May 14, 2004

Mr. L. William Pearce
Vice President
FirstEnergy Nuclear Operating Company
Beaver Valley Power Station
Post Office Box 4
Shippingport, PA 15077

SUBJECT: BEAVER VALLEY POWER STATION, UNIT NO. 2 - ISSUANCE OF AMENDMENT RE: ENGINEERED SAFEGUARDS FEATURES ACTUATION SYSTEM (ESFAS) SLAVE RELAY SURVEILLANCE TEST INTERVAL EXTENSION (TAC NO. MB7589)

Dear Mr. Pearce:

The Commission has issued the enclosed Amendment No. 141 to Facility Operating License No. NPF-73 for the Beaver Valley Power Station, Unit No. 2 (BVPS-2). This amendment consists of changes to the Technical Specifications (TSs) in response to your application dated February 4, 2003, as supplemented by letters dated October 24, 2003, and April 6, 2004.

The amendment allows the ESFAS slave relay test frequency in footnote (1) to TS 4.3.2.1.1 to be changed from once per 92 days to once per 12 months provided a satisfactory contact loading analysis has been completed, and a satisfactory slave relay service life has been established, for the slave relay being tested.

A copy of the related safety evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

Timothy G. Colburn, Senior Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-412

Enclosures: 1. Amendment No. 141 to NPF-73
2. Safety Evaluation

cc w/encls: See next page

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ADAMS Accession Numbers: Letter - ML041030082; TSs: - ML ;
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PENNSYLVANIA POWER COMPANY

OHIO EDISON COMPANY

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

THE TOLEDO EDISON COMPANY

FIRSTENERGY NUCLEAR OPERATING COMPANY

DOCKET NO. 50-412

BEAVER VALLEY POWER STATION, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 141
License No. NPF-73

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by FirstEnergy Nuclear Operating Company, et al. (the licensee), dated February 4, 2003, as supplemented by letters dated October 24, 2003, and April 6, 2004, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. NPF-73 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 141, and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated in the license. FENOC shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance and shall be implemented within 60 days.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Richard J. Laufer, Chief, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: May 14, 2004

ATTACHMENT TO LICENSE AMENDMENT NO. 141

FACILITY OPERATING LICENSE NO. NPF-73

DOCKET NO. 50-412

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

Remove	Insert
3/4 3-15	3/4 3-15

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 141 TO FACILITY OPERATING LICENSE NO. NPF-73

PENNSYLVANIA POWER COMPANY

OHIO EDISON COMPANY

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

THE TOLEDO EDISON COMPANY

FIRSTENERGY NUCLEAR OPERATING COMPANY

BEAVER VALLEY POWER STATION, UNIT 2

DOCKET NO. 50-412

1.0 INTRODUCTION

By application dated February 4, 2003, as supplemented by letters dated October 24, 2003, and April 6, 2004, the FirstEnergy Nuclear Operating Company (FENOC, the licensee), requested changes to the Technical Specifications (TSs) for Beaver Valley Power Station, Unit No. 2 (BVPS-2). The supplements dated October 24, 2003, and April 6, 2004, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on March 18, 2003 (68 FR 12953).

The proposed changes would allow the Engineered Safeguards Features Actuation System (ESFAS) slave relay test frequency in footnote (1) to TS 4.3.2.1.1 to be changed from once per 92 days to once per 12 months provided a satisfactory contact loading analysis has been completed, and a satisfactory slave relay service life has been established, for the slave relay being tested. The licensee's justification for extending the slave relay surveillance test interval (STI) to 12-months includes topical report WCAP-15887, Revision 2, "Probabilistic Risk Analysis of the Slave Relay Surveillance Test Interval Extension for Beaver Valley Power Station, Unit 2," dated December 2002. WCAP-15887 is plant-specific to BVPS-2 and was submitted for Nuclear Regulatory Commission (NRC) staff review. The licensee stated that the proposed amendment will reduce the required testing of the slave and interposing relays, reduce the probability of spurious equipment actuation, and limit the potential for plant upset and human error.

2.0 REGULATORY EVALUATION

BVPS-2 footnote (1) to TS 4.3.2.1.1 currently requires, in part, that, "[t]he test of slave relays (to be performed at least once per 92 days in lieu of at least once per 31 days) shall include, as a

minimum, a continuity check of associated actuation devices that are not testable." The licensee proposed to change the testing of slave relays from at least once per 92 days to at least once per 12 months.

2.1 Applicable Regulations

- Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.36, requires all operating licenses for nuclear reactors to include TSs. The Limiting Conditions for Operation (LCOs), along with the required surveillance, are specified for each system included in the TSs.

- Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants," General Design Criterion (GDC) 21, "Protection system reliability and testability."

- Appendix A to 10 CFR Part 50, GDC 37, "Testing of emergency core cooling system."

- Appendix A to 10 CFR Part 50, GDC 40, "Testing of containment heat removal system."

- Appendix A to 10 CFR Part 50, GDC 43, "Testing of containment atmosphere cleanup systems."

- 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance of nuclear power plants." (maintenance rule), paragraph (a)(4), as it relates to the configuration risk management with an extended slave relay STI.

