PRESSURIZED WATER REACTOR OWNERS GROUP

PWROG-17018-NP-A
Revision 0

WESTINGHOUSE NON-PROPRIETARY CLASS 3

Solid State Protection System General Warning Alarm Modification

Licensing Committee

PA-LSC-1366, Revision 2

August 2020

Westinghouse

PWROG-17018-NP-A
Revision 0

Solid State Protection System General Warning Alarm Modification

PA-LSC-1366, Revision 2

John D. Moorehead*
Licensing Engineering

August 2020

Reviewer: Margaret L. Ryan*
Standard Hardware and Common Q Platform

Approved: Robert B. Phillips*, Manager
Standard Hardware and Common Q Platform

Approved: Chad M. Holderbaum*, Program Director
PWR Owners Group PMO

*Electronically approved records are authenticated in the electronic document management system.

Westinghouse Electric Company LLC
1000 Westinghouse Drive
Cranberry Township, PA 16066, USA

NRC FINAL SAFETY EVALUATION

This section contains the following correspondence:

1. NRC cover letter, Final Safety Evaluation by the Office of Nuclear Reactor Regulation for the Pressurized Water Reactor Owners Group Topical Report PWROG-17018, Revision 0, “Solid State Protection System General Warning Alarm Modification” (EPID: L-2018-TOP-0004), July 15, 2020.

2. Final Safety Evaluation by the Office of Nuclear Reactor Regulation for the Pressurized Water Reactor Owners Group Topical Report PWROG-17018, Revision 0, “Solid State Protection System General Warning Alarm Modification” EPID L-2018-TOP-0004

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

July 15, 2020

Mr. W. Anthony Nowinowski
Executive Director
PWR Owners Group,
Program Management Office
Westinghouse Electric Company
1000 Westinghouse Drive, Suite 380
Cranberry Township, PA 16066

SUBJECT: FINAL SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION FOR THE PRESSURIZED WATER REACTOR OWNERS GROUP TOPICAL REPORT PWROG-17018, REVISION 0, "SOLID STATE PROTECTION SYSTEM GENERAL WARNING ALARM MODIFICATION" (EPID: L-2018-TOP-0004)

Dear Mr. Nowinowski:

By letter dated February 1, 2018, as supplemented by letters dated July 5, 2018 and March 13, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML18039A033, ML18191B172, and ML20073N407, respectively), the Pressurized Water Reactor Owners Group (PWROG), transmitted Topical Report (TR) PWROG-17018-P/NP, Revision (Rev.) 0, "Solid State Protection System (SSPS) General Warning Alarm Modification" (ADAMS Accession No. ML18039A034) to the U.S. Nuclear Regulatory Commission (NRC) for review and approval. By letter dated June 23, 2020 (ADAMS Accession No. ML20175A847), the PWROG submitted comments on the draft safety evaluation (SE) and requested that the NRC staff prepare the final SE for PWROG-17018-P/NP against Rev. 0.

The NRC staff has completed the review of PWROG-17018-P/NP, Rev. 0 and has found that the subject TR, as modified by conclusions in Section 4.0 of the enclosed final SE, that the SSPS with GWA modification can continue to meet regulatory requirements when the associated NRC guidance is met for the licensees that reference the TR. Applicants who utilize the TR will be required to adhere to the conditions that the NRC staff impose in the SE and shall be subject to NRC staff review and approval on a case-by-case basis.

By letter dated May 12, 2020 (ADAMS Accession No. ML20114F904), the NRC staff provided the draft SE to the PWROG for review and comment. By letter dated June 23, 2020 (ADAMS Accession No. ML1922A259), the PWROG provided comments on the draft SE. The NRC staff's disposition table for the draft SE comments is provided in the final SE.

In accordance with the guidance provided on the NRC website, the NRC staff requests that the PWROG publish approved versions of PWROG-17018-NP, Rev. 0, within 3 months of receipt of this letter. The approved version shall incorporate this letter and the enclosed final SE after the title page. Also, the approved versions must contain historical review information, including NRC requests for additional information (RAIs) and the corresponding RAI responses. The approved versions shall include an "-A" (designating approved) following the TR identification symbol. As an alternative to including the request for RAIs and RAI responses behind the title

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page, if changes to the TR were provided to the NRC staff to support the resolution of RAI responses, and if the NRC staff reviewed and approved those changes as described in the RAI responses, there are two ways that the accepted version can capture the RAIs:

1. The RAIs and RAI responses can be included as an appendix to the accepted version.
2. The RAIs and RAI responses can be captured in the form of a table (inserted after the final SE) which summarizes the changes as shown in the approved version of the TR. The table should reference the specific RAIs and RAI responses which resulted in any changes, as shown in the accepted version of the TR.

If future changes to the NRC's regulatory requirements affect the acceptability of these TRs, PWROG will be expected to revise the TRs appropriately or justify their continued applicability for subsequent referencing. Licensees referencing these TRs would be expected to justify their continued applicability or evaluate their plant using the revised TRs.

If you have any questions, please contact Leslie Fields at 301-415-1186.

Sincerely,

/RA/

Dennis C. Morey, Chief
Licensing Processes Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 99902037

Enclosure:
Final SE

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SUBJECT: FINAL SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION FOR THE PRESSURIZED WATER REACTOR OWNERS GROUP TOPICAL REPORT PWROG-17018, REVISION 0, "SOLID STATE PROTECTION SYSTEM GENERAL WARNING ALARM MODIFICATION" (EPID: L-2018-TOP-0004) DATED JULY 15, 2020

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DATE	07/15/2020	07/15/2020	

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UNITED STATES
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WASHINGTON, D.C. 20555-0001

FINAL SAFETY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

FOR THE PRESSURIZED WATER REACTOR OWNERS GROUP

TOPICAL REPORT PWROG-17018-P/NP, REVISION 0,

"SOLID STATE PROTECTION SYSTEM GENERAL WARNING ALARM MODIFICATION"

EPID L-2018-TOP-0004

1.0 INTRODUCTION

By letter dated February 1, 2018 (Ref. 1), as supplemented by letters dated July 5, 2018 (Ref. 2), and March 13, 2020 (Ref. 3), the Pressurized Water Reactor Owners Group (PWROG) transmitted Topical Report (TR) PWROG-17018-P/NP, Revision (Rev.) 0, "Solid State Protection System (SSPS) General Warning Alarm Modification" (Ref. 4) to the U.S. Nuclear Regulatory Commission (NRC) for review and approval. By letter dated March 13, 2018 (Ref. 5), the NRC staff accepted the TR for review and subsequently, by emails dated April 2, 2018 (Ref. 6) and August 19, 2019 (Ref. 7), transmitted a request for additional information to PWROG in accordance with NRC's TR review process.

2.0 BACKGROUND AND REGULATORY EVALUATION

The proposed modification, as described within the subject TR, eliminates four automatic partial (half) reactor trips and replaces these automatic actions with an alarm and appropriate manual operator actions to eliminate sources of unnecessary reactor trips. This change is necessary to allow for a summary of new self-diagnostic results to be made available outside of the Solid State Protection System (SSPS) cabinets.

A licensee will use a variety of methods to evaluate the transients and accidents that could occur at its nuclear power plant (NPP). The NRC staff reviews these methods to ensure that they provide a realistic or conservative prediction such that it can be demonstrated that the requirements of 10 CFR can be satisfied.

2.1 NUREG-0800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants

NUREG-0800 provides the acceptance criteria for the review of TRs. Specifically, Standard Review Plan (SRP) Chapter 7, "Instrumentation and Controls," which addresses the requirements for instrumentation and control (I&C) systems in NPPs based on light-water reactor designs. SRP Chapter 7 and NRC Interim Staff Guidance (ISG), which augments

and supplements SRP Chapter 7, establishes the review criteria for Digital I&C systems, which the NRC staff applied to this safety evaluation (SE). Based on NRC staff's review this SE is limited to the evaluation of compliance with the applicable regulations and guidance documents to the degree that they can be met by the proposed modification description

2.2 10 CFR 50.55 a(h), Protection and Safety Systems

The following regulations are applicable to the subject TR:

10 CFR 50.55a(h) standards incorporated by reference include:

- The 1968 version of Institute of Electrical and Electronics Engineers (IEEE) Standard (Std.) IEEE Std. 279, "IEEE Standard: Criteria for Protection Systems for Nuclear Power Generating Stations,"
- The 1971 version of IEEE Std. 279, "IEEE Standard: Criteria for Protection Systems for Nuclear Power Generating Stations," and
- The 1991 version of IEEE Std. 603, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," including the correction sheet dated January 30, 1995.

Each of these IEEE Stds. contains a clause that requires an indication when a protective action is bypassed or removed from service.

- For IEEE Std. 279-1968, Clause 4.13, "Indication of Bypasses"
- For IEEE Std. 279-1971, Clause 4.13, "Indication of Bypasses"
- For IEEE Std. 603-1991, Clause 5.8.3, "Indication of Bypasses"

The NRC staff used the following guidance when it evaluated the applicant's compliance with the underlying "Indication of Bypasses" requirements:

2.3 Regulatory Guide (RG) 1.47, Revision 1, "Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems"

RG 1.47 (Ref. 8), describes a method acceptable to the NRC staff for complying with the regulatory requirements regarding the bypassed and inoperable status indication for nuclear power plant safety systems.

2.4 10 CFR Part 50, General Design Criteria (GDC) for Nuclear Power Plants

The NRC staff also used the following application-specific to 10 CFR Part 50, Appendix A, "General Design Criteria [(GDC)] for Nuclear Power Plants," to evaluate the TR for use in safety systems, as follows:

GDC 23, "Protection system failure modes," which states,

> "The protection system shall be designed to fail into a safe state or into a state demonstrated to be acceptable on some other defined basis if conditions such as disconnection of the system, loss of energy (e.g., electric power, instrument air), or postulated adverse environments (e.g., extreme heat or cold, fire, pressure, steam, water, and radiation) are experienced."

3.0 TECHNICAL EVALUATION

This technical evaluation section documents the NRC staff's evaluation of the TR against the relevant criteria identified in Section 2.0 above. The technical evaluation has been separated into the following sections:

3.1 Solid State Protection System Description
3.2 Fail Safe Feature Description
3.3 Bypassed and Inoperable Status Indication

3.1 Solid State Protection System Description

The SSPS is a product line in use in Westinghouse designed NPPs. The salient features of the SSPS are summarized as follows:

1. The system is comprised of redundant, identical Trains (A and B) that are physically and electrically independent. Access to the cabinets in each train is administratively controlled. Additionally, each train is provided with a Demultiplexer cabinet to interface with the main control board and plant computer (if applicable).

2. The system performs reactor trip and engineered safety features voting and actuation functions as well as non-protective control and equipment protection type functions.

3. A bypass breaker in parallel with each trip breaker enables on-line testing of the trip breakers. The Train A protection system de-energizes the Train A reactor trip breaker and the Train B bypass breaker undervoltage coils, the Train B protection system de- energizes the Train B reactor trip breaker and the Train A bypass breaker undervoltage coils. The bypass breakers are interlocked to prevent simultaneous closure thus preventing both trains from being bypassed simultaneously.

4. System status information is transmitted to the control board status lamps and annunciators as well as to the plant computer.

5. Testing of the complete SSPS can be performed with the plant at power or shutdown. The process instrumentation portion of the protection system, the logic, and the reactor trip and engineered safety features actuation circuits are tested separately.

6. A system status alarm for each train is annunciated in the control room. The alarm is generated by the associated train General Warning circuit. If a General Warning condition should develop simultaneously in both trains, the General Warning circuits will automatically trip the reactor. This design feature is in addition to the bypass breaker interlock trip feature discussed in No. 3.

   a. One part of the system status alarm (i.e., SSPS General Warning Alarm (GWA)) is that the four conditions (see description below) addressed by this modification produce an alarm and a half trip.

7. Testability of all reactor trip and engineered safety feature actuation functions can be performed at power (i.e., without an undesired effect on plant operation), is incorporated in the design.

The NRC approved the TR for the boards (cards) that contain a complex programmable logic device (CPLD) (Ref. 9 and Ref. 10) that proposed eight replacement circuit boards for the voting logic and associated communications to the main control board and plant computer Demultiplexers. The new design boards also contain some enhancements which include board edge light emitting diodes (LEDs) for enhanced status and self-diagnostics indication. The proposed modification of the subject TR for this SE would make this self-diagnostic information available external to the SSPS cabinets, on the main control board.

The TR proposes to change the functioning of the system status alarm portion of the SSPS system when four specific conditions occur. Only the fourth of these four conditions, listed below, involves a loss of function; the others do not. The four conditions are: (1) the loss of one (of the two) 15 VDC power supplies in either train, (2) the loss of one (of the two) 48 VDC power supplies in either train, (3) the multiplexer test switch selected to the "Inhibit" position or transitioning between positions, and (4) the pulled card (Rows 2-5) interlock. Annunciation of these four conditions is needed because they all represent a degradation of SSPS functionality. These four conditions currently result in an SSPS GWA and half trip. These four half-trip inputs do not protect against any specific transients or design basis accidents; they are used, in part, to help ensure the reliability and availability for the SSPS equipment (If an SSPS GWA is activated in both trains, the SSPS trips the reactor.).

