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

ENCLOSURE 1

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATING TO DET FOLLOW-UP STAFF ACTION ITEMS 5(A) AND 5(B) REGARDING BORON DILUTION ANALYSIS WITH ALL RODS OUT

HOUSTON LIGHTING AND POWER COMPANY

SOUTH TEXAS PROTECT ELECTRIC GENERATING STATION UNITS 1 AND 2

DOCKET NOS. 50-498 AND 50-499

1.0 INTRODUCTION

The South Texas Project Electric Generating Station (STPEGS) has a unique design for a rapid refueling system which calls for withdrawal of all of the rod cluster control assemblies into the head and upper internals package where they are held for the duration of the refueling process. This feature is called "rod lockout" and is usually performed with the plant in Mode 5 prior to refueling. However, the original safety analysis for the boron dilution event documented in Section 15.4.6 of UFSAR did not consider the condition with all the control rods fully out in Mode 5. The above stated safety concern was discovered by the licensee and reported in its Station Problem Report (SPR) No. 920066 dated February 21, 1992. This issue was raised by the NRC Diagnostic Evaluation Team (DET) for the STPEGS and listed as a staff action item for further staff evaluation.

2.0 EVALUATION

In a letter dated March 9, 1992, the licensee requested that Westinghouse perform a review to ensure that all aspects of rapid refueling have been adequately considered in the STPEGS safety

analysis. In response to the licensee's request, Westinghouse in its letter dated June 17, 1992, indicated that the boron dilution analysis performed for the STPEGS past and current cycles remains applicable for the all rods out (ARO) configuration.

During our review of the subject concern, we requested that the licensee provide the details of the Westinghouse evaluation to support its conclusion stated above. In response to the staff request, the licensee provided a letter from Westinghouse dated October 14, 1993 which addresses its reevaluation of the boron dilution event with ARO in Mode 5 with reactor coolant loops filled. The boron dilution analysis during Mode 5 with reactor coolant loops not filled and Mode 6 were not performed since a postulated boron dilution event is prevented by administrative controls which isolate the reactor coolant system (RCS) from the potential dilution source during these modes of operation. These administrative controls are specified in the South Texas Plant Technical Specifications 4.4.1.4.2.2 and 4.9.1.3.

The existing boron dilution analysis for Mode 5 with reactor coolant loops filled was performed with conservative assumptions except the assumption of all rods in minus the highest worth rod stuck out (ARI1). The South Texas Plant Technical Specification Figure 3.1-2 defines the minimum required shutdown margin at various maximum RCS critical boron concentrations which is based on the boron dilution analysis. The analysis demonstrates that 15 minutes is available to take operator action for terminating the event prior to loss of shutdown margin. The acceptable RCS boron concentration can be calculated from this Technical Specification by procedure.

In the Westinghouse reanalysis, the only assumed condition requiring change is the control rod configuration which went from ARI1 to ARO. The effect of this change on the maximum critical boron concentration confirms that there was a large margin to the

maximum critical boron concentration limit even with the assumption of ARO for all affected cycles at the South Texas plant. For the maximum differential boron worth (DBW) confirmation, Westinghouse stated that no reanalysis was needed because this item had already been confirmed for all the affected cycles by performing calculations with a conservatively assumed ARO control rod configuration. Since dilution time to criticality is reduced with a greater critical boron concentration or a larger differential boron worth, the confirmation of the previously calculated maximum boron concentration and maximum differential boron worth remain limiting. This ensures that the minimum operator action time of 15 minutes is still available for terminating the boron dilution event prior to loss of shutdown margin. The staff agrees with the Westinghouse approach in reevaluating the boron dilution event with ARO configuration in Mode 5 and finds the results of the reevaluation acceptable. The current Technical Specification Figure 3.1-2 regarding minimum required shutdown margin remains valid.

3.0 CONCLUSION

Based on the staff evaluation in Section 2.0 above, the staff concludes that the licensee's reevaluation of the boron dilution event with ARO configuration in Mode 5 with reactor coolant loops filled is acceptable and the current Technical Specification Figure 3.1-2 remains valid to ensure sufficient shutdown margin available following a boron dilution event with ARO configuration in Mode 5 with reactor coolant loops filled. Technical Specifications 4.4.1.4.2.2 and 4.9.1.3 remain in effect to prevent a postulated boron dilution event from occurring during Mode 5 with reactor coolant loops not filled and Mode 6.

4.0 REFERENCES

1. Memorandum from J. Taylor, NRC to T. Murley, NRC, "Staff Actions Resulting from the Diagnostic Evaluation at South Texas Project," August 3, 1993.

