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

# SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

# RELATED TO AMENDMENT NO. 192 TO

# FACILITY OPERATING LICENSE NO. NPF-6

# ENTERGY OPERATIONS, INC.

# ARKANSAS NUCLEAR ONE, UNIT NO. 2

# DOCKET NO. 50-368

## 1.0 INTRODUCTION

By letter dated May 19, 1995, Entergy Operations, Inc. (the licensee) submitted a request for changes to the Arkansas Nuclear One, Unit No. 2 (ANO-2) Technical Specifications (TS). The requested changes would modify the TS 3.5.1 by extending the allowed outage times (AOTs) for a single inoperable Safety Injection Tank (SIT) from one hour to 24 hours, and for a single inoperable SIT specifically due to malfunctioning SIT water level or nitrogen cover pressure instrumentation inoperability from one hour to 72 hours.

The letters from the licensee dated February 27, and September 30, 1996, and related information submitted by the Combustion Engineering Owners Group (CEOG), on June 14, 1996, provided clarifying information that did not change the initial proposed no significant hazards consideration determination.

## 2.0 BACKGROUND

Since the mid-1980s, the NRC has been reviewing and granting improvements to TS that are based, at least in part, on probabilistic risk assessment (PRA) insights. In its final policy statement on TS improvements of July 22, 1993, the NRC stated that it:

> "expects that licensees, in preparing their Technical Specification related submittals, will utilize any plant-specific PSA [probabilistic safety assessment][1] or risk survey and any available literature on risk insights and PSAs. . . . Similarly, the NRC staff will also employ risk insights and PSAs in evaluating Technical Specifications related submittals. Further, as a part of the Commission's ongoing program of improving Technical Specifications, it will continue to consider methods to make better use of risk and reliability information for defining future generic Technical Specification requirements."

The NRC reiterated this point when it issued the revision to 10 CFR 50.36, "Technical Specifications," in July 1995 (60 FR 36953). In August 1995, the NRC adopted a final policy statement on the use of PRA methods in nuclear regulatory activities that encouraged greater use of PRA to improve safety decisionmaking and regulatory efficiency (60 FR 42622). The PRA policy statement included the following points:

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[1]PSA and PRA are used interchangeably herein.

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1. The use of PRA technology should be increased in all regulatory matters to the extent supported by the state of the art in PRA methods and data and in a manner that complements the NRC's deterministic approach and supports the NRC's traditional defense-in-depth philosophy.

2. PRA and associated analyses (e.g., sensitivity studies, uncertainty analyses, and importance measures) should be used in regulatory matters, where practical within the bounds of the state of the art, to reduce unnecessary conservatism associated with current regulatory requirements.

3. PRA evaluations in support of regulatory decisions should be as realistic as practicable and appropriate supporting data should be publicly available for review.

In August 1995, the Combustion Engineering Owners Group (CEOG) submitted several Joint Application Reports for the staff's review. One of the CEOG Joint Application Reports provided justifications for extensions of the TS AOTs for SITs.[2] The justifications for these extensions are based on a balance of probabilistic considerations, traditional engineering considerations, including defense-in-depth, and operating experience. Risk assessments for all of the Combustion Engineering (CE) plants are contained in the reports. The staff reviewed the Joint Application Reports and the licensee's plant-specific amendment request which had also included the Joint Application Reports as supporting documentation.

In addition, one of the proposed changes would revise TS 3.5.1, "Safety Injection Tanks (SITs)" to incorporate recommendations and suggestions from Generic Letter (GL) 93-05, "Line-Item Technical Specifications Improvements to Reduce Surveillance Requirements for Testing During Power Operations."

## 3.0 EVALUATION

The licensee proposes extending the TS completion time for one SIT that is inoperable for the inability to verify level or pressure from one to 72 hours. The licensee also proposes extending the TS completion time for one SIT that is inoperable for reasons other than boron concentration being outside of limits or the inability to verify level or pressure from one to 24 hours.