The modified design in the TR would result in an SSPS Non-urgent Alarm for these four conditions, with no half trip input. The elimination of the four half trip inputs in each train means that some SSPS equipment conditions that would currently result in a plant trip would now only alarm as a result of the modification. In addition to these four conditions, other potential conditions identified by the self-diagnostics features of the new boards that contain a CPLD (which in the SSPS with the original boards would only be identified by surveillance testing) would also activate the SSPS Non-urgent Alarm. The motivation for this change is to improve efficiency and safety. In the current configuration, an operator must open the SSPS cabinet doors to see the status of the self-diagnostics that would identify failures, which are rarely expected to occur. Since the new self-diagnostics include (but are not limited to) identification of loss or degraded function, it is preferable to notify the operators immediately in the control room. Therefore, as part of the proposed design, new self-diagnostic features information will be made directly available to operators in the main control room.

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3.2 Fail Safe Feature Description

The NRC staff considered 10 CFR Part 50, Appendix A, when evaluating the TR for use in safety systems, as follows:

> GDC 23, "Protection system failure modes," which states:
>
> > "The protection system shall be designed to fail into a safe state or into a state demonstrated to be acceptable on some other defined basis if conditions such as disconnection of the system, loss of energy (e.g., electric power, instrument air), or postulated adverse environments (e.g., extreme heat or cold, fire, pressure, steam, water, and radiation) are experienced."

The current design of the SSPS meets this criterion by tripping the reactor when a card in each train of the SSPS is disconnected (from the card cage backplane connector). In addition, there is annunciation in the control room when each card is disconnected.

The TR, as supplemented, proposes to remove the fail-safe feature when a card in rows 2 through 5 is disconnected, but enhances (1) the "bypassed and inoperable status indication" aspects, and (2) the administrative aspects to prevent disconnecting a card in the operable SSPS train.

The proposed change decreases the likelihood of the two-pulled-cards malfunction by adding administrative controls to minimize opportunities for the human error of pulling a card in each train and does not affect the likelihood of the other three malfunctions. In addition, the proposed change increases the overall reliability of the SSPS by improving the early identification and correction of certain degraded conditions. Furthermore, the proposed change improves the outcomes of certain combinations of malfunctions by allowing for a controlled shutdown of the plant, if necessary, as opposed to an automatic trip.

In summary, the modification improves safety and reliability by: (1) adding administrative controls for avoiding an adverse condition and loss of protective function, (2) avoiding spurious trips which places unnecessary burden on plant systems and operators, and (3) identifying, in a timely manner, potential degradations in the SSPS equipment. In aggregate, the increases in reliability and safety provide reasonable assurance of protection and are an acceptable alternative to the current fail-safe features with half-trips. Therefore, the modification proposed in the TR would continue to meet GDC 23 by the activation of a control room annunciator when a card in rows 2 through 5 is disconnected.

3.3 Bypassed and Inoperable Status Indication

RG 1.47 describes a method acceptable to the NRC staff for complying with the regulatory requirements regarding the bypassed and inoperable status indication for nuclear power plant safety systems. The NRC staff evaluated the change with respect to the six positions in the RG as follows:

> Position 1. "Administrative procedures should be supplemented by an indication system that automatically indicates, for each affected safety system or subsystem, the bypass or deliberately induced inoperability of a safety function

and the systems actuated or controlled by the safety function. Provisions should also be made to allow the operations staff to confirm that a bypassed safety function has been properly returned to service."

The NRC staff agrees that there is no change in the conditions that produce an alarm (i.e., the same conditions continue to produce an alarm) and this position continues to be met. However, because a new alarm is being added and since the conditions producing the SSPS GWA are being changed, the TR states that a licensee will update alarm response procedures in accordance with the licensee's quality assurance program.

Position 2. "The indicating system of Position 1 above should also be activated automatically by the bypassing or the deliberately induced inoperability of any auxiliary or supporting system that effectively bypasses or renders inoperable a safety function and the systems actuated or controlled by the safety function."

The NRC staff agrees that there is no change in the conditions that produce an alarm (i.e., the same conditions continue to produce an alarm) and this position continues to be met.

Position 3. "Annunciating functions for system failure and automatic actions based on the self-test or self-diagnostic capabilities of digital computer-based I&C safety systems should be consistent with Positions 1 and 2 above."

The original SSPS cards do not have self-diagnostic capabilities; therefore, position No. 3 did not apply to these cards. The new cards, however, discussed in the subject TR have self-diagnostic capabilities. The TR allows a modification to implement annunciating functions for degradations or failures of the cards in rows 2 through 5. The staff agrees that this approach is consistent with Positions 1 and 2.

Position 4. "The bypass and inoperable status indication system should include a capability for ensuring its operable status during normal plant operation to the extent that the indicating and annunciating functions can be verified."

NRC staff's evaluation to this position is addressed below.

Position 5. "Bypass and inoperable status indicators should be arranged such that the operator can determine whether continued reactor operation is permissible. The control room of all affected units should receive an indication of the bypass of shared system safety functions."

The SSPS Non-urgent alarm would prompt the operator to determine the cause of the alarm in the affected SSPS train. Each of the CPLD-based cards in rows 2 through 5 have card edge LEDs that indicate the particular condition that generated the alarm; the operator can easily determine each card's operable status and, thereby, determine whether continued reactor operation is permissible. Therefore, NRC staff agrees these card edge LEDs support meeting bypass and inoperable status and indication capabilities.

Position 6. "Bypass and inoperable status indicators should be designed and installed in a manner that precludes the possibility of adverse effects on plant safety systems. The indication system should not be used to perform functions that are essential to safety, unless it is designed in conformance with criteria established for safety systems."

The staff reviewed the proposed modification described in the TR and determined that it precludes the possibility of an adverse effect. In addition, the SSPS Non-urgent Alarm alerts the operator of the need to evaluate the condition of the SSPS and does not automatically initiate any actions (i.e., does not perform functions that are essential to safety). Therefore, NRC staff agrees that the proposed design provides reasonable assurance of safety in the presence of potential adverse effects on plant systems.

In summary, NRC staff has reasonable assurance that the design can meet the six regulatory positions in RG 1.47, and, therefore, the TR can meet the regulatory requirements for the bypassed and inoperable status indication.

4.0 CONCLUSIONS

Based on the evaluations and technical reviews discussed herein, the NRC staff finds the SSPS, as modified by TR PWROG-17018-P/NP, Revision 0, can continue to meet regulatory requirements when the associated NRC guidance is met for licensees that reference the TR. The NRC staff finds that the unique configuration of each plant requires that each licensee analyze whether the GWA change can be made under 10 CFR 50.59 without prior NRC approval.

This SE addresses only the generic safety issues associated with GWA change. Licensees may reference this SE, as applicable, when performing a 10 CFR 50.59 Screening/Evaluation.

4.1 Summary of Regulatory Compliance

The NRC staff 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 the GWA change, and (2) there is reasonable assurance that such activities will be conducted in compliance with the NRC's regulations.

5.0 CONDITIONS, LIMITATIONS, AND/OR ACTION ITEMS

The NRC staff did not evaluate whether implementation of the subject TR by each licensee will satisfy the requirements of 10 CFR 50.59(c)(2). Each licensee must consider its licensing basis in whole as provided in the final safety analysis report and plant specific configurations involving the SSPS in its 10 CFR 50.59 Screening/Evaluation. More specifically, 50.59(c)(2) states a licensee shall obtain a license amendment pursuant to 10 CFR 50.90(c)(2) prior to implementing a proposed change if the change meets any of the eight criteria related to potential malfunctions, accidents, and methods.

The SE of this subject TR does not generically pre-approve an outcome of each licensee's evaluation against specific 10 CFR 50.59 criteria. The SE of this subject TR only addresses the

generic safety issues associated with making the proposed change contained therein. These generic technical findings may be referenced in the site-specific 10 CFR 50.59 Screening/Evaluation process at the discretion of the licensee, to the extent that NRC has approved the specific design configurations and operations in the subject TR as an acceptable way of generically meeting regulatory requirements.

6.0 REFERENCES

1. Letter from W. A. Nowinowski, Pressurized Water Reactor Owners Group, to USNRC Document Control Desk, February 1, 2018, Submittal of PWROG-17018-P/NP, "Solid State Protection System General Warning Alarm Modification," ADAMS Accession No. ML18039A033.

2. Letter from W. A. Nowinowski, Pressurized Water Reactor Owners Group, to USNRC Document Control Desk, July 5, 2019, Transmittal of the Response to NRC Request for Additional Information Email for WCAP-17018-P/NP, Revision 0, "Solid State Protection System General Warning Alarm Modification," ADAMS Accession No. ML18191B172.

3. Letter from W. A. Nowinowski, Pressurized Water Reactor Owners Group, to USNRC Document Control Desk, March 13, 2020, Transmittal of the Response to the Second NRC Request for Additional Information for WCAP-17018-P/NP, Revision 0, "Solid State Protection System General Warning Alarm Modification," ADAMS Accession No. ML20073N407.

4. Topical Report PWROG-17018-NP, Revision 0, "Solid State Protection System General Warning Alarm Modification," January 31, 2018, ADAMS Accession No. ML18039A034.

5. Letter from USNRC, to W. A. Nowinowski, Pressurized Water Reactor Owners Group dated March 13, 2018, "Acceptance For Review of the Pressurized Water Reactor Owners Group Topical Report PWROG-17018-P/NP, 'Solid State Protection System General Warning Alarm Modification,'" ADAMS Accession No. ML18057A080.

6. Email from B. Benney, USNRC to C. Holderbaum, PWR Owners Group dated April 2, 2018, Transmittal of Request for Additional Information.

7. Email from J. Drake, USNRC to C. Holderbaum, PWR Owners Group dated August 19, 2019, Transmittal of Request for Additional Information, ADAMS Accession No. ML19295E585.

8. Regulatory Guide 1.47, Revision 1, "Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems," February 28, 2010, ADAMS Accession No. ML092330064.

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9. WCAP-17867-P-A Revision 1, "Westinghouse SSPS Board Replacement Licensing Summary Report," October 31, 2014, ADAMS Accession No. ML14287A130.

10. WCAP-17867-P-A Revision 1, "Appendix A, SSPS New Design Boards Theory of Operation," October 31, 2014, ADAMS Accession No. ML14287A129.

Principal Contributor: Norbert Carte, NRR/DE/ECIB

Date: July, 15 2020

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TOPICAL REPORT PWROG-17018-P/NP, REVISION 0 COMMENT RESOLUTION TABLE					
Comment Number	Text Location in the Proprietary DSE		Comment Type (Clarification, Editorial, Accuracy, Proprietary)	PWROG Suggested Revision	NRC Response
	Page	Line			
1	1	19	Clarification	Please revise: "The TR" to "Reference 1" Reference 3 revised the TR to delete the discussion regarding 10CFR50.59 from the TR.	NRC staff finds the comment acceptable and the revisions have been incorporated.
			Editorial	Please revise: "requests" to "requested"	
2	1	20	Clarification	Please add "Screens/E"	NRC staff finds the comment acceptable and the revisions have been incorporated.
3	1	21	Editorial	Please revise: "modifications" to "modification"	NRC staff finds the comment acceptable and the revisions have been incorporated.
4	1	30	Editorial	Please revise: "a certain set" to "those four"	NRC staff finds the comment acceptable in part. It was not the intent to specifically describe (in the introduction) the conditions in both trains which would cause a trip, in part because of the many possibilities. Therefore, the clause was eliminated entirely rather than modifying it.
5	1	31-32	Clarification	Please delete: "for a summary of" and replace it with "the" Please replace "results" with "capabilities"	NRC staff does not find the comment acceptable and the revisions have not been incorporated.

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TOPICAL REPORT PWROG-17018-P/NP, REVISION 0 COMMENT RESOLUTION TABLE					
Comment Number	Text Location in the Proprietary DSE		Comment Type (Clarification, Editorial, Accuracy, Proprietary)	PWROG Suggested Revision	NRC Response
	Page	Line			
					The current phrasing is more accurate since the only information available on the main control board is whether an alarm condition exists or not.
6	3	17-18	Clarification	Please revise the sentence: "The cabinets in each train are capable of being locked to allow for administrative control of access." To: "Access to the cabinets in each train is administratively controlled.	NRC staff finds the comment acceptable and the revisions have been incorporated.
7	3	26-28	Clarification	Please revise the sentence: "The Train A logic de- energizes the Train A trip breaker and the Train B bypass breaker, the Train B logic de- energizes the Train B trip breaker and the Train A bypass breaker." To: "The Train A protection system de- energizes the Train A reactor trip breaker and the Train B bypass breaker undervoltage coils, the Train B protection system de-energizes the Train B reactor trip breaker and the Train A bypass breaker undervoltage coils."	NRC staff finds the comment acceptable and the revisions have been incorporated.
8	3	48	Clarification	Please revise the beginning of the sentence: "Testability of all engineered safety features that can be operated at power…" To: "Testability of all reactor trip and engineered safety feature actuation functions can be performed at power…"	NRC staff finds the comment acceptable and the revisions have been incorporated.

