relief requested as part of the licensee's IST program are contained in this safety evaluation.

2.0 BACKGROUND

In a letter dated December 27, 1995, Houston Lighting and Power, the licensee for South Texas Project (STP), Units 1 and 2, submitted a request for approval of an alternative related to the STP IST Program for Pumps and Valves. Specifically, Relief Request RR-16 proposes, as an alternative to the requirements for testing the emergency cooling water pumps at a repeatable reference value, to use pump curves for determining acceptance criteria while testing at the "as-found" flow and differential pressure conditions. The STP

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IST program was developed to the 1983 Edition, Summer 1983 Addenda, of Section XI of the ASME Code, for the first 10-year interval for both units. The commercial operation dates of Unit 1 and Unit 2 are August 25, 1988, and June 19, 1989, respectively.

3.0 RELIEF REQUEST RR-16

The essential cooling water (ECW) system supplies cooling for loads which are necessary for the safe shutdown of the reactor and mitigation of the consequences of postulated accidents (i.e., the system functions as the ultimate heat sink). The system also supplies cooling water during normal operating conditions and plant shutdowns. The ASME Code requirements for testing the ECW pumps are found in IWP-3100 which states that the resistance of the system shall be varied until either the measured differential pressure or the measured flow rate equals the corresponding reference value. The quantities given in Table IWP-3100-1 shall then be measured or observed and recorded and compared with the corresponding reference value.

3.1 Basis For Relief

The licensee states the following basis for the request:

> (1) The Essential Cooling Water System is designed so total pump flow can not readily be adjusted to one reference value for testing without adversely impacting the operating flow balance of the system or utilizing excessive operator resources which would be better utilized to monitor the safe operation of the plant. The Essential Cooling Water Pumps must be tested in a manner that does not adversely affect the flow balance and system operability.
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> (2) The Essential Cooling Water System trains are not designed with a full flow test line with a single throttle valve. Flow in each of the three independent trains is balanced through six parallel loads (Standby Diesel, 2 Essential Chillers, Component Cooling Water Heat Exchanger, Component Cooling Water Pump Supplementary Cooler and Essential Cooling Water Pump Lube Water). Total system flow is obtained by totalling flow measurements for each of these loads. The flow through each of these loads is throttled to a specific flow range and changes to flow through one load frequently change the flow through one or more of the other loads. Each of the six loads has a range of acceptable flow. The total flow through the system has an acceptable normal operating range. Adjustment to system resistance, by throttling any combination of these loads, often moves one or more outside its respective operating range. Although the operating range of the Essential Cooling Water pump may remain acceptable, these flow perturbations can require entry into Technical Specification Limiting Condition of Operations (LCO) for the affected individual components until correct flows are reestablished. The

requirement to adjust Essential Cooling Water (ECW) flow during quarterly inservice testing challenges the system design, the operators, and component operability.

(3) Each train of ECW is flow balanced when it is returned to service following a refueling or LCO outage to ensure all loads are adequately supplied. A flow range is specified for each load to balance all the flows against each other. Once properly balanced, very little flow adjustment can be made without adversely impacting the operability of the remaining loads. Each time the system is balanced, proper individual component flows are produced, but this in turn does not necessarily result in one specific value for total flow. Because each load has an acceptable flow range, overall system flow has a range. Overall system flow can vary from a low of approximately 15,700 gpm to a high of approximately 20,610 gpm. Consequently, adjusting flow to one specific value on a quarterly basis for the performance of inservice testing conflicts with the system design and challenges system operability.

Quality and Safety Impact: The design of the South Texas Project Unit 1 and 2 Essential Cooling Water systems make it impractical to adjust system resistance to obtain a single fixed reference value for inservice testing without adversely affecting the system flow balance and Technical Specification operability requirements of the components cooled by ECW. The use of pump curves for reference values of flow rate and differential pressure is an acceptable alternative if the impracticality of establishing a fixed set of references has been clearly demonstrated by the licensee (NUREG-1482, Section 5.2 - "Use of Variable Reference Values for Flow Rate and Differential Pressure During Pump Testing"). The proposed alternate testing using a reference pump curve for each pump provides adequate assurance and accuracy in monitoring pump conditions to assess pump operational readiness and detect pump degradation. Alternate testing will have no impact on plant and public safety.

In addition to the information included in the request, drawing 5R289F05038, Sheet 1, "Piping and Instrumentation Diagram Essential Cooling Water System Train 1A," was submitted. The drawing is representative of the Unit 1 and Unit 2 ECW trains. Shown on the drawing are the ECW pumps, the throttle valves, the five cooling loads, and the pump lube water piping.