The proposed changes result in the following AOTs for an inoperable SIT:

(1) 72 hours if the SIT is inoperable due to the boron concentration of the water within the tank being outside limits (2200 to 3000 ppm);

(2) 72 hours if the SIT is inoperable due to the inability to verify level or pressure because of problems with instrumentation;

(3) 24 hours if the SIT is inoperable for reasons other than (1) or (2). Such problems include actual deviation from pressure and level limits, equipment problems that could interfere with the delivery of water to the reactor coolant system, or surveillance or qualification issues that challenge the operability of the SITs.

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[2]CE NPSD-994, "Joint Application Report for Safety Injection Tank AOT/STI Extension," May 1995

The staff evaluated the licensee's proposed amendment to the TS using a combination of traditional engineering analysis, PRA methods, and a review of operating experience. The staff's traditional analysis evaluated the capabilities of the plant to mitigate design basis events with one SIT inoperable. The staff then used insights derived from the use of PRA methods to determine the risk significance of the proposed changes. The results of these evaluations were used in combination by the staff to determine the safety impact of extending the AOTs for one inoperable SIT.

3.1 Level and Pressure Instrumentation

The NRC issued GL 93-05 on September 27, 1993, and recommended that licensees add a condition to the SIT TS for the case where one SIT is inoperable due to the inoperability of water level and pressure channels in which the completion time to restore the SIT to operable status would be 72 hours. GL 93-05 stated that the NRC staff and industry efforts to develop new STS recognized that SIT instrumentation operability was not directly related to the capability of the SITs to perform their safety function. Therefore, surveillance requirements for SIT pressure and level instrumentation were relocated from the new STS and the only surveillance that was retained was that surveillance required to confirm that the parameters defining SIT operability are within their specified limits. At the time of the development of the STS, the staff did not include a separate condition in the SIT TS for a SIT inoperable due to the inability to verify level or pressure, as was recommended in GL 93-05. However, the staff believes this is appropriate based on the analysis done during the development of NUREG-1366, "Improvements to Technical Specifications Surveillance Requirements," which formed the basis for the issuance of GL 93-05.

The current ANO-2 TS do not differentiate between a SIT that is inoperable due to tank inventory or nitrogen gas pressure discrepancies and a SIT whose inventory or gas pressure cannot be verified due solely to malfunctioning water level instrumentation or pressure instrumentation. Because these instruments provide no safety actuation, it is reasonable to extend the completion time to 72 hours under these conditions since the SIT is available to perform its safety function during this time. This change is consistent with the staff's recommendations in GL 93-05. Given that the equipment, configuration, and use of the instrumentation at ANO-2 is consistent with the generic evaluations performed by the staff and documented in NUREG-1366, the staff finds the proposed change acceptable.

3.2 General AOT Extension from one to 24 hours

Industry operating experience has demonstrated that many of the causes of SIT inoperability have been diagnosed and corrected within a relatively short period, but one that is often longer than the existing 1-hour completion time. In several cases, the diagnosis of an inoperable SIT has resulted in plant shutdowns.

If a single SIT were to be diagnosed as inoperable for reasons other than boron concentration being outside of limits (which is already addressed under a separate Action with a 72-hour completion time), TS 3.5.1, Action B, would currently allow only one hour for operators to restore the SIT to operability. If the action were not completed within one hour, the plant would have to be placed in Mode 3 within the next 6 hours and brought to less than 700 psia within the next 12 hours. The extension of the existing SIT completion time from one to 24 hours should provide the licensee with sufficient time in which to diagnose and possibly repair minor SIT system malfunctions at power, thereby averting an unplanned plant shutdown. Since risk analyses

demonstrate that the increased risk of operating with a single SIT out of service is negligible, increasing the completion time can be beneficial by possibly avoiding unplanned shutdowns associated with an inoperable SIT. Unnecessary plant shutdowns associated with the outage of non-risk-significant equipment are undesirable because mode changes have the potential to increase the risk above that of steady state operation.

3.2.1 Traditional Analysis

The performance of all of the ECCS, including SITs, is calculated in accordance with 10 CFR Part 50, Appendix K, such that the ECCS ensures that the acceptance criteria of 10 CFR 50.46 are satisfied. These criteria were established in order to define deterministic acceptance criteria that could be used to judge the acceptability of a given ECCS design. The methodology defined in Appendix K conservatively represents LOCA thermohydraulic and hydrodynamic phenomenology to calculate fuel peak clad temperature. As a result, the methodology may well overstate the minimum equipment requirements for adequate response to an event.