2.2 Applicable Regulatory Criteria/Guidelines

Regulatory Guide (RG) 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," dated November 2002, and RG 1.177, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications," dated August 1998, provide specific guidance and acceptance guidelines for assessing the nature and impact of licensing basis changes, including proposed permanent TS changes to STIs, by considering engineering issues and applying risk insights. NUREG-0800, Standard Review Plan (SRP), Chapter 16.1, "Risk-Informed Decisionmaking: Technical Specifications," describes acceptable approaches and guidelines on the use of risk-informed decision making in the review of proposed TS modifications, including extended STIs. Paragraph (a)(4) of the maintenance rule, 10 CFR 50.65, requires a licensee assessment before maintenance activities are performed on structures, systems, and components (SSCs) covered by the maintenance rule to manage the increase in risk that may result from the proposed activities. RG 1.182, "Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants," dated May 2000, provides guidance on implementing the provisions of 10 CFR 50.65. RG 1.174, Section 2.3, Element 3, "Define Implementation and Monitoring Program," states that monitoring that is in conformance with the maintenance rule can be used to satisfy Element 3 when the monitoring performed under the maintenance rule is sufficient for

the SSCs affected by the risk-informed application. The staff requirements memorandum (SRM) for SECY-98-067 also stated that 10 CFR 50.65(a)(4) may be used by a licensee to satisfy the criteria of RG 1.177 for a Tier 3, "risk-Informed configuration risk management" program.

The licensee stated that its amendment request for BVPS-2 and WCAP-15887 justification is consistent with guidance specified in RG 1.174 and RG 1.177. WCAP-15887, submitted by the licensee, provides a risk-informed justification for extending the slave relay STI from the current 92 days to 12 months. The licensee's submittal addresses the impact on defense-in-depth, safety margins, and the change in risk as measured by the impact on core damage frequency (CDF) and large early release frequency (LERF). The licensee also confirmed their conformance to the requirements of paragraph (a)(4) of the maintenance rule, 10 CFR 50.65, as they relate to the proposed 12-month slave relay STI.

3.0 TECHNICAL EVALUATION

The NRC staff has reviewed the licensee's regulatory and technical analyses in support of its proposed license amendment described in WCAP-15887 of the licensee's submittal. The licensee's technical basis and justification included discussion of other relays than those listed as slave relays in WCAP-15887. However, the NRC staff focused its deterministic review and approval on only those relays specified as slave relays that were considered within the scope of the licensee's proposed TS change to footnote (1) of TS 4.3.2.1.1 for BVPS-2. The evaluation supports the conclusion 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.

3.1 Risk Analysis

3.1.1 Background

Previous slave relay STI evaluations by the Westinghouse Owners Group (WOG) include topical reports, WCAP-10271, Supplement 2, "Evaluation of Surveillance Frequencies and Out of Service Times for the Engineered Safety Features Actuation System"; WCAP-13877, "Reliability Assessment of Westinghouse Type AR Relays Used as SSPS Slave Relays"; and WCAP-13878, "Reliability Assessment of Potter & Brumfield MDR Series Relays."

WCAP-10271, Supplement 2, dated March 1987, used fault trees and a risk analysis to determine the impact of increased STIs and allowed outage times (AOTs) on engineered safety features (ESF) signal unavailability. The risk analysis estimated CDF and man-rem exposure based on modified surveillance intervals and test times. This topical report used a Millstone risk model as the basis for the generic study. The ESFAS evaluation included in WCAP-10271, Supplement 2, concluded that an extension of slave relay STI was not justified based on the sensitivities noted for the slave relay unavailabilities for various surveillance intervals. WCAP-10271, Supplement 2, concluded that with a proposed test interval of 18 months, the main contributor to solid state protection system (SSPS) or relay protection system unavailability was the common cause failure of the slave relays and logic cabinets. This WCAP did not request an extended STI for the slave relays, but instead recommended an extension of

test and maintenance times for ESFAS components and an extension of analog channel surveillance intervals.

The second effort initiated by the WOG was WCAP-13877, the latest version of which is Revision 2, which had the objective of providing a reliability assessment of Westinghouse-type AR relays to demonstrate that SSPS reliability would not be adversely affected by extending the STI for AR-type relays installed as slave relays to 18 months. The evaluation involved a failure modes and effects analysis (FMEA) and aging assessment to determine the viability of a refueling-based slave relay STI. The evaluation concluded that relay failure modes were not sensitive to a short surveillance interval and that the identified failure modes are equally insignificant at a quarterly or refueling STI. For normally energized AR-type relays the WOG did conclude that the heat rise of a normally energized relay coil accelerates the aging of AR-type relays such that operability would be compromised within a 40-year plant life. However, only a limited number of SSPS slave relays are normally energized and the WOG stated that the adverse impact to operability and reliability could be avoided by replacement of normally energized AR-type relays at an appropriate interval. The NRC staff's safety evaluation (SE) dated July 12, 2000, required that each plant incorporating WCAP-13877, Revision 2, determine the qualified life of the relays based on plant-specific environmental conditions. BVPS-1 and 2 Westinghouse-type AR slave relay data was used in WCAP-13877. The five failures attributed to BVPS-1 and 2 AR-type slave relays referenced in the topical report were determined not to be indicative of relay failure, but the result of design application and test errors.

WCAP-13878, the latest version of which is Revision 2, involved a similar assessment for Potter & Brumfield-type MDR relays used in SSPS applications. The FMEA for MDR-type relays reached similar conclusions in that the WCAP found that normally de-energized MDR-type relay aging effects were suitable for the 40-year life of the plant with minimal need for testing and surveillance. The WOG also stated that SSPS reliability would not be adversely affected by extending the surveillance interval for MDR-type relays to 18 months when used in SSPS slave relay applications. The topical report noted that normally energized MDR-type relays could operate successfully for 30 years without aging concerns. As a result, the WOG concluded as it had for the AR-type normally energized relays that replacement at an appropriate interval could avoid any adverse impacts to operability and reliability. The NRC staff's SE for WCAP-13878, Revision 2, dated July 12, 2000, concurred with this assessment. BVPS-1 and 2 MDR slave relay data was used in WCAP-13878. One failure was reported by the licensee with respect to MDR slave relays. The failure assessment determined that the failure of the relay was attributable to the relay contacts being overloaded. The cause of the contact failure was not attributed to the relay, but was the result of relay contact load limitations not considered in the design application.