2. South Texas Project Electric Generating Station, Station Problem Report (SPR) No. 920066, February 21, 1992.

3. Letter from R. Cobb, Westinghouse Electric Corporation, to D. Hoppes, Houston Lighting and Power Company, "South Texas Project Electric Generating Station Units 1 and 2, Mode 5 Boration/Dilution Analysis," February 26, 1992.

4. Letter from R. Cobb, Westinghouse Electric Corporation, to D. Hoppes, Houston Lighting and Power Company, "South Texas Project Electric Generating Station Units 1 and 2, Mode 5 Boration/Dilution Analysis," March 5, 1992.

5. Letter from S. Rosen, Houston Lighting and Power Company, to D. Lipman, Westinghouse Electric Corporation, "Safety Analysis Consideration of the Reactor Control Rods in the Full Out Position During Cold Shutdown Conditions," March 9, 1992.

6. Letter from D. Lipman, Westinghouse Electric Corporation, to S. Rosen, Houston Lighting and Electric Company," South Texas Project Units 1 and 2, Rapid Refueling Issues," June 17, 1992.

7. Letter from M. Sinwell, Westinghouse Electric Corporation, to L. Snell, Houston Lighting and Electric Company, "Reevaluation of Boron Dilution Event with all Rods Out in Mode 5," October 14, 1993.

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

January 14, 1994

MEMORANDUM FOR: Suzanne C. Black, Project Director
Project Directorate IV/II
Division of Reactor Projects

FROM: James A. Norberg, Chief
Mechanical Engineering Branch
Division of Engineering

SUBJECT: STAFF ACTIONS RESULTING FROM THE DIAGNOSTIC EVALUATION AT SOUTH TEXAS PROJECT (STP)

Reference:

1. Memorandum from James M. Taylor to Thomas E. Murley, Director NRR et.al. dated August 3, 1993 relating to staff actions resulting from the diagnostic evaluation at the South Texas Project.

2. Memorandum from James A. Norberg to S. C. Black, PD, NRR, dated October 19, 1993 relating to staff actions resulting from the diagnostic evaluation at South Texas Project.

As requested in Reference 1, the Mechanical Engineering Branch is evaluating Issue No. 6 relating to the fuel injection hold down stud failures in the standby diesel generators (SDGs) at STP. A summary of the status of review and schedule for the disposition of this issue was provided in Reference 2.

The staff reviewed available data at the plant site in December 1993 to determine the adequacy of the licensee's operability analysis for various scenarios involving multiple inoperable cylinders as discussed in Reference 2. Based on a review of the additional information provided by the licensee and the site data, the staff is unable to determine the adequacy of the licensee's operability analysis. The engine analyzer data provided by the licensee shows that engine operation is highly erratic, with cylinder peak firing pressures varying as much as 130 PSI in a single cylinder. Since engine balance is established using peak firing pressures, this erratic operation made it impossible to determine if the engines are balanced. In light of this, the staff can not agree or disagree, at this time, with the licensee's position regarding SDG operability with less than 20 cylinders operating.

The licensee with assistance from the vendor is obtaining additional information on interpreting the analyzer data. This information would enable the staff to establish engine balance and reach a conclusion regarding SDG operability with less than 20 cylinders operating.

The projected data for closure of this issue is end of March 1994.

ORIGINAL SIGNED BY:
Kamal A. Manoly
James A. Norberg, Chief
Mechanical Engineering Branch
Division of Engineering

cc: L. Kokajko
E. Tomlinson

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February 8, 1994

NOTE FOR : Alan Madison

FROM : Sada Pullani

SUBJECT : INPUT TO 1993 AEOD ANNUAL REPORT ON STP STAFF ACTIONS

REFERENCES :

1. Memorandum from Thomas E. Murley to James M. Taylor (NRC), Status of NRR Staff Actions Resulting from the Diagnostic Evaluation at South Texas Project (WITS-93133), February 1, 1994.

2. Memorandum from Thomas E. Murley to James M. Taylor (NRC), Status of NRR Staff Actions Resulting from the Diagnostic Evaluation at South Texas Project, November 2, 1993.

Enclosed for your review and use is my input on the subject in the standard format you requested, based on References 1 and 2.

Enclosure: as stated

cc:

H. Bailey
STP Staff Action File 1.52
DEIIB File D1012

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Action Source: Memorandum from J. Taylor to Office Directors and Region IV Administrator, "Staff Actions Resulting from the Diagnostic Evaluation at South Texas Project," dated August 3, 1993.