The SITs are passive pressure vessels partially filled with borated water and pressurized with a cover gas (nitrogen) to facilitate injection into the reactor vessel during the blowdown phase of a large break LOCA. This action provides inventory to assist in accomplishing the refill stage following blowdown. The SITs also provide reactor coolant system (RCS) makeup for a small break LOCA.

Each SIT is piped into an associated RCS cold leg via an ECCS line also utilized by HPSI and LPSI. Each SIT is isolated from the RCS during full pressure operations by two series check valves. Each SIT also has a normally deenergized open motor-operated isolation valve utilized to isolate the SIT from the RCS during normal cooldown and depressurization evolutions. Each of these valves receive a safety injection actuation signal to open. The SIT gas pressure and volume, water volume, and outlet pipe size are designed to allow three of the four SITs to inject the inventory necessary to keep clad melt and zirconium-water reaction within design assumptions following a design basis LOCA. The design assumes the loss of inventory from one SIT through the LOCA break.

LCO 3.5.1 requires that all SITs be operable whenever the plant is in Modes 1, 2, or 3, with pressurizer pressure greater than or equal to 700 psia. The LCO is based on the assumption that when the plant is in any of these modes of operation, the SITs must have the same functionality that would be required for a LOCA at full rated thermal power. When the plant is in any of the applicable modes, a SIT is considered operable when the following conditions exist:

- The associated isolation valve is fully open.
- Water inventory in the tank is within the assumed band.
- The boric acid concentration of the water inventory of the tank is within the assumed band.
- The nitrogen cover pressure within the tank is within the assumed band.

In the past, a justification for the short completion time for one inoperable SIT has been that the perceived severity of the consequences of not having all SITs available to provide passive injection during a design basis LOCA warranted the severity of the requirement to return the SIT

to operable status within one hour or shut down the unit. However, the current SIT completion time was based solely on engineering judgment and did not take into consideration a quantitative assessment of risk.

The SIT operational parameters are set by the design basis licensing large break LOCA analysis. Since the SIT is a passive device and provides a limited function, operability has been restricted to mean that the equipment's initial conditions are within a band supported by 10 CFR Part 50, Appendix K, design basis analysis. Analytical models of Appendix K to 10 CFR Part 50 are devised so as to overestimate the amount of liquid lost from the break and to underestimate the residual inventory in the reactor vessel lower plenum. Consequently, inventory discharge requirements are conservatively set at a high level. Extending the completion time from one to 24 hours for one SIT that is inoperable for reasons other than boron concentration being outside of limits or the inability to verify level or pressure will allow time for the licensee to correct minor problems with a SIT. Considering the short time frame that a SIT is allowed to be out of service, the low likelihood of a large break LOCA during this short time frame, and the potential risk associated with plant shutdowns, extending the SIT completion time will allow defense in depth to be maintained while not significantly affecting overall safety margins assumed in the design basis analysis.

3.2.2 PRA Used to Support the Proposed TS Changes

The staff uses a three-tiered approach to evaluate the risk associated with proposed TS changes similar to the requested AOT extension for the SITs at ANO-2. The first tier evaluates the PRA model and the impact of the AOT extensions for the SITs on plant operational risk. The second tier addresses the need to preclude potentially high risk configurations, should additional equipment outages occur during the time when one SIT is out of service. The third tier evaluates the licensee's configuration risk management program to ensure that the applicable plant configuration will be appropriately assessed from a risk perspective before entering into or during the proposed AOTs. Each tier and the associated findings are discussed below.

The technical evaluation report[3] used in support of the staff's evaluation for ANO-2 focused on[4]

- the process adopted by the CEOG to assess single AOT risk,
- the identification of ANO-2 accident sequences in which credit was taken for SITs,
- independent verification of the single AOT risk [essentially equivalent to incremental conditional core damage probability (ICCDP)[5]], and
- determination of the significance of single AOT risk relative to an acceptance guideline value.