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TOPICAL REPORT PWROG-17018-P/NP, REVISION 0 COMMENT RESOLUTION TABLE					
Comment Number	Text Location in the Proprietary DSE		Comment Type (Clarification, Editorial, Accuracy, Proprietary)	PWROG Suggested Revision	NRC Response
	Page	Line			
9	4	1-2	Clarification/Accuracy	WCAP-17867-P-A Revision 1, "Westinghouse SSPS Board Replacement Licensing Summary Report", October 31, 2014, is listed as Reference 8 and repeated as Reference 9, with two different ADAMS Accession Numbers, please confirm these two references.	NRC staff finds the comment acceptable and the revisions have been incorporated. NRC staff clarified that use of TR beyond what is approved must be submitted to the NRC for review and approval
10	4	1	Editorial	Please revise the beginning of sentence: "The NRC approved complex programmable logic device (CPLD)-Based SSPS card TR…" To: "The NRC approved the TR for the boards (cards) that contain a complex programmable logic device (CPLD)…".	NRC staff finds the comment acceptable and the revisions have been incorporated.
11	4	7-8	Clarification	Please revise the end of sentence: "…would make this self-diagnostic information available outside of the SSPS cabinets, on the control board." To: "…would make this self-diagnostic information available external to the SSPS cabinets, on the main control board."	NRC staff finds the comment acceptable and the revisions have been incorporated.
12	4	18	Editorial	Please revise: "half-trips" to "half-trip inputs" "half-trip inputs"	NRC staff finds the comment acceptable and the revisions have been incorporated.
13	4	22	Editorial	Please revise: "with no half trip: to: "with no-half trip input" Please revise: "half-trips" to "half-trip inputs"	

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TOPICAL REPORT PWROG-17018-P/NP, REVISION 0 COMMENT RESOLUTION TABLE					
Comment Number	Text Location in the Proprietary DSE		Comment Type (Clarification, Editorial, Accuracy, Proprietary)	PWROG Suggested Revision	NRC Response
	Page	Line			
14	4	25-26	Editorial	Editorial Please revise the end of sentence: "…the new CPLD-based cards (which in the old system would only be identified by surveillance testing) would also drive the SSPS. Non-urgent Alarm." To: "…the new boards that contain a CPLD (which in the SSPS with the original boards would only be identified by surveillance testing) would also activate the SSPS Non-urgent Alarm."	NRC staff finds the comment acceptable and the revisions have been incorporated
15	4	46-47	Clarification	Clarification Please revise the sentence: "The current design of the SSPS meets this criterion by tripping the NPP when a logic card in each division of the SSPS is disconnected." To: "The current design of the SSPS meets this criterion by tripping the reactor when a card in each train of the SSPS is disconnected (from the card cage backplane connector)."	NRC staff finds the comment acceptable and the revisions have been incorporated
16	5	3	Clarification	Please delete "logic"	NRC staff finds the comment acceptable and the revisions have been incorporated.
17	5	5-6	Clarification	Please revise the end of the sentence: "a logic card in the only operable division of SSPS equipment." To: "a card in the operable SSPS train."	NRC staff finds the comment acceptable and the revisions have been incorporated.

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TOPICAL REPORT PWROG-17018-P/NP, REVISION 0 COMMENT RESOLUTION TABLE					
Comment Number	Text Location in the Proprietary DSE		Comment Type (Clarification, Editorial, Accuracy, Proprietary)	PWROG Suggested Revision	NRC Response
	Page	Line			
18	5	16	Editorial	Please delete the extra space.	NRC staff finds the comment acceptable and the revisions have been incorporated.
19	5	20	Editorial	Please revise "provides" to "provide" and "is" to "are"	NRC staff finds the comment acceptable and the revisions have been incorporated.
20	5	21	Editorial	Please delete "s"	NRC staff finds the comment acceptable and the revisions have been incorporated.
21	5	22	Editorial	Please revise "in" to "by"	NRC staff finds the comment acceptable and the revisions have been incorporated.
22	5	23	Clarification	Please delete "logic"	NRC staff finds the comment acceptable and the revisions have been incorporated.
23	5	44	Editorial	Please revise "as controlled by" to "in accordance with"	NRC staff finds the comment acceptable and the revisions have been incorporated
24	6	11	Clarification	Please delete: "in the previously approved TR did" and replace it with "do"	NRC staff finds the comment acceptable and the revisions have been incorporated.
25	6	13	Editorial	Please add "discussed" and revise "topical" to "TR"	NRC staff finds the comment acceptable and the revisions have been incorporated.

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TOPICAL REPORT PWROG-17018-P/NP, REVISION 0 COMMENT RESOLUTION TABLE					
Comment Number	Text Location in the Proprietary DSE		Comment Type (Clarification, Editorial, Accuracy, Proprietary)	PWROG Suggested Revision	NRC Response
	Page	Line			
26	6	14	Editorial	Please add "a"	NRC staff finds the comment acceptable and the revisions have been incorporated
	6	15	Clarification	Please delete "logic"	NRC staff finds the comment acceptable and the revisions have been incorporated.
27	6	29-30	Clarification	Please revise the sentence: "The SSPS Non-urgent would prompt the operator to go to the alarming cabinet and investigate." To: "The SSPS Non-urgent alarm would prompt the operator to determine the cause of the alarm in the affected SSPS train."	NRC staff finds the comment acceptable and the revisions have been incorporated.
28	6	30	Clarification	Please delete "logic"	NRC staff finds the comment acceptable and the revisions have been incorporated.
29	6	31	Editorial	Please revise "to" to "that"	NRC staff finds the comment acceptable and the revisions have been incorporated.
30	7	14	Clarification	Please add "Screen/"	NRC staff finds the comment acceptable and the revisions have been incorporated.
31	7	28	Editorial/ Clarification	Please add "Screens/E"	NRC staff finds the comment acceptable and the revisions have been incorporated.
32	7	36	Editorial/ Clarification	Please add "10 CFR" and "Screens/E"	NRC staff finds the comment acceptable and the revisions have been incorporated.

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TOPICAL REPORT PWROG-17018-P/NP, REVISION 0 COMMENT RESOLUTION TABLE					
Comment Number	Text Location in the Proprietary DSE		Comment Type (Clarification, Editorial, Accuracy, Proprietary)	PWROG Suggested Revision	NRC Response
	Page	Line			
33	8	35-39	Clarification	WCAP-17867-P-A Revision 1, "Westinghouse SSPS Board Replacement Licensing Summary Report", October 31, 2014, is listed as Reference 8 and repeated as Reference 9, with two different ADAMS Accession Numbers, please confirm these two references.	NRC staff finds the comment acceptable and the revisions have been incorporated.

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Dominion Connecticut	Millstone 2 (CE)		X
	Millstone 3 (W)	X	
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Entergy Nuclear Northeast	Indian Point 2 & 3 (W)		X
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	Arkansas 2 (CE)		X
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Luminant Power	Comanche Peak 1 & 2 (W)	X	
Pacific Gas & Electric	Diablo Canyon 1 & 2 (W)	X	

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South Carolina Electric & Gas	V.C. Summer (W)		X
So. Texas Project Nuclear Operating Co.	South Texas Project 1 & 2 (W)		X
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	Vandellos 2 (W)		X
Axpo AG	Beznau 1 & 2 (W)		X
Centrales Nucleares Almaraz-Trillo	Almaraz 1 & 2 (W)	X	
EDF Energy	Sizewell B (W)		X
Electrabel	Doel 1, 2 & 4 (W)		X
	Tihange 1 & 3 (W)		X
Electricite de France	58 Units		X
Elektriciteits Produktiemaatschappij Zuid-Nederland	Borssele 1 (Siemens)		X
Eletronuclear-Eletrobras	Angra 1 (W)		X
Emirates Nuclear Energy Corporation	Barakah 1 & 2		X
Eskom	Koeberg 1 & 2 (W)		X
Hokkaido	Tomari 1, 2 & 3 (MHI)		X
Japan Atomic Power Company	Tsuruga 2 (MHI)		X
Kansai Electric Co., LTD	Mihama 3 (W)		X
	Ohi 1, 2, 3 & 4 (W & MHI)		X
	Takahama 1, 2, 3 & 4 (W & MHI)		X
Korea Hydro & Nuclear Power Corp.	Kori 1, 2, 3 & 4 (W)		X
	Hanbit 1 & 2 (W)		X
	Hanbit 3, 4, 5 & 6 (CE)		X
	Hanul 3, 4 , 5 & 6 (CE)		X
Kyushu	Genkai 2, 3 & 4 (MHI)		X
	Sendai 1 & 2 (MHI)		X
Nuklearna Electrarna KRSKO	Krsko (W)		X
Ringhals AB	Ringhals 2, 3 & 4 (W)	X	
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REVISION HISTORY

Revision	Date	Change Description
0	January 2018	PWROG-17018-P / NP Revision 0 original issue.
0, Approved	August 2020	PWROG-17018-P-A / NP-A Revision 0 includes the following changes: 1. Updated the title page to add the –A designation to identify that the Topical Report (TR) was approved by the Nuclear Regulatory Commission (NRC). 2. Updated the signature page and proprietary statement. 3. Inserted the NRC transmittal letter and enclosed Final Safety Evaluation (FSE) after the signature page. 4. Updated the PWR Owners Group (PWROG) Member Participation lists to PA-LSC-1366, Revision 2. 5. Added Revision History. 6. In response to the NRC's Second Request for Additional Information (RAI) (2): Section 1.1: *"or a shared alarm window"* was deleted. The sentence was revised to: "*The non-urgent alarm will interface with the MCB to indicate audibly and visually by using a separate alarm window."* The following sentence was also added for clarity: *"The new annunciator window will have the capability to identify a non-urgent alarm condition in each SSPS train."* Section 4.2: the following text was revised from: *"The new alarm can be implemented separately from, or shared with the existing GW alarm annunciation."* to: *"The new alarm will be implemented separately from the existing GW alarm annunciation."* Section 4.2: "*However, the existing MCB alarm windows can be configured to indicate on both the GW alarm and the non-urgent alarm. This minimizes the impact on the MCB alarm panel configuration.*" was deleted. Section 4.2: "*A shared non-urgent alarm indication is currently implemented at another plant for the loss of SSPS output relay AC power. Therefore, both shared and separate MCB alarm panel configurations are currently implemented for SSPS alarm indications.*" was deleted. Section 4.3: "*For a shared MCB alarm window, the SSPS GW alarm and non-urgent alarm circuit inputs share common outputs, and any subsequent input condition is not alarmed, consistent with the current GW alarm (no reflash).*" was deleted.

		Section 5.3: the following text was revised from: *"The design for the MCB annunciator can be implemented via the use of a separate annunciator window, or to parallel the signal with an existing annunciator window."* to: "*The design for the MCB annunciator will be implemented via the use of a separate annunciator window."* Section 10: "*or a shared with a GW alarm window for each SSPS train"* was deleted, and the following text was inserted: "*The separate annunciator window configuration for the GWACM will provide an indication on the MCB of the status of the SSPS train. The operator response to the annunciator will be in accordance with the new ARP. The new annunciator window will have the capability to identify a non-urgent alarm condition in each SSPS train.*" 7. In response to the NRC's Second Request for Additional Information (RAI) (4) (a): Section 1.1: the following text was revised from: "*The non-urgent alarm will provide indications for conditions that do and do not involve a potential loss of safety function; therefore, the operator response to the new non-urgent alarm will be the same as the response to the current GW alarm.*" to: "*The non-urgent alarm will provide indications for conditions that do and do not involve a potential inoperability in the affected SSPS train; therefore, the operator response to the new non-urgent alarm will be in accordance with a new non-urgent alarm response procedure (ARP).*" Section 4.1: the following text was revised from: "*The new non-urgent alarm would require operator action that is the same as the operator response to a GW alarm response.*" to: *"The operator response to the new non-urgent alarm will be in accordance with the new ARP.*" Section 4.2: the following text was revised from: "*The operator response for the SSPS non-urgent alarm will be the same as the response to the current SSPS GW alarm response.*" to: *"The operator response to the new non-urgent alarm will be in accordance with the new ARP.*" Section 7.2: the following text was revised from: "*For the GWACM, all failures will be considered equal for the purpose of SSPS alarm response and diagnostics.*" to: *"The operator response to the new non-urgent alarm will be in accordance with the new ARP.*"

		Section 7.2: the following text was revised from: *"Response to the non-urgent alarm will be the same as the response to the receipt of the current GW alarm. Therefore, the change in human-system interface from the GWACM would require a change to the SSPS alarm response procedure for operators to respond to an SSPS non-urgent alarm condition to determine if a loss of safety function has occurred in the affected SSPS train.*" to: "*The operator response to an SSPS non-urgent alarm condition will be in accordance with the new ARP to determine the impact on operability of the affected SSPS train.*" Table 7-2: the following additional changes were made for clarity from: "*Failure of the module (PCB), potential loss of safety function*" to: "*Failure of the module (PCB), potential inoperability of an RTS or ESFAS function"* and from: "*Capability to perform the safety function is maintained by the redundant train.*" to: "*Capability to perform an RTS or ESFAS actuation is maintained by the redundant SSPS train.*" 8. In response to the NRC's Second Request for Additional Information (RAI) (4) (c): Section 4.1: the following text in <u>Loss of a single +48V1 or +48V2 power supply</u> was revised from: *"The SSPS train is operable with loss of redundancy (Single Point Vulnerability [SPV] state) and therefore, there is no loss of safety function in the affected SSPS train.*" to: "*The SSPS train is operable with loss of redundancy (Single Point Vulnerability [SPV] state) and therefore, there is no impact on the operability of any RTS or ESFAS function in the affected SSPS train.*" Section 4.1: the following text in <u>Loss of a single +15V1 or +15V2 power supply</u> was revised from: "*The SSPS train is operable with loss of redundancy (SPV state) and therefore, there is no loss of safety function of the affected SSPS train.*" to: "*The SSPS train is operable with loss of redundancy (SPV state) and therefore, there is no impact on the operability of any RTS or ESFAS function in the affected SSPS train.*"

