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

Enclosure

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

B&W OWNERS GROUP TOPICAL REPORT BAW-10182

JUSTIFICATION FOR INCREASING ESFAS ON-LINE TEST INTERVALS

1.0 INTRODUCTION

By letter dated March 2, 1992 (Reference 1), the B&W Owners Group (BWOG) submitted Topical Report BAW-10182, "Justification for Increasing Engineered Safety Features Actuation System (ESFAS) On-Line Test Intervals." This report was prepared by the B&W Nuclear Services Company and provides the technical basis to justify increasing the ESFAS on-line surveillance test interval (STI) in plant technical specifications from the current one-month to a three-month interval. The Idaho National Engineering Laboratory (INEL) assisted the staff in the review of BAW-10182. The INEL review results are documented in EGG-RTAP-10925 (Reference 2) and are summarized in this safety evaluation report. The following evaluation addresses both the acceptability of the probabilistic analysis presented in BAW-10182 and the acceptability of the proposed extension of the STI.

The methodology used in BAW-10182 is the same as that previously used in the B&WOG Topical Report BAW-10167, "Justification for Increasing the Reactor Trip System On-Line Test Intervals," which was submitted to justify the Reactor

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Trip System STI extension. The staff approved BAW-10167 and suggested some specific improvements in the methodology. BAW-10182 uses the improved methodology and reflects the major differences between the three ESFAS designs in the B&W operating reactors (Baily design at ANO-1 and Oconee, Gilbert design at Crystal River 3, Bechtel design at Davis-Besse) exclusive of Three Mile Island which was not represented in the BWOG on this issue. The unavailability of each of the three ESFAS designs is modeled in the report using reliability block diagrams for both the current one-month STI and the proposed three-month STI. The analysis evaluated the impact of the proposed STI extension on core melt frequency and system unavailability to demonstrate that the proposed change did not significantly increase plant risk when compared with the current technical specification requirements.

2. EVALUATION

The staff's evaluation included the following aspects of the probabilistic risk analysis (PRA) performed by B&W to justify the proposed extension of the ESFAS test interval:

1) Models and data used for the reliability analysis
2) Quantification of the analysis models
3) Uncertainty analysis

A time-dependent model was used to dynamically represent system configuration changes associated with testing and maintenance. The source of data for the analog channel components (sensors and instrument string) and digital subsystem components for both random and common mode failures was NUREG/CR-3289, "Common Cause Fault Rates For Instrumentation and Control Assemblies," and B&W reactor operating experience obtained from the Nuclear Plant Reliability Data System. An error factor of 10 (the largest error factor listed in WASH-1400, "An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," for instrumentation) was used for the ESFAS components random failure rate (lambda factor) as suggested in the staff safety evaluation report for BAW-10167. Also, as suggested by NUREG/CR-5801, "Procedure for Analysis of Common-Cause Failures in Probabilistic Safety Analysis," when a common-mode failure rate could not be determined from the component failure history, a beta factor (fraction of lambda factor in which two or more components are involved due to common-mode failure) was used. The random failure rates of the ESFAS components assumed in BAW-10182 were compared to a generic failure rate data base compiled by INEL in EGG-SSRE-8875, "Generic Component Failure Data Base for Light Water and Liquid Sodium Reactors PRAs," and both failure rates and error factors were found to be in close agreement.

A time-dependent quantification calculation was performed by B&W using reliability block diagrams and computer codes for each of the three B&W plant ESFAS designs. The analysis considered core melt frequencies (CMF) due to ESFAS failure for both the current one-month test interval and the proposed three-month test interval over a typical 18-month fuel cycle. This analysis was performed for: (1) six different loss of coolant accident (LOCA) events (including transient-induced LOCAs), each of which challenges different ESFAS parameters and requires a different ESFAS response; and (2) an aggregate case to bound all challenging events. The time-dependent results were then integrated to obtain an average CMF and any incremental difference in the CMF due to an increase in the test interval. BAW-10182 calculations show the incremental risk for a three-month ESFAS STI per reactor-year to vary from 1.45×10^{-7} to 2.03×10^{-8} for the three ESFAS designs, while the corresponding risk for the existing one-month STI varied from 4.0×10^{-7} to 2.11×10^{-8}. Thus, the analysis indicated that the impact on CMF of increasing the ESFAS test interval from one to three months is negligible.

An analysis of the change in CMF can also be utilized to determine changes in ESFAS unavailability. However, the B&WOG report did not present changes in ESFAS unavailability separate from the CMF results. To investigate the potential change in ESFAS unavailability, the staff duplicated the analysis for the Baily ESFAS design using BAW-10182 parameters and the time-dependent unavailability computer code FRANTIC. The analysis results showed an ESFAS unavailability increase by a factor of three, corresponding to the test interval increase (one to three months). However, CMF does not change in direct proportion to ESFAS unavailability because of other factors, such as, the reduced probability of human error when the test interval is extended. This is one of the motivations to develop and implement risk-based changes to the technical specification test intervals.

To determine the change in CMF as a result of a factor of three increase in ESFAS unavailability, the staff recalculated the risk using an ESFAS failure probability increased by a factor of three in the Oconee plant PRA using the fault tree/event tree analysis computer code IRRAS. The results showed negligible increase in CMF.

To test the robustness of the CMF analysis results, the staff also performed an uncertainty analysis for each of the three B&W plant ESFAS designs and both the current and proposed ESFAS test intervals using a Monte Carlo computer code and an error factor of ten (an order of magnitude variation in the failure rates in either direction from the median to the lower and upper bound values). The uncertainty analysis (6000 iterations) indicated that there is a 95% probability with 95% confidence (95%/95%) that the change in CMF associated with increasing the ESFAS test interval to three months is negligible. The staff further compared the B&WOG analyses with three PRAs discussed in NUREG/CR-4550, "Analysis of Core Damage Frequency: Surry, Unit 1 Internal Event," and found the analysis conclusion to be consistent with those in NUREG/CR-4550.

While the generic analysis of risk on the extended STI is considered acceptable, it does not consider the plant-specific effects of drift in both sensors and instrument strings. These plant-specific effects should be assessed and factored into the analysis in order to maintain the validity of the assumed failure rates. Therefore, each licensee referencing BAW-10182 should confirm that they have reviewed drift information including as-found and as-left values for each ESFAS instrument channel involved and determined that drift occurring in that channel over the period of the extended STI will not cause the setpoint value to exceed the allowable values as calculated for that channel by their setpoint methodology (instrument drift is defined as the portion between the upper leave-alone zone and tne allowable value). Each referencing licensee should also maintain onsite records showing the actual setpoint calculations and supporting data that are available in order to permit possible future staff audit. The data should consist of monthly information taken over at least the last 2 years, and a description of the current plant-specific setpoint methodology used to derive the safety margins.

3. CONCLUSION

Based on the above, the staff concludes that the data and analyses in BAW-10182 adequately demonstrate a negligible change in CMF and risk, and thus extending the ESFAS surveillance test interval from the current one-month to three-month interval is, therefore, acceptable. The staff also notes, however, that licensees referencing topical report BAW-10182 should 1) include a plant-specific analysis of setpoint drift for the extended surveillance interval to confirm the validity of the assumed analysis failure rates, 2) maintain onsite records showing actual setpoint calculations and information over at least the last 2 years, and 3) include a description of the current plant-specific setpoint methodology used to derive the safety margins.

4. REFERENCES

1. BWOG Letter (J. Taylor) to NRC (Scott Newberry), dated March 2, 1992

2. INEL Letter (C.F. Obenchain) to NRC (L.C. Ruth), dated October 18, 1993