3.1.2 Description of System/Component and Current Requirements

The proposed license amendment is related to the ESFAS. As referenced in NUREG-1431, Volume 2, Revision 2, "Standard Technical Specifications for Westinghouse Plants Bases," the ESFAS initiates necessary safety systems based on the values of select unit parameters to protect against violating core design limits and the reactor coolant system (RCS) pressure boundary to mitigate accidents. The ESFAS is divided into three parts comprising field instrumentation, signal processing, and the SSPS.

The reactor protection system (RPS) is designed to shut down the reactor and maintain it in a safe condition in the event a transient or accident occurs. The RPS is subdivided into two associated systems: (1) the reactor trip system (RTS) and (2) the ESFAS. Reactor operating limits are continuously monitored by the RPS through sensors that detect the necessary operating parameters. The sensor output is measured by the signal processing racks and processed by logic circuitry for comparison with pre-selected setpoints. A reactor trip is initiated and engineered safety features actuated when the required combinations of sensor inputs exceed their setpoints.

The RTS initiates a reactor shutdown when safe operating limits are exceeded because of a transient. The ESFAS initiates systems, safety equipment and components if an accident should occur. The ESFAS functions maintain the reactor in a shutdown condition, to provide sufficient core cooling to limit fuel and cladding damage and ensure integrity of the containment.

The logic portion of the BVPS-2 RPS is the solid state logic cabinet or SSPS. The SSPS provides both reactor trip and ESFAS actuation functions and consists of two redundant trains (A and B) that are physically and electrically independent. Inputs to the SSPS logic are derived from the process equipment racks, nuclear instrumentation, field contacts, and control board inputs. Most inputs are processed through the protection system signal conditioning with the bistable outputs sensed by the SSPS and combined into logic matrices representative of the logic combination for various transients. Reactor trip and ESFAS functions are derived from this logic. Should the logic be satisfied, the SSPS operates master and slave relays for ESFAS actuation. Each master relay energizes its associated slave relay(s) which causes the actuation of the end devices and ESFAS actuation. The slave relays provide contact multiplication. Slave relay contacts are designated by function and actuate components whose combined function will alleviate the condition. For some SSPS functions at BVPS-2 the slave relays operate components through interposing relays. Slave relays associated with the proposed STI extension are currently tested every 92-days.

The BVPS-2 Updated Final Safety Analysis Report (UFSAR) states that the basis for ESFAS performance test acceptability is the successful completion of overlapping tests performed on the initiating system and ESFAS. The UFSAR further states that solid state logic testing checks the digital signal path from the logic input relay contacts (inclusive) through the logic matrices and master relays. The test also performs a continuity test on the coils of the output slave relays to confirm master relay contact closure and confirm continuity of the signal path.

The final actuator test (slave relay test) operates the slave relays and actuates associated components if the operation of that component will not interfere with plant operation. For components that cannot be actuated during plant operation, slave relay contact operation is verified by a continuity check of the slave relay circuit.

3.1.3 Detailed Description of the Proposed Change

STIs are intervals for surveillance tests scheduled periodically as required by the TSs. STIs are performed to ensure that safety-related equipment continues to be operable and failures are detectable; limiting fault exposure time. The primary risk contribution attributed to increasing an STI comes from the increased probability of a component failure between scheduled STIs and, therefore, the probability that the component will be inoperable during the surveillance interval.

The extension of an STI affects plant risk, which is represented by CDF and LERF. An STI extension can affect the yearly risk in several ways:

- Reduce the risk by decreasing the number of test-caused equipment actuations by limiting the opportunity for test-caused errors such as inadvertent actuation of ESFAS equipment. This occurs simply because increasing the STI decreases the amount of testing for a given time.

- Reduce the risk by decreasing the unavailability of the RPS component by reducing the test frequency.

- Increase the risk by increasing the fault exposure time. This is because the increased STI increases the interval during which the equipment is subject to failure during standby. As the fault exposure time increases, there is a greater probability that failures during standby will not be detected by components involved with the STI extension.

With an STI, the idea is to strike a balance between more frequent testing which can adversely affect safety either through errors during testing, spurious actuations, configuration, or equipment wear out and extended intervals which can increase fault exposure times. A risk-informed approach to STIs in conjunction with deterministic engineering evaluations, can provide insights that allow STIs to be extended without significantly increasing plant risk.

Currently the BVPS-2 TS surveillance requirement 4.3.2.1.1 states that automatic actuation logic with master and slave relays shall be demonstrated OPERABLE by the performance of the ESFAS surveillance requirements. Footnote 1 to TS 4.3.2.1.1 provides the test requirements including the testing of slave relays once-per-92 days. The licensee proposes to extend the TS 4.3.2.1.1 STI requirement for slave relays from 92 days to 12 months by revising Footnote 1 to allow a 12-month slave relay STI.

In WCAP-15887, the licensee stated that the proposed slave relay STI extension up to 12 months for slave relay testing will reduce required testing, and, therefore, reduce the potential for spurious equipment actuation and the potential for plant upsets and human error. The licensee also stated that the extended slave relay STI will reduce wear on plant equipment and will reduce the out-of-service time experienced for these relays.

3.1.4 NRC Staff Review Methodology

The AR- and MDR-type slave relays installed at BVPS-2 were also included in the analysis provided by WCAP-13877 and WCAP-13878. However, the licensee elected not to use the failure modes and effects analysis (FMEA) methodology referenced in these topical reports. Instead, the licensee chose a risk-informed risk analysis approach similar to WCAP-10271, Supplement 2, except that the licensee's analysis is specific to BVPS-2 and uses RGs 1.174 and 1.177 for guidance. Because BVPS-2 uses relay types that were not included in the previous FMEA evaluations (WCAP-13877 and WCAP-13878), a risk-informed approach allows these relays to be considered in the licensee's analysis similar to the analysis done for WCAP-10271. The previous analysis documented in WCAP-10271, Supplement 2, concluded that a

generic 18-month surveillance interval for slave relays could not be justified in combination with additional AOTs and STIs, but it was also expected that plant-specific evaluations would show a smaller risk impact. The BVPS-2 risk analysis includes plant-specific data, whereas the relay data for WCAP-10271, Supplement 2, included various generic data sources.