		Section 4.1: the following text in Multiplexer Test Switch in the INHIBIT position was revised from: "*However, there is no loss of safety function in the affected SSPS train, since the opposite SSPS train will continue to provide MCB and plant computer trip/logic status data during this time.*" to: "*However, there is no impact on the operability of any RTS or ESFAS function in the affected SSPS train, only the MCB and plant computer indications in that SSPS train are affected. Additionally, the opposite SSPS train will continue to provide MCB and plant computer trip/logic status data when the Multiplexer Test Switch is in the INHIBIT position.*" 9. Section 1.1: the following sentence: *"A 10 CFR 50.59 Evaluation that was prepared for the PWROG reviewed those SSPS design basis documents and determined that the proposed SSPS GWACM could not be implemented without prior NRC review and approval." was deleted.* 10. Section 1.2: Consistent with the changes made in response to the NRC's Second Request for Additional Information (RAI) (2), the following text was revised from: *"The new non-urgent alarm will be installed as either a separate or shared indication from the existing GW alarm panel window on the MCB."* to: *"The new non-urgent alarm will be installed as a separate indication from the existing GW alarm panel window on the MCB."* 11. Section 7.1: revised "*identify the WCAP*" to "*Reference 9*" 12. Table 7-2: added *"(WDE or E10 self-test failure)"* after *"Failure of SSPS UVD, ULB, SGD PCB self-test"* for clarity. 13. Added Appendix A, to include the historical correspondence associated with the TR review, including the PWROG responses to NRC requests for additional information (RAIs).

ACRONYMS AND ABBREVIATIONS

Acronym	Definition
AC	Alternating Current
AEC	Atomic Energy Commission
CCB	Clock Counter Board
CFR	Code of Federal Regulations
CPLD	Complex Programmable Logic Device
DEC	Decoder Board
E10	Self-Test Failure for 10 Consecutive Cycles
ESF	Engineered Safety Feature
ESFAS	Engineered Safety Feature Actuation System
FMEA	Failure Mode Effects Analysis
GW	General Warning
GWMC	General Warning Monitor Circuit
GWAC	General Warning Alarm Circuitry
GWACM	General Warning Alarm Circuitry Modification
ICWG	Instrumentation and Control Working Group
IEEE	Institute of Electrical and Electronics Engineers
LED	Light Emitting Diode
LSC	Licensing Subcommittee
MCB	Main Control Board
NC	Normally Closed
NRC	Nuclear Regulatory Commission
NO	Normally Open
PA	Project Authorization
PCB	Printed Circuit Board
PWROG	Pressurized Water Reactor Owners Group
RTS	Reactor Trip System
SAT	Semi-Automatic Tester
SGD	Safeguards Driver Board
SEE	Systems and Equipment Engineering
SPV	Single Point Vulnerability

SSPS	Solid State Protection System
TR	Topical Report
UFSAR	Updated Final Safety Analysis Report
ULB	Universal Logic Board
U.S.	United States
UVD	Under Voltage Driver Board
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
WCAP	Westinghouse Commercial Atomic Power (topical report)
WDE	Watchdog Error

1 INTRODUCTION AND PURPOSE

1.1 INTRODUCTION

This topical report (TR) was developed for the Pressurized Water Reactor Owners Group (PWROG) Licensing Committee and Instrumentation and Control Working Group (ICWG) to support implementation of Solid State Protection System (SSPS) reliability improvements by minimizing the potential of inadvertent plant reactor trips associated with the current SSPS General Warning (GW) alarm. The SSPS GW alarm generates a partial (half) reactor trip signal when an SSPS train is in the GW alarm condition, and inadvertent reactor trips have occurred due to simultaneous occurrence of a GW alarm in both SSPS trains. Implementation of the General Warning Alarm Circuitry Modification (GWACM) described in this TR would reduce the number of inputs that could lead to an inadvertent reactor trip. The inputs removed from the GW alarm would be moved to a new non-urgent alarm that does not cause a reactor trip signal in the affected SSPS train. The addition of a new non-urgent alarm will also allow plants to enable the new design SSPS printed circuit board (PCB) self-test function to provide remote indication of a self-test alarm condition in the control room on the Main Control Board (MCB).

The GWACM involves removing the following inputs to the SSPS GW alarm circuit:

1) The loss of one 15 VDC power supply
2) The loss of one 48 VDC power supply
3) The multiplexer test switch selected to the “Inhibit” position
4) The pulled card (Rows 2-5) interlock

All of these GW alarm inputs will be moved to provide input to a new non-urgent alarm. The modification also enables the non-urgent alarm to indicate if a new design SSPS Universal Logic Board (ULB), Safeguards Driver (SGD), or Under Voltage Driver (UVD) PCB failed a self-test using the feature that continuously tests the functions of the PCB’s basic logic and output drivers. The non-urgent alarm will interface with the MCB to indicate audibly and visually by using a separate alarm window. The new annunciator window will have the capability to identify a non-urgent alarm condition in each SSPS train. It should also be emphasized that the term “non-urgent” was assigned to the new alarm, since it does not initiate a reactor trip input. The non-urgent alarm will provide indications for conditions that do and do not involve a potential inoperability in the affected SSPS train; therefore, the operator response to the new non-urgent alarm will be in accordance with a new non-urgent alarm response procedure (ARP).

The GW alarm is not included in the plant Technical Specifications, and is not assumed to mitigate any accident in the plant safety analyses.

These circuitry changes will change the SSPS GW alarm design and licensing bases. The SSPS GW alarm reactor trip function was installed as part of the SSPS design that was approved by the United States (U.S.) Atomic Energy Commission (AEC) (Reference 1). The system design basis is documented in WCAP-7672, “Solid State Logic Protection System Description” (Reference 2) and WCAP-7706, “An Evaluation of Solid State Logic Reactor Protection in Anticipated Transients” (Reference 4). These TRs describe the inputs that result in a partial reactor trip signal in an SSPS train, including a loss of 15V and 48V power supplies, a pulled card (PCB), and the multiplexer test switch selected to the “Inhibit” position.

1.2 PURPOSE

The purpose of this TR is to: 1) define the GWACM functional requirements, 2) describe the generic modification details, and 3) provide the technical justification for implementation of the SSPS GWACM.

The GWACM removes the partial reactor trip function for specific GW input signals (see Table 1-1) that, with the exception of the “Failed Self-Test” signal, currently generate a GW alarm condition in the respective SSPS train. The GWACM will move these input signals and the new design SSPS PCB failed self-test input to a new non-urgent audible and visual alarm on the MCB. The new non-urgent alarm will be installed as a separate indication from the existing GW alarm panel window on the MCB.

Table 1-1 SSPS General Warning Partial Reactor Trip Input Signals
Input Error Inhibit Switch in the INHIBIT position
Memories Test Switch not in the OFF position
Reactor Trip Bypass Breaker RACKED-IN and CLOSED (contact)
Output Mode Selector Switch in the TEST position
Permissive Test Switch not in the OFF position
Logic Test Switch A not in the OFF position
Blown ground return fuse (where applicable – not included in all SSPS designs)
Loss of 118 VAC Output Relay Power (where applicable – not included in all SSPS designs)
Card Frame Interlock Row 1 OPEN circuit
MOVE THE FOLLOWING GENERAL WARNING ALARM INPUT SIGNALS TO A NON-URGENT ALARM
Loss of +48V1 Power Supply
Loss of +48V2 Power Supply
Loss of +15V1 Power Supply
Loss of +15V2 Power Supply
Multiplexer Test Switch in the INHIBIT Position (Not in NORMAL or A+B position)
Pulled Card Interlock (Rows 2-5)
Failed Self-Test(1)
Note: 1. This function is contained in the new design SSPS ULB, UVD, & SGD PCBs only, and is not included in the original SSPS design or the GW input signals.

As shown in Table 1-2, the GWACM, as specified herein, is only applicable to plants that have the new design SSPS PCBs installed.

Table 1-2 New Design SSPS PCBs Required for the GWACM

Assembly Drawing	PCB Description
6D30225	Universal Logic Board (ULB)
6D30252	Safeguards Driver Board (SGD)
6D30350	Under Voltage Driver Board (UVD)
6D30520	Semi-Automatic Tester Board (SAT)

2 BACKGROUND

The SSPS GW alarm partial reactor trip function was installed as part of the original SSPS design that was approved by the AEC in the early 1970s. A GW alarm condition generates a partial reactor trip when active in a single SSPS logic train. If a GW alarm condition is generated in both SSPS trains a reactor trip will occur (see Figure 2-1 and Figure 2-2). Additional information on the current GW circuit design is contained in WCAP-7672 and WCAP-7488-L (References 2 and 3, respectively).

A survey of the Westinghouse SSPS plants was conducted by the PWROG in 2005. The survey identified that a reactor trip occurred on four separate occurrences during at-power actuation logic testing as a result of the SSPS GW alarm partial reactor trip function. A reactor trip occurred at those plants during surveillance testing that required the multiplexer test switch to be placed in the “A+B” position when one SSPS train was in a GW alarm condition and the opposite SSPS train multiplexer test switch was rotated through the “INHIBIT” position. Plant reliability can be improved by minimizing the potential for similar inadvertent reactor trips associated with the SSPS GW alarm.

a,c

Figure 2-1. SSPS GW Monitor Zener Circuit (3-Bay Typical [Left] / 4-Bay Typical [Right])

a,c

Figure 2-2. GWMC Simplified Interface Block Diagram (Typical 3-Bay and 4-Bay)

3 GENERAL WARNING ALARM DESIGN

A generic functional block diagram of the current GW alarm design is illustrated by Figure 3-1. The SSPS SAT PCB processes the GW alarm input signals shown on Figure 3-1 to generate the output signals for audible and visual indication on the MCB and also provide a local alarm indication at the SSPS cabinet, as well as initiation of a partial reactor trip. Either an original design or a new design SSPS SAT PCB can implement the functions illustrated in Figure 3-1.

a,c

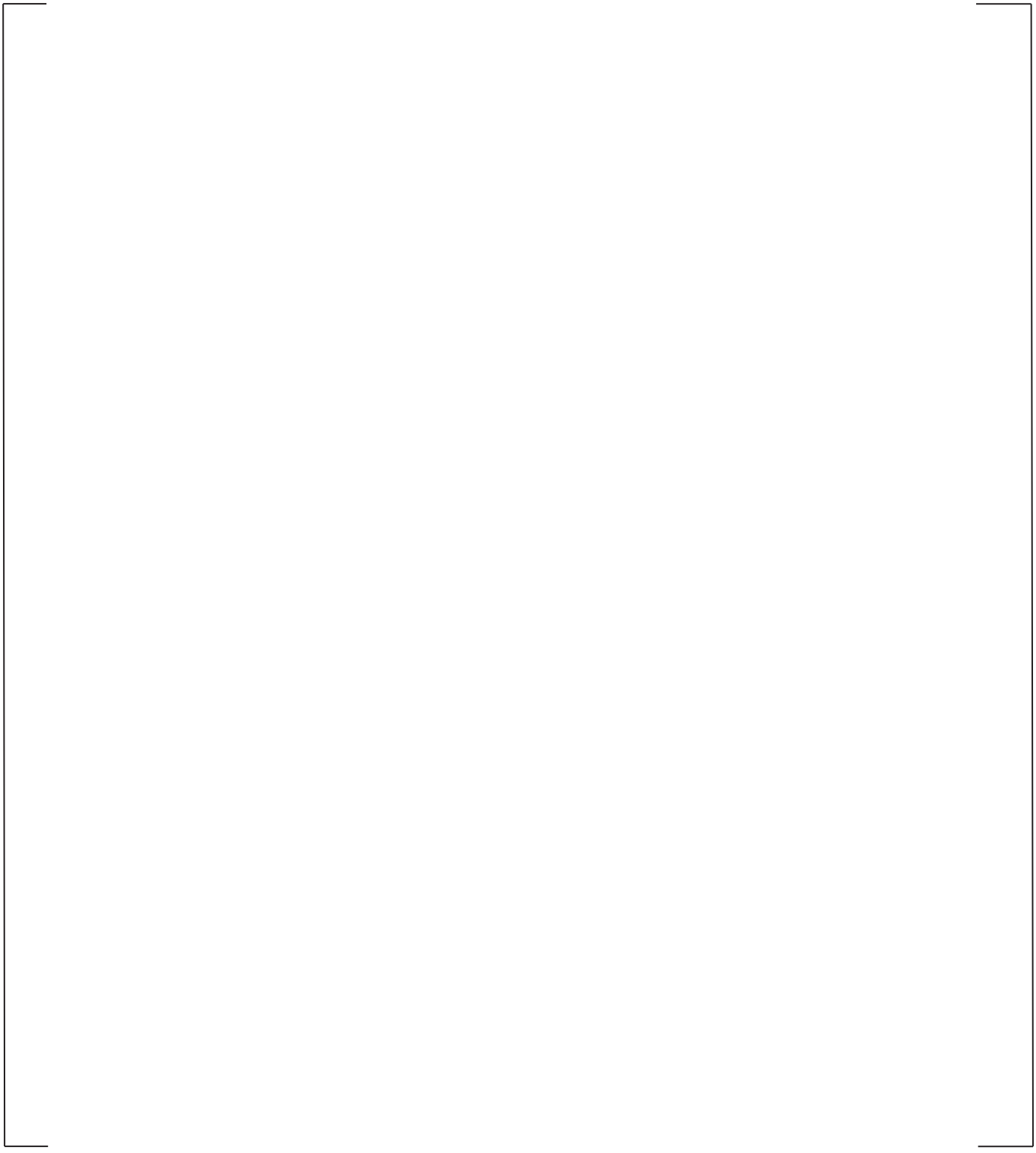

Figure 3-1. General Warning Alarm Circuitry Design (Typical)