Item 1: A number of operator workload issues were raised at South Texas Project (STP). Given the conditions that were prevalent at STP, the design of the facility, and operator workarounds, the scope of responsibilities and administrative work of the operating staff was excessive. For example, the team concluded that operator staffing, although it exceeded Technical Specifications (TS) minimum requirements, was strained in accomplishing the complex tasks for a scenario involving shutdown from outside the control room.

Action (b): Assess the generic implications of assigning conflicting multiple responsibilities to the operating staff for response to resource-intensive accidents such as fire brigade responsibilities plus support for shutdown from outside the control room.

Disposition: Ongoing.

As stated in the November 2, 1993, memorandum, Office of Nuclear Reactor Regulation (NRR) and Office of Nuclear Regulatory Research (RES) staff noted a need for further research on staffing levels and task allocation.

The staff has addressed this South Texas-specific item through the inclusion of the DET's observations as part of the operational data used in an ongoing NRC research project on shift staffing levels at nuclear power plants. The objective of that research project is to establish a technical basis for minimum shift staffing levels of licensed and non-licensed personnel at nuclear power plants to confirm the adequacy of the requirements of 10 CFR 50.54(m) or to establish a regulatory basis for modifying these requirements.

The project team will conduct analyses to determine the workload and function allocation for licensed and non-licensed personnel for high-workload transient responses. In addition to the DET report on South Texas, operational data from other off-normal events where shift crews appear to have been stretched in their ability to mitigate events are included in the research data.

The project team has reviewed these data and observed an emergency exercise to identify situations in which shift staffing may play a significant role. This information will be used in the selection of scenarios for simulator research and task network modeling for establishing the regulatory basis for minimum staffing levels needed to successfully accomplish all necessary safety functions. RES plans to

complete this project in early 1995 (Reference 1).

Item 2: The capability of the essential chilled water (ECW) system to perform its safety function during a design basis accident under low heat load conditions was never demonstrated, either through system testing or engineering analysis. The system design cooling capacity of 450 tons per train exceeds the requirements for the highest expected heat load, and greatly exceeds the expected heat load for cold weather conditions. The licensee has experienced surging and vibration of chillers, particularly when throttling ECW flow because of cool weather conditions. If an accident occurred during cold weather and all chillers operated as designed, in response to an engineered safety feature actuation, the chillers would be significantly under-loaded, potentially causing surging and failure. Failure of the chillers would result in loss of ECW system cooling of safety-related equipment. The piping design configuration did not allow the system to be tested with heat loads representative of those anticipated during accident conditions. The licensee indicated that the existing analysis did not adequately address the issue of chiller operation during a design basis accident under low heat load conditions, and agreed to perform an engineering analysis by September 1993.

Action (b): Assess the need and scope of baseline testing of the ECW system that would more closely simulate design basis accident heat load conditions and validate operability. Issue generic correspondence as appropriate.

Action (c): Assess the need and scope of periodic testing of the ECW system to ensure that it can perform its safety function. Issue generic correspondence as appropriate.

Disposition: Ongoing

Actions 2.b and 2.c require assessment of the need and scope of baseline and periodic testing of the ECW system. The NRR finds no justification for back-fitting ECW testing. At present, the staff is waiting for the licensee to propose testing that would verify that chiller performance corresponds to design performance (Reference 1).

Item 4: At STP collapse of the HVAC duct-work would prevent cooling of safety-related components and systems. To protect the HVAC duct-work from collapse during a tornado, the outside ventilation intake dampers are designed to close automatically within .25 seconds, at a differential pressure of 3 psi. Thirty dampers had not been tested to verify that they would operate as designed. An STP preventive maintenance action was scheduled on a ten year frequency, but had not yet been performed. STP agreed to motion test the dampers to verify operability.

Action (b): Assess the extent and frequency of damper motion testing at licensed facilities. Evaluate the need to establish technical specification damper motion testing requirements, and subsequent motion testing of ventilation dampers affecting safety-related equipment. Issue requirements as appropriate.

Action (c): Assess the need and scope of periodic testing of the dampers to ensure that they can perform their safety function. Issue guidance as appropriate.

Disposition: Ongoing

It appears that the effect of positive wind pressure from a tornado on heating, ventilation, and air conditioning (HVAC) dampers may not have been considered at STP and other plants. Moreover, there seem to be no standards for testing of the dampers. A review of the individual plant evaluation (IPE) for STP indicates that HVAC system failures in the electrical auxiliary building are a large initial contributor (totaling approximately 20%) to core damage frequency estimates. The contribution to risk from failure of dampers in the HVAC system does not appear to be specifically addressed in the IPE, although other causes leading to failure are addressed. Probabilistic risk assessments and ancillary information will be evaluated for estimates on how damper failures contribute to risk of core damage and radiation release to the environment at licensed nuclear plants.