The NRC staff reviewed the submittal using the three-tiered approach referenced in RGs 1.174 and 1.177, and SRP, Chapter 16.1. The first tier of the three-tiered approach includes assessing the risk impact of the proposed change in accordance with acceptance guidelines consistent with the Commission's Safety Goal Policy Statement, as documented in RGs 1.174 and 1.177. The first tier assesses the impact on operational plant risk based on the change in core damage frequency (ΔCDF) and change in large early release frequency (ΔLERF). The specific RG 1.177 acceptance guidelines (incremental conditional core damage probability ICCDP and incremental conditional large early release probability ICLERP) are not explicitly addressed since an extension of an STI does not affect these calculations. In addition, Tier 1 establishes that the quality of the probabilistic risk assessment (PRA) is compatible with the safety implications of the proposed TS change and that the scope and level of the PRA are fully adequate to support the evaluation of the TS change. The cumulative risk of the present TS change in light of past applications or additional applications under review is also considered along with the uncertainty/sensitivity analysis with respect to the assumptions related to the proposed TS change.

The second tier involves identifying potential high-risk configurations that may exist if other equipment or systems (in addition to the equipment associated with the proposed license amendment) were taken out of service simultaneously, or subjected to concurrent system or equipment testing. The purpose of the Tier 2 evaluation is to ensure that appropriate restrictions on dominant risk-significant configurations associated with the proposed change are in place.

The third tier addresses the licensee's overall configuration risk management program and confirms that risk insights are incorporated into the decision-making process before taking equipment out of service before or during relay testing. Tier 3 provides additional assurance over the second tier by identifying risk-significant configurations that may be encountered over extended periods of plant operation due to maintenance or other activities and ensuring that appropriate measures are taken to avoid such configurations. Licensees can implement the overall configuration risk management program (as referenced in RG 1.177) through the maintenance rule, 10 CFR 50.65, paragraph (a)(4). Specifically, the rule requires that, before performing any maintenance activity, the licensee must assess and manage the potential risk increase that may result from a proposed maintenance activity.

3.1.5 NRC Staff's Technical Evaluation

For the quantitative evaluation of the risk impact of extending the surveillance interval for slave and interposing relays the licensee used the BVPS-2 PRA model revision BV2REV3A and subsequently BV2REV3B. The model is an at-power Level 1 and Level 2, internal and external initiating events risk model (including both internal and external seismic and fire initiating events). The individual plant examination of external events (IPEEE) stated that external floods and transportation accidents were below the screening criteria.

3.1.5.1 Tier 1: PRA Capability and Insights

The analysis used in WCAP-15887 is specific to BVPS-2. Tier 1 evaluates the impact of the proposed 12-month slave relay surveillance interval on plant risk based on the BVPS-2 PRA model. Tier 1 also includes the evaluation of the PRA for the intended application and the evaluation of the PRA results and insights based on the incorporation of the proposed slave relay extended STI.

3.1.5.1.1 PRA Capability

The objective of the PRA capability review is to determine whether the PRA, as supplemented, is of sufficient scope and detail to support the proposed slave relay extended STI. The NRC staff reviewed the information provided in WCAP-15887 and the findings of previous studies and reports.

To ensure the applicability of WCAP-15887 to the licensee's plant, plant-specific information on PRA quality was evaluated by the NRC staff in the following areas:

(1) The plant-specific PRA reflects the as-built, as-operated plant

(2) Applicable PRA updates

(3) Conclusions of the peer review including facts and observations applicable to the proposed extended STI

(4) PRA quality assurance programs/procedures

(5) PRA adequacy and completeness with respect to evaluating the proposed slave relay STI extension risk impact

The licensee's submittal is based on the BVPS-2 PRA model and includes both internal and external events (both internal and external seismic and fire initiating events). The model was modified for this TS amendment request to develop plant-specific models of the reactor trip and ESF actuation signals. The model contains all slave relays and interposing relays involved in mitigating CDF sequences. The licensee stated that the model used to evaluate the extended slave relay STIs reflected the most current BVPS-2 model (revision 3A) at the time of the TS amendment request. The licensee stated that the model includes the most important ESFAS actuation signals and considers the actuating relays through to the sensor. The licensee also stated that the model includes all slave relays and interposing relays that contribute to the mitigation of CDF sequences created by the BVPS-2 revision 3A model. The model was quantified using generic data, Bayesian updated with plant-specific slave relay and interposing relay failure data. Four cases were run that included a 3-month base case, and 9-month, 12-month, and 18-month STIs.

3.1.5.1.1.1 Individual Plant Examination (IPE)

The NRC staff concluded that the licensee met the intent of Generic Letter (GL) 88-20. The NRC staff stated that the IPE was complete with respect to the information requested by GL 88-20. The NRC staff concluded the analysis was technically sound and capable of

identifying plant-specific vulnerabilities to severe accidents. The licensee used document review and walkdowns to verify that the IPE reflected the plant design and operation at that time. The NRC staff also noted that the IPE had extensive peer review.

3.1.5.1.1.2 Individual Plant Examination of External Events

For the BVPS-2 IPEEE, the NRC staff concluded that the IPEEE was complete and that the results were reasonable given BVPS-2 design, operation, and history. The NRC staff also concluded that the licensee's IPEEE process was capable of identifying the most likely severe accidents and severe accident vulnerabilities from external events.