4 GENERAL WARNING ALARM CIRCUITRY MODIFICATION

This section describes the system performance requirements for the GWACM design presented in Figure 4-1.

a,c

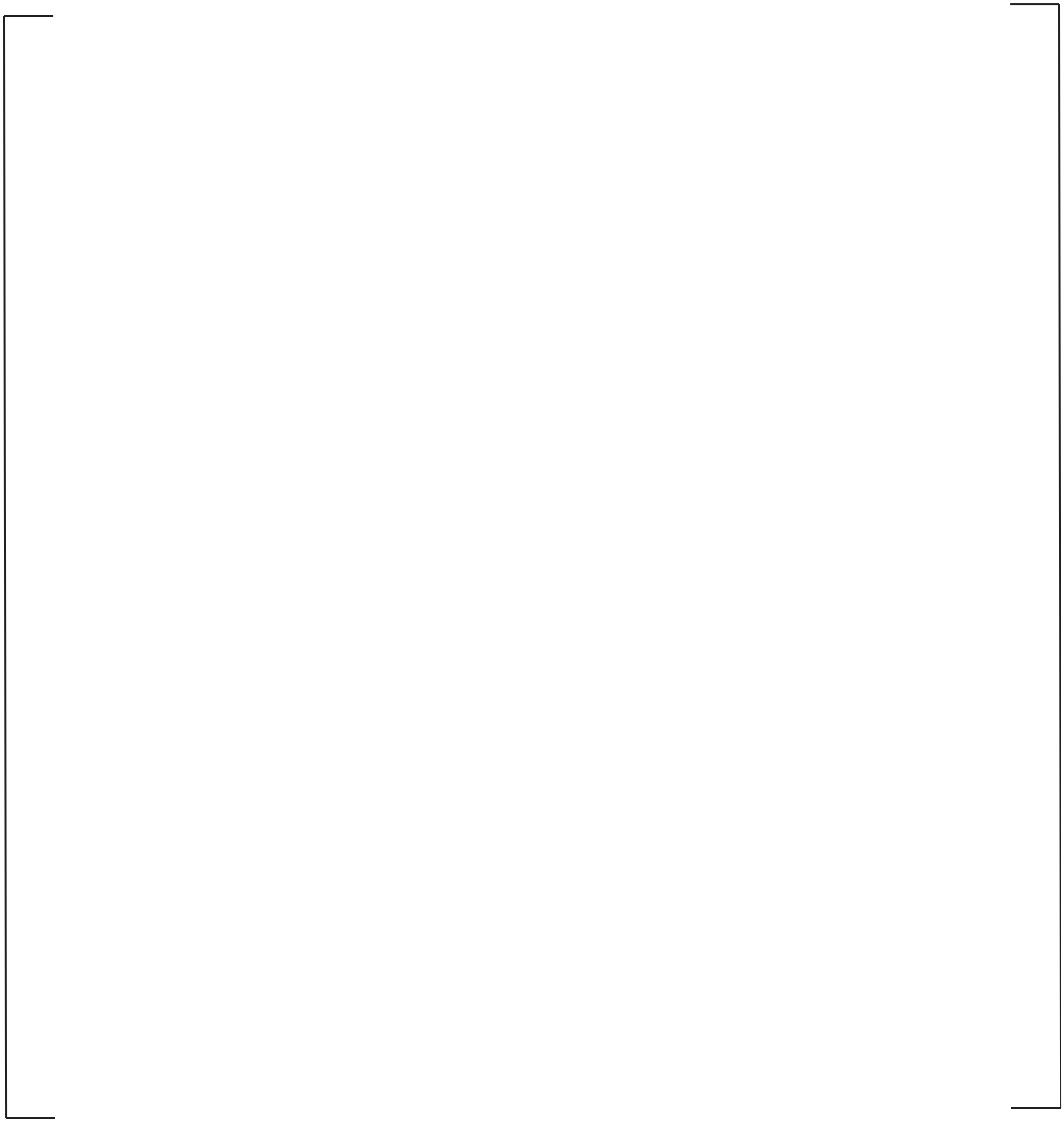

Figure 4-1. Generic GWACM Design

The following sections identify the system performance, annunciator/alarm, physical/fabrication, and compliance requirements for the GWACM.

4.1 NON-URGENT ALARM INPUTS

The GWACM will remove the SSPS train-specific GW alarm reactor trip signal caused by the occurrence of any one of the following alarm inputs. These inputs will provide a remote alarm from each SSPS train as shown in Figure 4-1:

1. Loss of +48V1 power supply
2. Loss of +48V2 power supply
3. Loss of +15V1 power supply
4. Loss of +15V2 power supply
5. Multiplex Test Switch not in the NORMAL or A+B position
6. Pulled Card Interlock Row 2 is an open circuit (due to removed / loose PCB)
7. Pulled Card Interlock Row 3 is an open circuit (due to removed / loose PCB)
8. Pulled Card Interlock Row 4 is an open circuit (due to removed / loose PCB)
9. Pulled Card Interlock Row 5 is an open circuit (due to removed / loose PCB)
10. New Design ULB, SGD or UVD PCB self-test alarm (E10) or Watchdog Error (WDE) indicating an error in the PCB circuitry.

In the original SSPS design, Items 1 through 9 above provide GW alarm inputs, which annunciate a local alarm at the SSPS cabinet and an alarm on the MCB, and the initiation of a partial reactor trip signal in the affected SSPS train consistent with the AEC-approved SSPS design described in References 2 and 3. Item 10 is an additional function that was added to the new design SSPS PCBs. The self-test alarm did not exist with the original SSPS design that was approved by the AEC. The following non-urgent alarm inputs will be implemented with the GWACM:

1&2. Loss of a single +48V1 or +48V2 power supply: Each +48V power supply is redundant (+48V1 and +48V2), and the output is diode auctioneered, such that a loss of one power supply does not inhibit the SSPS train's ability to perform its Reactor Trip System (RTS) and Engineered Safety Feature Actuation System (ESFAS) functions. The SSPS train is operable with loss of redundancy (Single Point Vulnerability [SPV] state), and therefore, there is no impact on the operability of any RTS or ESFAS function in the affected SSPS train. This condition would be indicated to the operator with the SSPS non-urgent alarm on the MCB, similar to the indication already in place with the current GW alarm. A loss of a +48V power supply is sensed by the SSPS SAT PCB. The loss of a single 48V power supply was removed from the three-train SSPS GW alarm design and a non-urgent alarm is sent through multiplexing to the MCB for indication. Therefore, this aspect of the GWACM, i.e., moving power supply monitoring from a GW alarm to a non-urgent alarm has previously been implemented.

3&4. Loss of a single +15V1 or +15V2 power supply: Each +15V power supply is redundant (+15V1 and +15V2), and the output is diode auctioneered, such that a loss of one power supply does not inhibit the SSPS train's ability to perform its RTS and ESFAS

functions. The SSPS train is operable with loss of redundancy (SPV state), and therefore, there is no impact on the operability of any RTS or ESFAS function in the affected SSPS train. This condition would be indicated to the operator with the SSPS non-urgent alarm on the MCB, similar to the indication provided by the current GW alarm. A loss of a +15V power supply is sensed by the SSPS SAT PCB. The loss of a single 15V power supply was removed from the three-train SSPS GW alarm design and a non-urgent alarm is sent through multiplexing to the MCB for indication. Therefore, this aspect of the GWACM, i.e., moving power supply monitoring from the GW alarm to a non-urgent alarm has previously been implemented.

5. Multiplexer Test Switch in the INHIBIT position: The multiplexer test switch is a three-position switch with the following three switch positions: “NORMAL,” “INHIBIT,” and “A+B.” Currently, a GW alarm is generated when this switch is placed out of the “NORMAL” or “A+B” position as it passes through the “INHIBIT” position, which removes the SSPS SAT PCB input path to ground causing an open circuit and a GW alarm signal. While the switch is in the “INHIBIT” position, multiplexing status information is blocked from the associated SSPS train by inhibiting data inputs, causing a loss of the SSPS train data to the MCB and plant computer. However, there is no impact on the operability of any RTS or ESFAS function in the affected SSPS train, only the MCB and plant computer indications in that SSPS train are affected. Additionally, the opposite SSPS train will continue to provide MCB and plant computer trip/logic status data when the Multiplexer Test Switch is in the INHIBIT position. All safety functions within the SSPS train will continue to operate as required with the multiplexer test switch in the “INHIBIT” position. With the GWACM, the multiplexer test switch in the “INHIBIT” position will be indicated with a non-urgent alarm. This modification is considered to be an SSPS reliability improvement because it minimizes the potential of inadvertently having both SSPS trains in a GW alarm partial reactor trip condition, which would cause a reactor trip.

6-9. Pulled Card Interlock in Rows 2–5: The SSPS ULB, SGD, and UVD PCBs are located in Rows 2–5. In the current SSPS design, a GW alarm occurs and places the affected SSPS train in a partial reactor trip when an SSPS ULB, SGD, or UVD PCB is pulled or not inserted. If it is determined that one of the SSPS ULB, SGD, or UVD PCBs were pulled or not fully inserted, that particular SSPS train’s ability to provide an RTS or ESFAS actuation may be affected. With the GWACM, a pulled or not fully inserted SSPS ULB, SGD, or UVD PCB will be indicated with a non-urgent alarm. The operator response to the new non-urgent alarm will be in accordance with the new ARP. The redundant SSPS train would provide an RTS or ESFAS actuation, if required. The Row 1 pulled card interlock for the SSPS DEC, CCB, and SAT PCBs is not modified and is retained with the GW alarm inputs. The GWACM pulled card interlock change in Rows 2–5 is necessary for the SSPS ULB, SGD, and UVD PCB self-test alarm to be annunciated on the MCB as described below.

10. New Design SSPS PCB WDT or an E10 Self-Test Failure: The SSPS ULB, SGD, and UVD PCBs have a self-test function that continuously tests the functions of the PCB’s basic logic and output drivers. [

]a,c

Following the GWACM SSPS logic cabinet wiring modifications and on-board PCB jumper configuration changes, when a new design SSPS ULB, SGD, or UVD PCB generates a self-test error, [

]a,c

and the SAT PCB will generate a non-urgent alarm without a partial reactor trip signal. This design feature requires the installation of the new design SSPS SAT, ULB, SGD, and UVD PCBs with the specific jumper configurations identified in this TR.

4.2 NON-URGENT ALARM SSPS/ANNUNCIATOR SYSTEM FUNCTIONAL INTERFACE

The GWACM will provide a new remote annunciation (train-specific) interface (e.g., relay contact) to facilitate audible and visual MCB indication upon receipt of a non-urgent alarm. The new alarm will be implemented separately from the existing GW alarm annunciation. The operator response to the new non-urgent alarm will be in accordance with the new ARP.

A separate indication for the non-urgent alarm identifies that the applicable SSPS train is not in a partial reactor trip condition, and also provides a GW alarm on the existing annunciation circuit. Additional annunciator windows are required for a separate indication. A separate non-urgent alarm indication is currently implemented at one plant for the loss of an SSPS output relay AC power supply.

4.3 NON-URGENT ALARM MAIN CONTROL BOARD INTERFACE

The remote annunciation on the MCB will illuminate on the occurrence of any one of the following signals. The non-urgent alarm is not required to have a reflash capability. Conditions 1–4 result in a loss of redundancy. Condition 5 results in a loss of SSPS train data to the MCB and plant computer with no loss of RTS or ESFAS actuation function. Conditions 6–10 result in a potential degraded SSPS logic train and potential inoperable state. However, the other SSPS train would be capable performing an RTS or ESFAS actuation, if required.

1. Loss of +48V1 power supply
2. Loss of +48V2 power supply
3. Loss of +15V1 power supply
4. Loss of +15V2 power supply
5. Multiplexer Test Switch not in the NORMAL or A+B position
6. Pulled Card Interlock Row 2 is an open circuit (due to removed / loose PCB)
7. Pulled Card Interlock Row 3 is an open circuit (due to removed / loose PCB)

8. Pulled Card Interlock Row 4 is an open circuit (due to removed / loose PCB)
9. Pulled Card Interlock Row 5 is an open circuit (due to removed / loose PCB)
10. New Design SSPS ULB, SGD or UVD PCB self-test alarm (E10) or WDE indicating an error in the PCB circuitry.