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[3]SCIE-NRC-318-97, "Technical Evaluation of Combustion Engineering Owners Group (CEOG) Joint Application for Safety Injection Tanks and Low Pressure Safety Injection System Allowed Outage Time (AOT) Extension," July 21, 1997.

[4]SECY-97-095, "Probabilistic Risk Assessment Implementation Plan Pilot Application for Risk-Informed Technical Specifications," April 30, 1997.

[5] ICCDP = [(conditional CDF with the subject equipment out of service) - (baseline CDF with nominal expected equipment unavailabilities)] X (duration of single AOT under consideration).

Impact of SITs on Tier 1, 2, and 3 Requirements (Risk Measures)

The following factors are chiefly responsible for the differences in SIT AOT risks among the CE plants:

- modeling for success criteria for SITs,
- initiating event (IE) frequency assumed for the initiators challenging the SITs, and
- credit for SITs in mitigating medium LOCAs.

The SIT single AOT risk (or essentially equivalently, ICCDP) for ANO-2 is 2.30E-08 which is below the acceptance guideline value of 5.0E-07 published in DG-1065, "An Approach for Plant-Specific Risk-Informed Decisionmaking: Technical Specifications," (62 FR 34321, June 25, 1997). In addition, the change in the ANO-2 updated baseline core damage frequency (CDF) (as reported in the CEOG Joint Application Report) due to the SIT AOT change is negligible, with the average CDF remaining at 3.28E-05 per year after including the assumptions for extended SIT AOTs. The negligible impact on CDF is within the acceptance guidelines published in Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Current Licensing Basis" (calculated increase in CDF less than 1.0E-06 per reactor year).

In the context of integrated decisionmaking, the acceptance guidelines should not be interpreted as being overly prescriptive. They are intended to provide an indication, in numerical terms, of what is considered acceptable. As such, the numerical acceptance guideline is an approximate value that provides an indication of the changes that are generally acceptable. Furthermore, the state of knowledge, or epistemic, uncertainties associated with PRA calculations preclude a definitive decision with respect to the acceptance of the proposed change based purely on the numerical results. The intent in making the comparison of the PRA results with the acceptance guidelines is to demonstrate with reasonable assurance that the increase in risk is small and consistent with the intent of the Commission's Safety Goal Policy Statement.

The Tier 2 evaluation did not identify the need for any additional constraints or compensatory actions that, if implemented, would avoid or reduce the probability of a risk-significant configuration. Because the SIT sequence modeling is relatively independent of that for other systems, the staff concludes that application of Tier 3 to the proposed SIT AOT is not necessary.

3.2.3 Implementation and Monitoring

The licensee has stated through endorsement of the CEOG Joint Application Reports that the maintenance rule (10 CFR 50.65) will be the vehicle that controls the actual equipment maintenance cycle by defining unavailability performance criteria for the SITs. The AOT extensions will allow efficient scheduling of maintenance within the boundaries established by implementing the maintenance rule. The effect of the AOT extensions should be considered if any adverse trends in meeting established performance criteria are identified for the SITs. The maintenance rule will thereby be the vehicle that monitors the effectiveness of the AOT extensions. Application of these implementation and monitoring strategies will help to ensure that extension of TS AOTs for SITs does not degrade operational safety over time and that the risk incurred when a SIT is taken out of service is minimized.

3.3 Summary

The staff has evaluated the licensee's proposed changes to TS 3.5.1 for compliance with regulatory requirements as documented in this evaluation and has determined that they are acceptable. The associated bases changes are also acceptable. This determination is based on the following:

1. The need to maintain reliable safety systems.

2. Consideration of the design basis requirements for the SITs.

3. Staff recommendations contained in GL 93-05 regarding SIT TS requirements.

4. Insights gained from the evaluation of the risk associated with extending the AOT for having one SIT out of service.

5. Performance monitoring through the maintenance rule to ensure that extension of TS AOTs for SITs does not degrade operational safety over time.

The staff therefore finds that the AOT for one SIT that is inoperable for the inability to verify level or pressure may be extended to 72 hours and the AOT for one SIT that is inoperable for reasons other than boron concentration not within limits or inability to verify level or pressure may be extended to 24 hours with a very small impact on risk and is therefore acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Arkansas State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (60 FR 39439). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

## 6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

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