3.1.5.1.1.3 Significance Determination Process (SDP) Benchmarking

During July 2003, the NRC staff and contractors compared the BVPS-2 SDP Phase 2 notebook and the licensee's risk model results to ensure that the SDP Phase 2 notebook was generally conservative. The BVPS-2 PRA included external events and sensitivity studies that were performed to assess the impact on SDP color determinations. The NRC staff also compared the results using a draft Revision 3i, Standard Plant Analysis Risk (SPAR) model for BVPS-2 with the licensee's model. The results of the comparison documented by letter dated September 24, 2003, showed a strong correlation between the SDP Phase 2 notebook and the licensee's PRA.

3.1.5.1.1.4 Peer Review

A peer review of the BVPS-2 PRA was performed in July 2002 by the WOG. The peer review resulted in 5 Category A and 19 Category B facts and observations (F&Os). The Category A and Category B observations were dispositioned and incorporated in an updated BVPS-2 PRA model (revision 3B). Because the original model used to develop the proposed slave relay surveillance amendment was based on the earlier revision 3A model, the licensee provided updated risk metric information via an NRC staff request for additional information (RAI). Sensitivity runs performed by the licensee indicate that the peer review comments have little or no impact on the proposed slave relay STI extension. Both ΔCDF and ΔLERF values remain within the guidelines given in RG 1.174.

3.1.5.1.1.5 PRA Maintenance and Updating

The licensee also provided information on the maintenance and updating of the BVPS-2 PRA. Administrative Procedure 1 / 2 - ADM-2033, "Risk Management Program," and Business Practice BVBP-DES-0001, "Probabilistic Risk Assessment Guideline," provide a program to keep the PRA model current with respect to plant design and operation and configuration control. The risk analysis software is maintained in a software quality assurance program. The software was tested against a vendor-supplied verification model. Software configuration control is maintained by version control and software updates provided by the vendor as part of the software users group. Updates, including problem report resolutions, are subjected to verification in accordance with the vendor quality assurance program.

The NRC staff reviewed the information provided in WCAP-15887. The NRC staff concludes that the licensee adequately addressed the issue of PRA capability, and the risk analysis was of

sufficient scope and detail to estimate the risk measures associated with the proposed slave relay extended STIs.

3.1.5.1.2 PRA Insights

One approach to demonstrate that the risk impact of the proposed change is acceptable is to show that the licensing basis meets the key principles set forth in RG 1.174 for the proposed change. One of these principles is to show that when the proposed change results in an increase in CDF or risk, the increased risk is small. In addition, the impact of the proposed change should be monitored using performance measurement strategies. RG 1.174 provides acceptance guidelines for meeting the above principles. Specifically, those guidelines include ΔCDF and ΔLERF.

The licensee selected a generic mean relay failure rate to represent a prior distribution for the slave and interposing relays installed at BVPS-2. Plant-specific values for all ESFAS slave and interposing relays were collected for the years 1996 through 2001. The licensee stated that the data was only for slave and interposing relays included in the quarterly test interval. Overall, one failure in 4,311 slave and interposing relay quarterly actuations was noted by the licensee.

Generic relay data reviewed included the (Electric Power Research Institute) EPRI, "Advanced Light Water Reactor Utility Requirements Document: Volume II, ALWR [advanced light water reactor] Evolution Plant, Chapter 1, Appendix A: Key PRA Assumptions and Groundrules, Annex A-Reliability Database for ALWR PRAs, (Table A3-1)," and NUREG/CR-4639, "Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR) - Data Manual." Based on the data reviewed, the licensee selected a value of 1.4E-4 failures per demand as the mean for the prior distribution along with an error factor of 3.0.

The licensee stated that a review of operating experience at BVPS-1 and 2 did not show any specific trends or problems concerning slave or interposing relays. In response to the NRC staff's RAI, the licensee also looked at the performance of slave and interposing relays for BVPS-1 that were not included in the licensee's analysis (quarterly slave relay testing). BVPS-1 slave relays are tested on monthly, quarterly, and refueling test intervals. The licensee updated the monthly relay failure rate to include the additional BVPS-1 data. The results of this additional data on the licensee's results is discussed in more detail in Section 3.1.5.1.3 below. The failure data for slave relays from BVPS-1 and the analyses performed in WCAP-13878 and WCAP-13877 indicate that slave relay failures do not appear sensitive to current slave and interposing relay surveillance intervals (limited time-related failure modes within the surveillance interval). Therefore, the assumption in the BVPS-2 risk analysis for the slave and interposing relay failure rates assumed for the proposed 12-month STI may be conservative.

The licensee also reviewed WCAP-13877 and WCAP-13878 which include operating data for Westinghouse AR and Potter & Brumfield MDR relays, respectively. Both AR and MDR relay types are used at BVPS-1 and 2. The 1.4E-4 failures per demand selected as the prior by the licensee also bounds the demand failure rates given in both topical reports. The licensee's equipment history showed one slave/interposing relay failure in 4,311 demands (quarterly testing) at BVPS-1 and 2. Operating data for slave/interposing relay quarterly tests were used to perform a Bayesian update of the generic data. The resulting value of 1.56E-4 per demand was used as the mean failure probability in the analysis for extending slave and interposing STIs to 12 months.

In addition to Westinghouse-type AR relays and Potter and Brumfield-MDR relays, BVPS-2 also uses additional relay types not addressed by either WCAP-13877 or WCAP-13878. For these additional relay types the licensee assumed the same generic failure rate updated with plant-specific data**.** The data collected by the licensee concluded that slave and interposing relays had comparable reliability and did not identify any specific issues regarding relay types. Therefore, generic failure rates were used for all slave and interposing relay types with the expectation that the additional relay types employed in slave and interposing relay applications at BVPS-2 will continue to show similar performance. The additional relay types should be monitored such that if the failure rates differ from the assumed generic values a reassessment of the extended surveillance test interval will be performed.