The state of a non-urgent alarm in an SSPS train must be known by the operator in the control room. The operator must be aware that the SSPS train may be degraded when an alarm condition exists.

[

] a,c

4.4 QUALIFICATION OF NON-URGENT ALARM CIRCUIT PARTS

The GWACM will use only parts that are qualified as Class 1E safety-related for implementation within the SSPS.

The SSPS is a Class 1E safety-related system; therefore, only safety or safety-related parts that have been qualified can be used.

4.5 PCB CONFIGURATION REQUIREMENTS

The GWACM will be implemented with a new design SSPS SAT, ULB, UVD, and SGD PCB in each SSPS train.

The new design SAT PCB must be configured and installed for separation and interface with the GW alarm and non-urgent alarm inputs and outputs as described in Section 5.1. New design SSPS ULB, UVD, and SGD PCBs must be installed and configured to provide a remote non-urgent alarm upon detecting either a WDE or E10 self-test error signal.

4.6 SSPS QUALIFICATION IMPACTS

The GWACM does not impact the equipment qualification of the SSPS. The PCB components are qualified as discussed in WCAP-17867-P-A (Reference 9) and the master and slave relay qualifications are not impacted by this change.

4.7 SSPS RESPONSE TIME IMPACTS

The GWACM does not impact response time requirements as documented in WCAP-14036-P-A (Reference 8) and WCAP-17867-P-A. The GWACM configuration change to the new design PCBs does not affect the PCB response time.

The response time of SSPS components used to process RTS and ESFAS signals is bounded by time response allocations and requirements contained in WCAP-14036-P-A.

4.8 RTS AND ESFAS IMPACTS

The GWACM does not impact the RTS or ESFAS functions provided by the SSPS. The non-urgent alarm circuitry change does not interface with the ESFAS or RTS signals.

5 GENERIC MODIFICATION DETAILS

The following section presents generic modification details for the 3-bay SSPS GWACM. The specific wiring locations, wiring removal, and wiring installation will be confirmed on a plant-specific basis.

5.1 SIMPLIFIED SCHEMATIC DIAGRAMS

Figure 5-1 provides a simplified schematic diagram of the current General Warning Alarm Circuitry (GWAC). Figure 5-2 provides a simplified schematic diagram of the GWAC with the modification installed.

a,c

Figure 5-1. GWAC Simplified Current Schematic (Typical)

a,c

Figure 5-2. GWACM Simplified Schematic (Typical)

The GWACM design implements a non-urgent alarm from any one of the inputs listed in Section 4.1 and eliminates the partial reactor trip for these functions. When a non-urgent alarm is generated by the SAT as depicted in Figure 5-2, an audible and visual MCB SSPS non-urgent alarm will be initiated. The non-urgent alarm may also be initiated by the multiplexer test switch when it is out of the “NORMAL” or “A+B” position. [

]a,c

5.2 NEW DESIGN PCBS TO BE INSTALLED

Table 5-1 provides a listing of the new design SSPS PCBs to be installed. Replace all current design SSPS ULB, SGD, UVD, and SAT PCBs with the new design PCB type and groups as specified in Table 5-2. All SSPS ULB, SGD, UVD, and SAT PCBs in both SSPS trains must be new design PCB types. For plants with the new design SSPS PCBs currently installed, the SSPS ULB, SGD, UVD, and SAT PCB jumpers must be configured for the groups identified in Table 5-1.

Table 5-1 New Design SSPS PCBs

PCB	Description
6D30225G02	Universal Logic Board with E10 Interlock
6D30252G03(1)	Safeguards Driver Board with E10 Interlock
6D30350G02	Under Voltage Driver Board with E10 Interlock
6D30520G03(2)	Semi-Automatic Tester Board with Non-Urgent Alarm for Pulled Card Interlock Rows 2 – 5 and Power Supply Failure

Notes:
1. 6D30252G04 for plants that use 6D30252G02
2. 6D30520G04 for three-train SSPS only

Figures 5-3 through 5-8 show the SSPS ULB, SGD, and UVD PCBs before and after the GWACM. Figure 5-9 shows the configuration switch on the SAT PCB.

a,c

Figure 5-3. Universal Logic Board Before GWACM

a,c

Figure 5-4. Universal Logic Board After GWACM

a,c

Figure 5-5. Safeguards Driver Board Before GWACM

a,c

Figure 5-6. Safeguards Driver Board After GWACM

a,c

Figure 5-7. Under Voltage Driver Board Before GWACM

a,c

Figure 5-8. Under Voltage Driver Board After GWACM

a,c

Figure 5-9. Semi-Automatic Tester Board Configuration Switch

5.3 NON-URGENT ALARM MAIN CONTROL BOARD ANNUNCIATOR WINDOW

[ ]a,c The design for the MCB annunciator will be implemented via the use of a separate annunciator window.

The field cable must be routed from each SSPS output relay cabinet (SSPS Trains A & B) to the MCB annunciator system.

5.4 OTHER CONSIDERATIONS FOR THE GWACM IMPLEMENTATION

5.4.1 MASTER RELAY

[ ]a,c

5.4.2 Slave Relay

[ ]a,c

5.4.3 4-Bay SSPS General Warning Alarm Circuit

The 4-bay SSPS has different circuitry for the GW alarm than depicted in Figure 5-1 and Figure 5-2. The implementation of the non-urgent alarm circuitry is not impacted by the design difference in the 4-bay SSPS GW alarm circuitry.

5.4.4 Three-Train SSPS Alarm Circuit Design

The three-train SSPS has an existing non-urgent alarm for the loss of a single 15V or 48V power supply. The implementation of the non-urgent alarm for the pulled card interlock and E10 self-test error requires a modification to the current non-urgent alarm circuitry.

a,c

Figure 5-10. SSPS Three Train Non-Urgent Alarm Excerpt

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] a,c

5.5 GWACM QUALIFICATION

The qualification for the new design SSPS PCBs included environmental and seismic testing.

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6 POST–MODIFICATION TESTING

A functional test of each non-urgent alarm input signal will be performed after the GWACM modification is installed. The E10 self-test failure on each of the SSPS ULB, SGD, and UVD PCBs will be tested. The acceptance criteria are as follows:

- Each input signal must initiate the non-urgent alarm.
- No partial reactor trip signal will be initiated in the SSPS train being tested.

Perform a functional test of the GW alarm input signals. The acceptance criterion is:

- Each input signal must initiate a GW alarm with a partial reactor trip signal in the SSPS train being tested.

7 FAILURE MODES EVALUATION

Plant reliability can be improved by minimizing the potential of inadvertent reactor trips associated with the SSPS GW alarm. Plant safety can be improved by maximizing the SSPS availability via the new design SSPS ULB, SGD, and UVD PCBs that will immediately alert the operator with an audible and visual MCB alarm if an SSPS PCB fails a self-test, as opposed to being identified when the next surveillance test is performed to identify a degraded SSPS ULB, SGD, or UVD PCB.

7.1 IDENTIFICATION OF NEW FAILURE MODES

The failure modes and effects analyses (FMEAs) that were performed on the new design SSPS PCBs in Reference 9 confirmed that the FMEA that was performed for the SSPS that is contained in WCAP-7706, remains valid. The new design SSPS ULB, SGD, and UVD PCB failure modes are the same as the original design SSPS ULB, SGD, and UVD PCBs. The similarity of the FMEA results for the new design SSPS ULB, SGD, and UVD PCBs when compared to the original design SSPS ULB, SGD, and UVD PCBs confirmed that there will be no malfunctions of an SSC important to safety with a different result than any previously evaluated in the Updated Final Safety Analysis Report (UFSAR).

Table 7-1 provides a summary of the current GW alarm design functions, the GWACM changes, and identifies those functions that are discussed in WCAP-7488-L and WCAP-7706 (References 3 and 4). The new design SSPS ULB, SGD, and UVD PCB self-test error is also included.

WCAP-7672 Section III.D, “Alarm System” states:

“*If trouble in both trains should develop simultaneously, the reactor will be tripped automatically by the alarm system*.”

Implementation of the GWACM will remove the GW alarm partial reactor trip inputs that are shown in Figure 4-1. Therefore, the changes to the SSPS GW alarm failure modes are identified in Table 7-1.

Table 7-1 General Warning Alarm Summary of Proposed Changes

General Warning (GW) Alarm			GW Alarm Function Discussed in WCAP-7488-L	GW Alarm Function Discussed in the SSPS FMEA	
Functions	**Current Design**	**GWACM Design**		**WCAP-7706**	**Description**
Input Error Inhibit Switch in "INHIBIT"	General Warning with Partial Trip	General Warning with Partial Trip	Yes	Yes	Input Error Inhibit Switch S1, Fuse FU1 (continuously monitored with open circuit alarm and trip)
Logic Test Switch A not in "OFF"	General Warning with Partial Trip	General Warning with Partial Trip	Yes	No	
Memories Test Switch not in "OFF"	General Warning with Partial Trip	General Warning with Partial Trip	Yes	No	
Permissive Test Switch not in "OFF"	General Warning with Partial Trip	General Warning with Partial Trip	Yes	No	
Output Mode Selector Switch in "TEST"	General Warning with Partial Trip	General Warning with Partial Trip	Yes	No	
Loss of 118Vac Output Relay Power (not all plants have this feature)	General Warning with Partial Trip	General Warning with Partial Trip	Yes	No	
Reactor Trip Bypass Breaker racked-in and closed.	General Warning with Partial Trip	General Warning with Partial Trip	Yes	No	
Pulled card interlock (Row 1)	General Warning with Partial Trip	General Warning with Partial Trip	Yes	Yes	The improper insertion of any CCB, DEC, or SAT PCB, one in each SSPS logic train, will generate a reactor trip signal.
Loss of one 48 V power supply	General Warning with Partial Trip	**Non-Urgent Alarm - no partial trip**	Yes	No	
Loss of one 15V power supply	General Warning with Partial Trip	**Non-Urgent Alarm - no partial trip**	Yes	No	
Multiplexer Test Switch to Inhibit	General Warning with Partial Trip	**Non-Urgent Alarm - no partial trip**	Yes	No	
Pulled card interlock (Rows 2-5)	General Warning with Partial Trip	**Non-Urgent Alarm - no partial trip**	Yes	Yes	
Self-Test Error (E10 or WDE)	None	**Non-Urgent Alarm - no partial trip**	No	No	N/A

7.2 GWACM FAILURE EVALUATION

A failure modes and effects analysis was performed for the GWACM as shown in Table 7-2.

A traditional FMEA uses a weight rating that is based on multiplying the criticality (C), likelihood (L), and detectability (D) rankings together, with larger values normally used to indicate more critical failure modes. The combination of criticality and likelihood offers provides insight into the component's impact on the mission if it failed or was at risk. The combination of likelihood and detectability provides insight to the component's need for monitoring, inspection, or testing. This combination offers insight into the surveillance test frequency and other maintenance considerations. The operator response to the new non-urgent alarm will be in accordance with the new ARP.

The multiplexer test switch to generate an inhibit position alarm is not a component failure; therefore, it is not included in Table 7-2. The multiplexer test switch inhibited alarm provides indication when one SSPS train is in test to prevent spurious alarms to the operator; while the opposite SSPS train provides indication during testing. Multiplexing is a non-safety-related function; therefore, a partial reactor trip is not needed for the multiplexer test switch to generate an inhibit position alarm.

The loss of a redundant power supply does not affect an SSPS train's operability; therefore, a partial reactor trip is not needed. Also, note that a failure of both of the 15V or both of the 48V power supplies in an SSPS train causes a reactor trip; therefore, a second power supply failure is fail-safe.

The pulled-card interlock alarm is administratively controlled by limiting access to the SSPS train cabinets. Verification that the SSPS ULB, SGD, and UVD PCBs remain inserted is self-evident by the absence of an alarm from the pulled card interlock circuit. A non-urgent alarm condition will occur when a PCB is pulled, or not fully inserted for card interlock Rows 2-5. PCB insertion is confirmed prior to securing each SSPS train cabinet, by confirming there is no SSPS GW or non-urgent alarm condition.

The addition of a PCB self-test failure indication to the non-urgent alarm ensures that PCB failures are immediately detectable. Determination of the non-urgent alarm cause would require observation of local status indications at the affected SSPS logic cabinet. The operator response to an SSPS non-urgent alarm condition will be in accordance with the new ARP to determine the impact on operability of the affected SSPS train. Only after the cause of the non-urgent alarm has been determined, can an assessment be made regarding the affected SSPS train's operability.

Table 7-2 SSPS General Warning Alarm Circuit Modification FMEA Impacts

Failure	Symptoms/ Local Effects in the Affected SSPS Train	Mitigating Features	System Effects	Method of Detection
Failure of one 48 VDC power Supply	Loss of Power	Redundant power supply	None	Non-Urgent Alarm
Failure of one 15 VDC power Supply	Loss of Power	Redundant power supply	None	Non-Urgent Alarm
Failure of SSPS UVD, ULB, SGD PCB self-test (WDE or E10 self-test failure)	Failure of the module (PCB), potential inoperability of an RTS or ESFAS function	Opposite SSPS Train	Capability to perform an RTS or ESFAS actuation is maintained by the redundant train.	Non-Urgent Alarm
Pulled Card Interlock Rows 2-5	Failure of the module (PCB), potential inoperability of an RTS or ESFAS function	Opposite SSPS Train	Capability to perform an RTS or ESFAS actuation is maintained by the redundant train.	Non-Urgent Alarm

8 NEW DESIGN SSPS PCB OPERATION AND TESTING

The operation and testing of the new design SSPS PCBs is described in WCAP-17867-P-A. Implementation of the GWACM enables the SSPS self-test feature on the SSPS ULB, SGD, and UVD PCBs to activate a new non-urgent alarm on the MCB. [

] [a,c] The only operational change to the new design PCBs associated with the GWACM is the external (jumper and switch) alarm circuit configuration that will provide a remote non-urgent alarm on the MCB. No changes are required to the SSPS ULB, SGD, UVD, and SAT PCB design to implement the GWACM.