3.2 Proposed Alternative Testing

The licensee proposes:

As an alternative to the testing requirements of IWP-3100, South Texas Project proposes to assess pump performance through the use of reference pump curves as discussed in Section 5.2 of

NUREG-1482. Flow rate and pump differential pressure will be measured during inservice testing in the as found condition and compared to an established reference curve. The following elements will be used in the development of the reference pump curves:

(1) A reference pump curve (flow rate vs. discharge pressure) will be established for each of the ECW pumps from data taken when these pumps are known to be operating acceptably.

(2) Pump curves will be established from measurements taken with instrumentation meeting or exceeding the accuracy requirements listed in Table IWP-4110-1 or OM Part 6, Table 1.

(3) Each curve will be based on at least five points beyond the flat portion of the pump curve in the normal operating range of the pumps (at flows greater than 15,700 gpm). Rated capacity of these pumps is 19,280 gpm. The pumps will be tested at their full design flow rates, approximately 15,700 gpm minimum and approximately 20,610 gpm maximum.

(4) The reference pump curves will be based on flow rate vs. differential pressure. The acceptance criteria (i.e, acceptable, alert, and required action) curves will be based on differential pressure limits given in IWP-3100-2 or OM Part 6, Table 3b when this system is converted to OM Code.

(5) Vibration levels will be measured at each of the reference points. If negligible variation in the vibration readings is observed over the range of pump conditions, a single reference value may be assigned to each vibration measurement location. If vibration readings change over the range of pump conditions, appropriate acceptance criteria will be assigned to regions of the pump curve. The acceptance criteria for vibration will be based on the limits given in IWP-3100-2 or OM Part 6, Table 3a, when this system is converted to the OM Code.

(6) After maintenance or repair that may affect the existing reference pump curve, a new reference pump curve shall be determined or the existing pump curve revalidated by an inservice test. If necessary, a new pump curve shall be established based on at least five points beyond the flat portion of the pump curve.

3.3 Evaluation

The ASME Code pump testing requirements were based on achieving a repeatable test condition so that test data could be compared from test to test (i.e., trending data). With a reference value of flow or differential pressure set during each test, with the other parameter measured, trending can be used to indicate if degradation in a pump's capability is occurring. As such, corrective actions can be taken before the pump's performance degrades

to an unacceptable level. This scheme of testing is easily achieved for standby pumps tested on recirculation flow, but may be more difficult for pumps that operate during normal power conditions.

As noted by the licensee, in Section 5.2 of NUREG-1482, the NRC recognized that for certain pumps within the scope of 10 CFR 50.55a which operate during normal plant operating conditions, such as service water pumps or the ECW pumps, the design of the system is such that adjusting the flow or differential pressure for performing IST is unusually difficult and creates a hardship on the licensee. Even though testing at a single reference value may be possible without a modification to the plant by manipulating a number of throttle valves at each of the coolers supplied by the ECW pumps, the system is not designed to be operated in such a manner. IST was not intended to place the plant in a condition that could adversely affect normal operations. The pumps operate under normal conditions and the flow varies with the cooling loads demand. Manipulation of the flow and differential pressure by throttling the loads to the five coolers has an adverse impact on the operation of the plant. Cooling loads are disturbed from the normal demand at the time of testing, possibly resulting in overheating or overcooling and potential unbalancing of the system. It also distracts control room operators from other plant monitoring duties because the adjustments must be made slowly and in a coordinated manner (adjusting one, adjusting another, and readjusting) so as not to upset the flow balance of the system and jeopardize its continued operability.

Imposing the code requirements does not have a compensating increase in the level of quality and safety because the condition of the pumps can be adequately monitored using pump curves and applying the controls listed in the licensee's proposed alternative. While there is greater uncertainty in using pump curves, the ECW pumps are tested in a range close to or above the design flow rate (i.e., in the upper 25% of the pump's rating). Trending points along the pump curve should identify if the pump's capability begins to degrade. Alert and required action ranges consistent with the code ranges will be applied to the reference curve for each pump. In sum, the alternative testing will assure adequate monitoring in consideration of the hardship and difficulties in performing IST using a single reference point.

3.4 Conclusion

Pursuant to 10 CFR 50.55a(a)(3)(ii), the alternative testing using pump curves is authorized based on the hardship and unusual difficulty associated with performing IST in accord with the code requirements for testing at a reference value of flow or differential pressure. In considering authorization of the alternative, it was determined that there is no compensating increase in the level of quality and safety in imposing the code requirements on the licensee

in that testing with the normal cooling loads and using pump curves for determining the trends of pump performance and establishing alert and required action ranges will allow monitoring for degradation.

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