In addition, at BVPS-2, some slave relays are already currently tested at an 18-month interval. The relays identified by the licensee include slave relays associated with the automatic transfer to recirculation. The licensee also stated that the monthly testing associated with the automatic transfer to recirculation only applies to SSPS logic testing and does not include the slave relays. As a result, in the licensee's analysis these relays are set at six times the 3-month failure probability of 1.56E-4 (the base case 3-month interval) to 9.35E-4 failures per demand to reflect the current surveillance interval of 18 months.

The licensee evaluated the acceptability of extending the slave relay and interposing relay STI by calculating the changes to CDF and LERF for surveillance intervals for the base case, 9 months, 12 months, and 18 months. The resulting CDF and LERF for each interval were then compared to the base case. The increases in CDF and LERF for each interval were then compared to the acceptance guidelines in RG 1.174.

The ΔCDF and ΔLERF values estimated by the licensee were originally based on the BVPS-2 revision 3A model, which did not undergo industry peer review. The revision 3 A ΔCDF and ΔLERF values were 6.0E-7/year and 8.0E-8/year, respectively, for the proposed 12-month slave relay STI. The BVPS-2 revision 3B model incorporated both category A and category B F&Os affecting the model. The revision 3B results indicated that the ΔCDF decreased to 3.8E-7/year and ΔLERF increased to 8.6E-8/year. Both results show the increases in CDF and LERF are within the acceptance guidelines of 1E-6/year and 1E-7/year, respectively, for very small changes in risk.

3.1.5.1.3 PRA Uncertainty

As referenced in RG 1.174 and NUREG/CR-6141, "Handbook of Methods for Risk-Based Analyses of Technical Specifications," published in 1994, the licensee can perform sensitivity studies to provide additional insights into the uncertainties related to the proposed STI extension to demonstrate compliance with the guidelines, and evaluate uncertainties related to modeling and completeness issues. The licensee did not provide a specific uncertainty discussion, but in response to the NRC staff's RAI relating to inclusion of additional BVPS-1 slave and interposing relay test data, the licensee revised the slave relay failure probability from 1.56E-4/demand to 1.99E-4/demand for quarterly testing. The BVPS-2 PRA model was requantified for both a quarterly and a 12-month surveillance with the slave relay failure probability increased by a factor of four to evaluate the proposed 12-month surveillance interval. The results for ΔCDF remained less than the RG 1.174 guideline of 1.0E-6/year. The value for ΔLERF was slightly greater than the RG 1.174 guideline of 1.0E-7/year but within the RG 1.174

guidelines of 1.0E-7year to 1.0E-6/year with a total LERF of less than 1.0E-5 (i.e. a small change).

The licensee, in response to the NRC staff's RAI, also ran a sensitivity case that assumed a slave and interposing relay demand failure rate increased by a factor of two from the original 12-month slave relay STI analysis. The BVPS-2 PRA model was requantified with the increased failure probability. The results were also within the acceptance guideline of 1.0E-6/year for ΔCDF. Again, the value for ΔLERF was greater than the RG 1.174 criteria of 1.0E-7/year, but within the RG 1.174 guidelines of 1.0E-7year to 1.0E-6/year for a very small change with a total LERF of less than 1.0E-5 (i.e. a small change).

In addition, previous reliability assessments of Westinghouse-type AR relays and Potter and Brumfield-type MDR relays included in WCAP-13877 and WCAP-13878 noted that both relays are industrial control relays designed for a significant number of operations (i.e., 100,000 demands for MDR-type and 10 million demands for AR-type) over the service life of the relay. However, for SSPS applications the number of operations is expected to be significantly less (approximately 1,000 operations) over a 40-year service life. In an industrial application, failures were characterized by failure per relay operation and would be expected to be due to component wear out. In an SSPS application, it is not expected that slave relays would fail due to wear or operational factors but due to component failure due to temperature and age-related effects. The referenced topical reports therefore concluded that with a sufficiently slow degradation process, slave relay testing at a 3-month interval would be no more likely to detect significant changes in slave relays than extended surveillance testing. Therefore, the probability of a relay failing to actuate on demand is not significantly influenced by the surveillance interval. Based on the conclusions provided in the above topical reports it is expected that a slave relay extended STI will have only a minimal impact on slave relay reliability. The NRC staff's SEs for both WCAP-13877 and WCAP-13878 accepted an extended refueling outage STI frequency for both AR-type and MDR-type relays used in SSPS applications.

3.1.5.1.4 Cumulative Risk

The licensee stated two programs are in progress at BVPS-2 that could have an impact on the acceptability of the proposed slave relay STI extension. These involve the conversion of the BVPS-2 containment from subatmospheric to atmospheric and extended power uprate.

The licensee stated that the atmospheric containment conversion will not impact the availability or the reliability of the actuation signals. The licensee stated that the slave relay extended STI is independent of the type of containment. However, setpoint changes proposed as part of the containment conversion may impact operator actions. The proposed setpoint changes may impact the time available for operator action should automatic actuation functions fail. The proposed slave relay surveillance interval does not change operator actions. Operator action is documented in procedures and the time available should not significantly change with an atmospheric containment. The licensee has committed to re-evaluating the impact of containment-related setpoint changes on the 12-month relay test interval following the update to the BVPS-2 PRA that incorporates the proposed containment conversion.

The other program being developed by the licensee is an extended power uprate amendment. Again, the licensee stated that the extended power uprate amendment will not affect the slave

relay reliability or the availability of actuation signals. The proposed extended power uprate amendment is independent of the surveillance interval proposed for the slave relays. However, as with the proposed containment conversion, the time available for operator action may be impacted by the extended power uprate. The licensee has committed to re-evaluate the impact on the 12-month relay test interval and include this as part of the extended power uprate submittal.