9 ASSESSMENT OF REGULATORY REQUIREMENTS GUIDANCE AND INDUSTRY STANDARDS

WCAP-17867-P-A provides a cross-reference between the regulatory requirements, selected guidelines, and Industry Standards identified in NUREG-0800 Chapter 7, Table 7-1 (Reference 10), that are applicable to the new design SSPS PCBs. WCAP-17867-P-A identifies the applicable regulation, guidance or Industry Standard, whether the SSPS new design SSPS PCB changes are in compliance, in partial compliance, or not in compliance, and the basis for non-compliance. The topical report sections and/or external references that provide information supporting the new design SSPS PCB compliance with each regulation and guideline are also listed.

Many of the regulatory requirements, selected guidelines, and Industry Standards listed in WCAP-17867-P-A apply on a system level. The new design SSPS PCBs were designed to maintain the current SSPS design and licensing basis so that installation of the new design PCBs has no impact on the SSPS' ability to perform its safety functions. The original design SSPS was designed to IEEE Std. 279-1971 (Reference 11). The new design SSPS PCBs comply with IEEE Std. 603-1991 (Reference 12). The SSPS GWACM does not impact the new design SSPS PCB design and licensing basis.

Aside from the new design SSPS PCBs, the components used in the implementation of the GWACM are not digital and do not contain any programmable devices. The design of the SSPS ULB, SGD, UVD, and SAT PCBs has not changed from the design that was approved by the NRC in WCAP-17867-P-A. The self-test function existed on the PCBs that were approved in WCAP-17867-P-A and the regulatory requirements, selected guidelines, and Industry Standards for these PCBs were addressed in WCAP-17867-P-A. [

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10 SUMMARY AND CONCLUSIONS

Implementation of the GWACM improves plant reliability by minimizing the potential for inadvertent plant reactor trips associated with the SSPS GW alarm. The inputs removed from the GW alarm will be moved to a new non-urgent alarm that does not cause a reactor trip signal in the affected SSPS train. Plant safety will also be improved by maximizing SSPS availability via the new non-urgent alarm to immediately alert the operator if an SSPS PCB fails a self-test. The addition of a new non-urgent alarm will allow plants to enable the new design SSPS PCB self-test function to provide remote indication of a self-test alarm condition on the MCB. The GWACM will alert the operator with an audible and visual MCB alarm if an SSPS PCB fails a self-test, as opposed to being identified when the next surveillance test is performed to identify a degraded SSPS ULB, SGD, or UVD PCB.

The GWACM involves reducing the number of inputs to the SSPS GW alarm circuit by removing the loss of one 15 VDC power supply, the loss of one 48 VDC power supply, the multiplexer test switch selected to the “Inhibit” position, and the pulled card interlock. These inputs will be moved to a new non-urgent alarm. The non-urgent alarm will interface with the MCB annunciator system to indicate using a separate alarm window. The separate annunciator window configuration for the GWACM will provide an indication on the MCB of the status of the SSPS train. The operator response to the annunciator will be in accordance with the new ARP. The new annunciator window will have the capability to identify a non-urgent alarm condition in each SSPS train. The reduction of inputs to the SSPS GW alarm will reduce the likelihood of inadvertent reactor trips while maintaining plant safety with the remaining inputs to the GW alarm that will provide input for a partial reactor trip signal as originally designed.

The GWACM also enables the non-urgent alarm to indicate if a new design SSPS PCB failed a self-test. The new design SSPS ULB, SGD, and UVD PCBs all contain built in self-test features, including a self-test function that continuously tests the functions of the PCB’s basic logic and output drivers. Protection channel trips and actuation signals received during the performance of self-test processes will result in a reactor trip or ESFAS actuation, when required, as originally designed. The SSPS PCB self-test feature does not impact the Technical Specification SSPS surveillance tests or impact the SSPS protection functions. The self-test feature provides early detection of a potential component failure, including logic operation and input power failure. The continuous PCB self-tests on the SSPS ULB, SGD, and UVD PCBs are designed to facilitate timely recognition and identification of equipment that is not performing as designed, so that maintenance can be performed. The addition of LED indications on the visible card edge of the new design SSPS PCBs provide signal status information that is not available on the original design SSPS PCBs. These features, in conjunction with the GWACM, will alert the operator with an audible and visual MCB alarm if an SSPS PCB fails a self-test, as opposed to being identified when the next surveillance test is performed to identify a degraded SSPS ULB, SGD, or UVD PCB.

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9. WCAP-17867-P-A, Rev. 1 (Westinghouse Proprietary), "Westinghouse SSPS Board Replacement Licensing Summary Report," October 2014.
10. NUREG-0800 Chapter 7, "Instrumentation and Controls – Overview of Review Process," U.S. Nuclear Regulatory Commission.
11. IEEE Std 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."
12. IEEE Std 603-1991, "Criteria for Safety Systems for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1991.

APPENDIX A – PWROG CORRESPONDENCE AND RESPONSES TO NRC REQUESTS FOR ADDITIONAL INFORMATION

This section contains the following correspondence:

1. Request for Additional Information Email from Mr. Brian Benney, NRC to Mr. Chad Holderbaum, PWR Owners Group, April 2, 2018

2. OG-18-162, Transmittal of the Response to NRC Request for Additional Information Email for WCAP-17018-P/NP, Revision 0, “Solid State Protection System General Warning Alarm Modification” (PA-LSC-1366), July 5, 2018 (ADAMS Accession No. ML18191B172)

3. Second NRC Request for Additional Information Email from Mr. Jason Drake, NRC to Mr. Chad Holderbaum, PWR Owners Group, August 19, 2019

4. OG-20-85, Transmittal of the Response to the Second NRC Request for Additional Information for WCAP-17018-P/NP, Revision 0, “Solid State Protection System General Warning Alarm Modification” (PA-LSC-1366), March 13, 2020

From: No-Reply@amrdec.army.mil [mailto:No-Reply@amrdec.army.mil]
Sent: Monday, April 02, 2018 3:10 PM
To: Holderbaum, Chad M.
Subject: AMRDEC Safe Access File Exchange Delivery Notice

Direct replies will not be read by a human.

==========

DO NOT FORWARD

Please note, IAW Para 4-5.a(8) and 4-12.c, AR 25-2, it is a violation of SAFE security policy to share/forward Package passwords.

You must contact the Package originator, Brian.Benney@nrc.gov to have the Package re-sent via SAFE (https://urldefense.proofpoint.com/v2/url?u=https-3A__safe.amrdec.army.mil_safe_&d=DwIGaQ&c=Scw5Q-w0YkzmgQckG2UMv_F15wUD7DoFbJjMRh6PGnA&r=C2ghfacEMs6q-dFoJ3BKUNFOEPAf2mcrjGYcvYNn0Hc&m=xAYZ8V-7MEWZ1Y1AuL9D5zbdbc-tJM1-40MkmteBZTM&s=yYmkFJNxFSdwJ6WiDsFimVcxVkgJg3yubJI-1jyA5l4&e=) to other users.

NOTICE: If any doubt exists as to the safety or origin of the file(s) or the veracity of the sender, the recipient reading this message should NOT download the file(s) and should contact the appropriate Information Assurance Security Officer immediately for further guidance.

Brian Benney, Brian.Benney@nrc.gov has granted you access to a file(s) uploaded on 4/2/2018 2:09:57 PM Central Time Zone, USA.

File Description: RAIs for PWROG 17018

Package ID: 13046493

The file(s) will be available at:

https://urldefense.proofpoint.com/v2/url?u=https-3A__safe.amrdec.army.mil_safe_pickupfiles.aspx-3Fid-3D13046493&d=DwIGaQ&c=Scw5Q-w0YkzmgQckG2UMv_F15wUD7DoFbJjMRh6PGnA&r=C2ghfacEMs6q-dFoJ3BKUNFOEPAf2mcrjGYcvYNn0Hc&m=xAYZ8V-7MEWZ1Y1AuL9D5zbdbc-tJM1-40MkmteBZTM&s=QAphv3WhfpymnKEVd_ND9z_TaQE6qv4BpOR0aa8Ocwo&e=

Until: 4/12/2018

If you have questions or need assistance with the contents of the packages, please contact the package originator.

If you require technical assistance, please contact the AMRDEC SAFE Team at usarmy.redstone.rdecom-amrdec.mbx.safe-team@mail.mil or call 256-336-1200 and reference Package ID 13046493 and include a copy of this email message in your request.

Thank you.

This message may be forwarded to usarmy.redstone.rdecom-amrdec.mbx.safe-team@mail.mil for technical support purposes.

By letter dated February 1, 2018 (ADAMS Accession No. ML18039A033), the PWR Owners Group (PWROG) docketed WCAP-17018-P/NP, Revision 0, "Solid State Protection System General Warning Alarm Modification." The staff has reviewed this report and determined that additional information is required (as explained below).

The solid state protection system (SSPS) is equipment that is used for the voting and actuation logic portion of some Westinghouse designed nuclear power plants (NPPs). This equipment was previously evaluated and approved by NRC (Originally per WCAP-7488-L and WCAP-7672; most recently by ADAMS Accession No. ML14260A143) to meet the requirements of the GDCs (i.e., 10 CFR 50 Appendix A) and IEEE 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations." Specifically, the GDCs state:

> "*Criterion 23—Protection system failure modes.* The protection system shall be designed to fail into a safe state or into a state demonstrated to be acceptable on some other defined basis if conditions such as disconnection of the system…are experienced."

Furthermore, IEEE 279-1971 states:

> "**4.11 Channel Bypass or Removal from Operation.** The system shall be designed to permit any one channel to be maintained, and when required, tested or calibrated during power operation without initiating a protective action at the systems level. During such operation the active parts of the system shall of themselves continue to meet the single failure criterion.
>
> ***Exception:*** *"One-out-of-two" systems are permitted to violate the single failure criterion during channel bypass provided that acceptable reliability of operation can be otherwise demonstrated. For example, the bypass time interval required for a test, calibration, or maintenance operation could be shown to be so short that the probability of failure of the active channel would be commensurate with the probability of failure of the "one-out-of-two" system during its normal interval between tests.*"

The submitted WCAP proposes to change the failure modes of some of the SSPS equipment. Specifically, the pulled card interlocks in Rows 2-5, will no longer generate a half-trip and alarm, but rather just an alarm. To continue the review, NRC staff need the following:

(1) Please describe the pulled card interlock circuit. Please describe all of the ways that (or conditions in which) these pulled card interlock signals are generated. Specifically, are there any card failures (in Rows 2-5) that currently result in a pulled card interlock signal (i.e., alarm and a half-trip - Fail Safe)?

    If the implementation of this WCAP would allow a card failures (in Rows 2-5) to no longer fail safe, but only to provide an alarm, please explain why and how only generating an alarm is acceptable.

(2) Please describe how this WCAP will be referenced in 10 CFR 50.59 Screens/Evaluations. Specifically, the letter docketing the WCAP states:

> "PWROG-17018 is being submitted for NRC review and approval. Licensees will reference the NRC-approved Topical Report in their 10 CFR 50.59 Screens/Evaluations associated with the implementation of the modification to the GW alarm."

Further, the WCAP states on page 1-1:

> "A 10 CFR 50.59 Evaluation that was prepared for the PWROG reviewed the SSPS design basis documents and determined that the proposed SSPS GWACM could not be implemented without prior NRC review and approval."

Please discuss the specific 50.59 criteria (e.g., Criteria 1-8), that NRC endorsement of this topical report would address, and to what extent, with respect to a licensee referencing the topical in a future site-specific 50.59 evaluation or LAR.

Also, please identify the licensing conflicts that this topical report is addressing with respect to: (1) the approved SSPS design basis document(s), (2) applicable regulations, and (3) any applicable guidance documents.

Program Management Office
1000 Westinghouse Drive
Cranberry Township, Pennsylvania 16066

WCAP-17018-P/NP, Revision 0
Project Number 99902037

July 5, 2018

OG-18-162

U.S. Nuclear Regulatory Commission
Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

Subject: PWR Owners Group
Transmittal of the Response to NRC Request for Additional Information Email for WCAP-17018-P/NP, Revision 0, "Solid State Protection System General Warning Alarm Modification," (PA-LSC-1366)

References:

1. Letter Submittal of PWROG-17018-P/NP, "Solid State Protection System General Warning Alarm Modification," PA-LSC-1366 dated February 1, 2018 (ADAMS Accession No. ML18039A033)
2. NRC Acceptance for Review of the Pressurized Water Reactor Owners Group Topical Report PWROG-17018-P/NP, "Solid State Protection System General Warning Alarm Modification," dated March 13, 2018
3. Request for Additional Information Email from Mr. Brian Benney, NRC to Mr. Chad Holderbaum, PWR Owners Group dated April 2, 2018

On February 1, 2018, in accordance with the Nuclear Regulatory Commission (NRC) Topical Report (TR) program for review and acceptance, the Pressurized Water Reactor Owners Group (PWROG) requested formal NRC review and approval of PWROG-17018-P/NP, Revision 0, "Solid State Protection System General Warning Alarm Modification" for referencing in regulatory actions (Reference 1).