The original plan called for a probabilistic risk assessment by early 1995. However, the schedule for this will be moved up to the fourth quarter 1994. As a result, a task order for this staff action has been drafted and a contractor is expected to be assigned after the staff reviews the statement of work (Reference 1).

Item 6: At STP nine failures of standby diesel generator (SDG) high pressure fuel injection pump hold down studs occurred from 1987 through 1993. Each time a failure occurred, the SDG was declared inoperable. Subsequent licensee operability reviews determined that failure of the fuel injector hold down studs would render the associated cylinder inoperable, but would not render the SDG inoperable. The licensee received correspondence from Cooper-Bessemer indicating that as many as 2 cylinders could be out of service and the SDG would still be operable. However there was no analysis available for team review.

The licensee attributed the failures to various root causes such as, faulty material, use of improper installation tools and improper lubrication of the hold down studs prior to torquing. Preliminary indications from the licensee also indicated that other utilities with Cooper-Bessemer SDGs have experienced fuel injector hold down stud failures. However, to date no formal industry notification has been issued by the

licensee or the vendor.

Action (b): Evaluate the need to provide additional generic regulatory correspondence for multiple fuel injector hold down stud failures. Issue guidance as appropriate.

Disposition: Ongoing

The licensee submitted an operability analysis that justified operation of the diesel engine with inoperable cylinders on October 11, 1993. Supported by NRR, regional staff inspected the emergency diesel generators in December 1993. The results of this inspection are documented in NRC Inspection Report 93-44 dated January 18, 1994.

The staff agrees that the licensee's position is conceptually valid. However, an issue related to this finding involving erratic cylinder firing pressures and engine balance warrants further review. Therefore, this issue will not be fully resolved until the end of March 1994 (Reference 1).

Item 7: The standard TS guidance regarding overtime appears to have been developed based on a normal 8-hour shift. The licensee was on site-wide 12-hour shifts. As a result, any need to hold an operator over resulted in exceeding the TS overtime guidance by working more than 24 hours in a 48 hour period. This situation had occurred relatively frequently, largely because of minimally staffed shift crews.

Action: Evaluate the applicability of TS overtime requirements for plants on 12-hour shifts. Issue additional guidance as appropriate.

Disposition: Resolved

The staff has approved a specific TS amendment to accommodate 12-hour shifts by allowing for a "nominal" 40-hour work week. The fundamental objective of the NRC policy on nuclear power plant staff working hours, regardless of shift duration, is to prevent situations where fatigue could reduce the ability of operating personnel to keep the reactor in a safe condition. The staff recognizes that licensees with operating crews on 12-hour shift rotations may need to employ different scheduling practices than those licensees using 8-hour shift rotations. The staff concluded that the current NRC guidance is applicable to 12-hour shift rotations and additional guidance is not appropriate (Reference 2).

References:

1. Memorandum from Thomas E. Murley to James M. Taylor (NRC), Status of NRR Staff Actions Resulting from the Diagnostic Evaluation at South Texas Project (WITS-93133), February 1, 1994.

2. Memorandum from Thomas E. Murley to James M. Taylor (NRC), Status of NRR Staff Actions Resulting from the Diagnostic Evaluation at South Texas Project, November 2, 1993.

Enclosure 2

SPLB SALP INPUT

Plant Name: South Texas Project Electric Generating Station
SER Subject: Staff Actions Resulting from the Diagnostic Evaluation
TAC No.: M87165 and M87166

Summary of Review

Plant Systems Branch conducted a review of staff actions resulting from the Diagnostic Evaluation at South Texas Project Electric Generating Station (STP) regarding essential chilled water (CH) system operation. We determined that Houston Lighting and Power Company (HL&P), the licensee for STP, has completed an acceptable engineering evaluation demonstrating that the CH system is capable of performing its safety function under design basis maximum and minimum heat load conditions. We also found HL&P's test program for the CH system to be acceptable. Plant Systems Branch will draft an Information Notice for release in the second quarter of 1994 to notify the industry of HL&P's actions in addressing this issue.

Narrative Discussion of Licensee Performance-Engineering/Technical Support

The licensee performed a thorough analysis demonstrating that the essential chilled water system will perform acceptably under minimum loading conditions after full implementation of modifications to the service water piping providing cooling water to the essential chillers. Additionally, the licensee conducted post-modification testing that provided data used to validate the results of the analysis. However, the inspectors noted that additional administrative controls were necessary to justify certain assumptions in the analysis.

Author: S. Jones

Date: MAR 1 [illegible] 1994

D/SP