The licensee also reviewed previously submitted risk-informed submittals and provided an evaluation of the potential impact on the proposed slave relay STI extension. Two submittals were identified. The first involved an accumulator AOT extension request which was approved by the NRC staff as Amendment Nos. 253 and 133 to BVPS-1 and 2, respectively. The second submittal involved a request to extend containment integrated leak rate testing. This amendment was approved by the NRC staff as Amendment Nos. 254 and 134 to BVPS-1 and 2, respectively. The evaluation showed that the incorporation of these amendments would have only a minimal impact on the proposed slave relay surveillance interval extension results.

3.1.5.2 Tier 2: Avoidance of Risk-Significant Plant Configurations

The proposed slave relay STI extension does not affect the current AOT times, test configurations, or procedures, and, therefore, has limited impact to generate additional potentially high-risk configurations. The BVPS-2 PRA model includes component unavailability due to maintenance and test configurations. These values are based on actual BVPS-2 plant data. The CDF and LERF values in the BVPS-2 model already reflect component and slave relay maintenance unavailability. The licensee did not identify any potentially high-risk configurations or operational issues resulting from the proposed slave relay STI extension. Therefore, the licensee did not propose or require additional compensatory measures or TS restrictions with respect to extended slave relay STIs.

3.1.5.3 Tier 3: Risk-Informed Configuration Risk Management

RG 1.177 states that a licensee should develop a program to ensure that the risk impact of out-of-service equipment is appropriately evaluated before a maintenance activity is performed. RG 1.174 states that monitoring performed in conformance with 10 CFR 50.65 (the maintenance rule) can be used when the monitoring performed under the maintenance rule is sufficient for the SSCs affected by the risk-informed application. A licensee's plant-specific submittal should include a discussion on the licensee's configuration risk management program for assessing the risk associated with removal of slave relays from service and their conformance to the requirements of 10 CFR 50.65(a)(4), as they relate to the proposed license amendment.

A Tier 3 program ensures that while a slave relay is in an LCO condition, additional activities will not be performed that could further degrade the capabilities of the plant to respond to a condition the inoperable slave relay or system was designed to mitigate, resulting in increased plant risk beyond that assumed by the topical report analysis. Tier 3 programs as implemented by 10 CFR 50.65(a)(4), ensure that during slave relay maintenance, (1) additional maintenance does not increase the likelihood of an initiating event intended to be mitigated by the out-of-service equipment, (2) the effects are evaluated of additional equipment out of service during slave relay maintenance activities that would adversely impact the plant risk, such as redundant

systems or components and, (3) the impact is evaluated of maintenance on equipment or systems assumed to remain operable by this license amendment.

BVPS-2 implements the maintenance rule through Administrative Procedure 1 / 2-ADM-2114, "Maintenance Rule Administrative Procedure." Other work procedures and administrative procedures consider the safety impact of work processes, risk assessment, and the sequencing of work activities. The licensee utilizes a daily risk profile that is based on the BVPS-2 PRA and is implemented using safety monitor software. The safety monitor is used to evaluate the risk impact of maintenance activities including the removal of SSCs from service. Each weekly work schedule is reviewed by PRA personnel prior to commencing work.

The NRC staff finds that the licensee's program to control risk is capable of adequately assessing the activities being performed to ensure that high-risk plant configurations do not occur and/or compensatory actions are implemented if a high-risk plant configuration or condition should occur (including existing procedure implementation, equipment protection, or expedited equipment restoration). As such, the licensee's program meets the intent for Tier 3 in RG 1.177.

3.1.5.4 Comparison Against Regulatory Guidelines

The results presented in WCAP-15887 are consistent with the acceptance guidelines given in RG 1.174 and show a small increase in plant risk due to the extension of surveillance intervals for the slave and interposing relays installed at BVPS-2. This conclusion is predicated on adopting the topical report consistent with the NRC staff's SE and the guidelines and assumptions identified in WCAP-15887.

3.1.5.5 NRC Staff"s Findings

Based on the above evaluation, the NRC staff concludes that the licensee's proposed change to TS 4.3.2.1.1 to extend the surveillance interval for slave relays from every 92 days to every 12 months is acceptable from a risk perspective, based on meeting the acceptance guidelines of RG 1.174.

3.2 Deterministic Analysis

The primary risk contribution attributed to increasing an STI comes from the increased probability of a component failure between scheduled STIs, and, therefore, the probability that the component will be inoperable during the surveillance interval. The extension of an STI affects yearly risk, which is represented by CDF and LERF. An STI extension can affect the yearly risk in several ways:

- Reduce the risk by decreasing the number of test-caused equipment actuations by limiting the opportunity for test-caused errors. This occurs simply because increasing the STI decreases the amount of testing for a given time.

- Reduce the risk by decreasing the unavailability of the RPS component by reducing the test frequency.

- Increase the risk by increasing the fault exposure time. This is because the increased STI increases the interval during which the equipment is subject to failure during standby. As the fault exposure time increases, there is a greater probability that failures during standby will not be detected by components involved with the STI extension.

With an STI, the idea is to strike a balance between more frequent testing which can adversely affect safety either through errors during testing, spurious actuations, configuration, or equipment wear out and extended intervals which can increase fault exposure times. A risk-informed approach to STIs in conjunction with deterministic engineering evaluations, can provide insights that allow STIs to be optimized without significantly increasing plant risk.

Currently, BVPS-2 TS 4.3.2.1.1 states that automatic actuation logic with master and slave relays shall be demonstrated OPERABLE by the performance of the surveillance requirements. Footnote 1 to TS 4.3.2.1.1 states the surveillance requirements including the testing of slave relays once per 92 days. The licensee proposes to extend the STI required by TS 4.3.2.1.1 for slave relays from 92 days to 12 months by revising Footnote 1.

3.2.1 Evaluation of Slave-Relay

The WOG evaluated the impact of the slave-relays STI increase by use of an FMEA and a slave relay performance failure data evaluation approach. This WCAP specifically addressed Westinghouse-type AR and Potter & Brumfield-type MDR relays. Only certain MDR and AR type relays were included in the study since these are the types most commonly used as slave relays in WOG plants. The strength of the risk approach is that the assessments can be done using plant-specific PRA models that include plant-specific slave relay configurations based on plant-specific type slave relays.

3.2.2 Impact on Defense-In-Depth

The proposed change needs to meet the defense-in-depth principle that consists of a number of elements. These elements and the impact of the proposed change on these elements follow:

(1) A reasonable balance among preventing core damage, preventing containment failure, and consequence mitigation is preserved.

The proposed STI change has only a small calculated impact on CDF and LERF. The STI change does not affect containment integrity. The change neither degrades core damage prevention at the expense of containment integrity, nor does it degrade containment integrity at the expense of core damage prevention. The balance between preventing core damage and preventing containment failure is the same. Consequence mitigation remains unaffected by the proposed changes. Furthermore, no new accident or transient is introduced with the requested change, and the likelihood of an accident or transient is not impacted. No new activities on the SSPS will be performed at-power that could lead to a new transient event. Conversely, the increased STI may reduce the likelihood of a test-induced transient or accident.

(2) Over-reliance on programmatic activities to compensate for weakness in plant design is avoided.

The plant design will not be changed to accommodate this slave relay test interval extension. All safety systems, including the SSPS, will still function in the same manner with the same signals available to trip the reactor and initiate ESF functions, and there will be no additional reliance on additional systems, procedures, or operator actions. The calculated risk increase for the change is very small, and additional control processes are not required to compensate for any risk increase.

(3) System redundancy, independence, and diversity are maintained commensurate with the expected frequency and consequences of challenges to the system.

There is no impact on the redundancy, independence, or diversity of the SSPS or of the ability of the plant to respond to events with diverse systems. The SSPS is a diverse and redundant sub-system and will remain so. There will be no change to the signals available to trip the reactor or initiate ESFAS.

(4) Defenses against potential common-cause failures are maintained and the potential for the introduction of new common-cause failure mechanisms is assessed.

Defenses against common-cause failures are maintained. The slave relay test interval extension is not sufficiently long to expect a new common-cause mechanism to occur. In addition, the operating environment for these components remains the same, therefore no new common-cause failure modes are expected. In addition, back-up systems and operator actions are not impacted by the change; and, there are no common-cause links between the SSPS and these back-up options.

(5) Independence of barriers is not degraded.

The barriers protecting the public and the independence of these barriers are maintained. It is not expected that multiple systems will be out of service simultaneously which could lead to degradation of these barriers and an increase in risk to the public with implementation of the extended slave relay test interval.

(6) Defenses against human errors maintained.

No new operator actions related to the slave relay test interval extension are required. No additional operation or maintenance procedures have been introduced nor are existing procedures required to be revised due to the change. No new at-power test or maintenance activities are expected to occur as a result of the change. Fewer surveillance tests will be performed at-power, which will reduce the potential for test-induced reactor trips and safety system actuations. This represents a risk benefit, i.e., a reduction in risk.

3.2.3 Impact on Safety Margins

The safety analysis acceptance criteria as stated in the UFSAR are not impacted by the proposed change. Diversity with regard to the signals, which provide a reactor trip and actuation of engineered safety features, will also be maintained. The proposed change will not result in operation of the unit in a configuration outside of the design basis. All signals credited as primary or secondary and all operator actions credited in the accident analysis will remain the same. Therefore, there is no impact on the safety margins.

Since the slave relays used at BVPS-2 are Westinghouse-type AR model 440AR and Potter Brumfield-type MDR model 4121 relays and the NRC staff has previously reviewed and approved these two types of slave relays based on WCAP-13877and WCAP-13878, the NRC staff finds that the licensee's proposed TS change acceptable so long as the licensee adopts the NRC staff's conditions for acceptability of these relays. These conditions are required to assure that relays' contacts are not overloaded and to establish the replacement schedule for normally energized slave relays.

3.2.4 Conclusion

Based on the above, the NRC staff finds the proposed 12-month STI for the slave relays acceptable with the following requirements:

(1) To ensure that the contact loading analysis for the slave relays has been performed to determine the acceptability of these relays;

(2) To determine the qualified life for the continuously energized slave relays based on plant-specific environmental conditions.

The licensee's April 6, 2004, letter revised the TS 4.3.2.1.1 footnote (1) requirements to capture the above conditions. The NRC staff has determined that the revised footnote adequately captures the above conditions, and is, therefore, acceptable.

4.0 REGULATORY COMMITMENTS

The following future licensing actions were identified by the licensee that may have an impact on the proposed slave relay extended surveillance interval request. The licensee has committed to reviewing the cumulative risk impacts with respect to slave relay surveillance extensions:

1. The cumulative impact of the following containment conversion setpoint changes on ΔCDF and ΔLERF associated with slave...relay STI extensions will be evaluated against the acceptance guidelines of RG 1.174 three months following the PRA model update that incorporates atmospheric containment.

    - Safety injection and feedwater isolation on high-containment pressure.

    - Safety injection - transfer from injection to the recirculation mode on extreme low RWST level.

- Containment spray actuation on high-high containment pressure.
- Containment isolation phase B on high-high containment pressure.
- Steam line isolation on intermediate high-high containment pressure.

2. The cumulative impact of an extended power uprate and related changes on ΔCDF and ΔLERF associated with slave...relay STI extensions will be evaluated against the acceptance guidelines of RG 1.174 three months following the PRA model update that incorporates the extended power uprate.

5.0 STATE CONSULTATION

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

6.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a surveillance requirement. 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 (68 FR 12953). 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.

7.0 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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