The NRC Staff accepted the Topical Report for review on March 13, 2018 (Reference 2).

The PWROG was notified on April 2, 2018 of the NRC staff's determination that additional information was necessary to complete the review (Reference 3).

Enclosure 1 to this letter provides the response to Reference 3.

If you have any questions, please do not hesitate to contact me at (805) 545-4328 or Mr. W. Anthony Nowinowski, Program Manager of the PWR Owners Group, Program Management Office at (412) 374-6855.

Sincerely yours,

Ken J Schrader

Ken Schrader, COO & Chairman
PWR Owners Group

JKS:am

Enclosure 1: Responses to NRC RAIs 1 and 2 on PWROG-17018-P / PWROG-17018-NP - LTR-PL&E-18-024 (Non-Proprietary)

cc with enclosures:
PWROG Steering and Management Committee
PWROG Licensing Committee
PWROG I&C Working Group
PWROG PMO
B. Benney, US NRC
J. Andrachek, WEC
J. Moorehead, WEC
T. Gruber, WEC

Electronically Approved Records are Authenticated in the Electronic Document Management System.

LTR-PL&E-18-024

ATTACHMENT 1

Responses to NRC RAIs 1 and 2 on PWROG-17018-P / PWROG-17018-NP (Non-Proprietary)

By letter dated February 1, 2018 (ADAMS Accession No. ML18039A033), the PWR Owners Group (PWROG) docketed WCAP-17018-P/NP, Revision 0, "Solid State Protection System General Warning Alarm Modification." The staff has reviewed this report and determined that additional information is required (as explained below).

The solid state protection system (SSPS) is equipment that is used for the voting and actuation logic portion of some Westinghouse designed nuclear power plants (NPPs). This equipment was previously evaluated and approved by NRC (Originally per WCAP-7488-L and WCAP-7672; most recently by ADAMS Accession No. ML14260A143) to meet the requirements of the GDCs (i.e., 10 CFR 50 Appendix A) and IEEE 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations." Specifically, the GDCs state:

"*Criterion 23—Protection system failure modes.* The protection system shall be designed to fail into a safe state or into a state demonstrated to be acceptable on some other defined basis if conditions such as disconnection of the system…are experienced."

Furthermore, IEEE 279-1971 states:

"**4.11 Channel Bypass or Removal from Operation.** The system shall be designed to permit any one channel to be maintained, and when required, tested or calibrated during power operation without initiating a protective action at the systems level. During such operation the active parts of the system shall of themselves continue to meet the single failure criterion.

Exception: *"One-out-of-two" systems are permitted to violate the single failure criterion during channel bypass provided that acceptable reliability of operation can be otherwise demonstrated. For example, the bypass time interval required for a test, calibration, or maintenance operation could be shown to be so short that the probability of failure of the active channel would be commensurate with the probability of failure of the "one-out-of-two" system during its normal interval between tests."*

The submitted WCAP proposes to change the failure modes of some of the SSPS equipment. Specifically, the pulled card interlocks in Rows 2-5, will no longer generate a half-trip and alarm, but rather just an alarm. To continue the review, NRC staff need the following:

(1) Please describe the pulled card interlock circuit. Please describe all of the ways that (or conditions in which) these pulled card interlock signals are generated. Specifically, are there any card failures (in Rows 2-5) that currently result in a pulled card interlock signal (i.e., alarm and a half-trip - Fail Safe)?

If the implementation of this WCAP would allow a card failures (in Rows 2-5) to no longer fail safe, but only to provide an alarm, please explain why and how only generating an alarm is acceptable.

Response to RAI 1:

Section 4.1 of PWROG-17018-P discusses the pulled card interlock function. The pulled card interlock signal passes through each universal logic (ULB), safeguards driver (SGD) and undervolted driver (UVD) card in the same row in the SSPS racks in series with the semi-automatic (SAT) card pulled card interlock input. This signal is the same in both the original design ULB, SGD, and UVD card and the new design ULB, SGD, and UVD cards.

1

*** This record was final approved on 6/28/2018 9:10:33 AM. (This statement was added by the PRIME system upon its validation)

On the original design ULB, SGD, and UVD cards, the signal passes through a printed circuit card trace between the card interlock connector pins (Pins 21 to 22) to confirm that the cards are installed and fully inserted into the SSPS card cage connectors. The original design cards do not have any self-diagnostic function and no circuit failure can generate a pulled card interlock alarm.

The new design ULB, SGD, and UVD cards incorporate the interlock function and also include circuitry to initiate a card interlock alarm (which is not contained in the original design cards), if a card self-test alarm (E10) or Watchdog Error (WDE) occurs as discussed in Section 4.1 of PWROG-17018-P. As discussed in Sections 4.1 and 5.2 of PWROG-17018-P, the circuit that affects the pulled card interlock will be enabled as part of this modification to the GWA circuit. This modification will provide an alarm on the main control board (MCB) that would identify a potential inoperability of the affected SSPS train. The non-urgent alarm modification can only be implemented with the new design cards (ULB, SGD, UVD, and SAT).

Section 7.2 of PWROG-17018-P discusses the failure modes associated with the modification to the GWA circuitry. By eliminating the partial trip from the pulled card interlock, this modification introduces the potential for two inoperable SSPS trains if one ULB, SGD, or UVD card in rows 2 – 5 is pulled from one SSPS train and the other SSPS train is being tested or has a ULB, SGD, or UVD card removed. However, administrative controls are in place that prevent testing or maintenance to be performed on both SSPS trains at the same time. These administrative controls address the potential of two inoperable SSPS trains due to a pulled ULB, SGD, or UVD card in rows 2 – 5. These cards would be inserted in the card frame, and could only be removed during maintenance or testing activities in the SSPS train.

The new design SSPS cards contain local card edge indications (as discussed Appendix A of WCAP-17867-P-A) such that it is confirmed that the ULB, SGD, and UVD cards are fully inserted into the card frame of the SSPS train by the absence of the local LED indication on the card. For example, the new design cards contain a green LED indication that indicates whether there is power to the card, i.e., these LEDs are illuminated when the card is fully inserted in the card frame. If a card is not fully inserted or pulled from the card frame, the LED will not be illuminated. Each of the new design cards that include the self-test feature (i.e., the ULB, SGD, and UVD) contain a red LED indication that illuminates a self-test alarm (E10) or a Watchdog Error (WDE) occurs. The illumination of the red LED differentiates between an issue associated with testing, versus a card that is not fully inserted into the card frame, i.e., a pulled card with no green LED illuminated.

Section 7.2 of PWROG-17018-P discusses that the response to the non-urgent alarm will be the same as the response to the receipt of the current GW Alarm (which currently results in a partial trip condition). Aside from the non-urgent alarm associated with the pulled card interlock, the other non-urgent alarm inputs do not impact the Operability of the SSPS Train. Therefore, if a non-urgent alarm is initiated on the MCB, the following administrative controls will confirm the status of each SSPS train.

1. The current administrative controls discussed above that prevent testing or maintenance activities to be performed on both SSPS trains at the same time. These administrative controls prevent a card from being pulled in both SSPS trains at the same time.
2. Administrative controls will be implemented after the non-urgent alarm modification is installed and will require inspecting the card edge LEDs in the affected SSPS train(s) when a non-urgent alarm exists on the MCB to confirm that no ULB, SGD,

or UVD has been pulled and that the non-urgent alarm is not associated with a card self-test alarm (E10) or Watchdog Error (WDE). The inspection of the card edge LED is required, as an initial response to the non-urgent alarm, because the non-urgent alarm is not reflashed.

(2) Please describe how this WCAP will be referenced in 10 CFR 50.59 Screens/Evaluations. Specifically, the letter docketing the WCAP states:

"PWROG-17018 is being submitted for NRC review and approval. Licensees will reference the NRC-approved Topical Report in their 10 CFR 50.59 Screens/Evaluations associated with the implementation of the modification to the GW alarm."

Further, the WCAP states on page 1-1:

"A 10 CFR 50.59 Evaluation that was prepared for the PWROG reviewed the SSPS design basis documents and determined that the proposed SSPS GWACM could not be implemented without prior NRC review and approval."

Please discuss the specific 50.59 criteria (e.g., Criteria 1-8), that NRC endorsement of this topical report would address, and to what extent, with respect to a licensee referencing the topical in a future site-specific 50.59 evaluation or LAR.

Also, please identify the licensing conflicts that this topical report is addressing with respect to: (1) the approved SSPS design basis document(s), (2) applicable regulations, and (3) any applicable guidance documents.

Response to RAI 2:

In the current GWA circuitry, a partial reactor trip signal will be initiated if any of the following conditions exist in one SSPS train:

- The loss of a 15vdc power supply
- The loss of a 48vdc power supply
- The multiplexer test switch in the "Inhibit" position
- The pulled card interlock

If any of the above conditions exist in the second SSPS train, a reactor trip will occur.

The UFSARs for some plants with an SSPS contain a discussion of the GWA in the Failure Modes and Effects Analysis Section for the RTS, and the conditions that will cause a GWA, including any the 4 conditions identified above.

Additionally, the UFSARs for some of the plants with an SSPS reference WCAP-7672, "Solid State Logic Protection System Description," the Non-Proprietary version and/or the Proprietary version of that WCAP, i.e., WCAP-7488-L. The 4 conditions identified above are discussed in the WCAP, which was approved by the AEC in a letter from the United States Atomic Energy Commission to Mr. Romano Salvatori, Manager, Nuclear Safety Department, signed by D.B. Vassallo, Chief, Light Water Reactors, Project Branch 1-1, Directorate of Licensing – Regulation, Enclosure: "Evaluation of WCAP-7488-L and WCAP-7672," March 6,1974.

3

*** This record was final approved on 6/28/2018 9:10:33 AM. (This statement was added by the PRIME system upon its validation)

The response to Question 1 in a 50.59 Screen was "Yes," i.e., "Does the activity to which this screening applies represent:"

"A modification, addition to, or removal of a structure, system, or component (SSC) such that a design function as described in the Updated FSAR is adversely affected?"

Basis for the "Yes," response:

The partial reactor trip condition caused by the GWA will be eliminated for four design input functions. Removal of the Loss of one 48 VDC Power Supply, Loss of one 15VDC Power Supply, Multiplexing Test Switch to Inhibit, and Pulled Card Interlock inputs to the General Warning Alarm circuit poses a potential adverse impact to a design function of the SSPS, which requires this change to be screened in for further evaluation.

The SSPS is designed to initiate a reactor trip function for those inputs that are proposed to be removed from the GW Alarm reactor trip circuit. Therefore, the proposed activity is a modification to an SSC such that a design function as described in the Updated FSAR may be adversely affected.

The response to Question 6, as stated below, in a 50.59 Evaluation was "Yes":

"Does the proposed activity create the possibility for a malfunction of an SSC important to safety with a different result than any previously evaluated in the Updated FSAR?"

Basis for the "Yes," response:

The proposed change would result in a malfunction of an SSC important to safety with a different result than any previously evaluated in the plant FSAR, because any of the 4 reactor trip inputs would no longer generate a partial reactor trip in one SSPS train, and a reactor trip if any of those inputs were received in both SSPS trains.

Additionally, WCAP-7488-L/WCAP-7672 discusses the NRC-approved SSPS design, which discusses that any of those 4 inputs would result in a partial reactor trip in one SSPS train, and a reactor trip if and of those inputs were received in both SSPS trains.

It should be noted that the loss of both 15vdc or 48vdc power supplies in one SSPS train will initiate a reactor trip. This design feature is not affected by the modification to the GWA circuitry.

PWROG-17018 contains the justification for eliminating the SSPS GW alarm partial reactor trip input function associated with any of the 4 conditions discussed above and relocated those for input functions to a non-urgent alarm on the MCB.

After the NRC issues the Final Safety Evaluation for PWROG-17018, and the NRC approved Topical Report (TR) is accepted by the NRC, the NRC approved TR will be referenced in the UFSAR, in addition to WCAP-7672, "Solid State Logic Protection System Description," the Non-Proprietary version and/or the Proprietary version of that WCAP, i.e., WCAP-7488-L, as part of the UFSAR change that deletes the 4 conditions discussed above, that result in a partial reactor trip in one SSPS train.

4

*** This record was final approved on 6/28/2018 9:10:33 AM. (This statement was added by the PRIME system upon its validation)

While the 50.59 Screen/Evaluation has not been prepared, the response to Question 1 in the 50.59 Screen discussed above, may be "No" based on the NRC approved TR, or if the response to the UFSAR change in the 50.59 Screen is "Yes" i.e., is Screened in, the response to Question 6 in the 50.59 Evaluation would "No" based on the NRC approved TR.

5

*** This record was final approved on 6/28/2018 9:10:33 AM. (This statement was added by the PRIME system upon its validation)

*** This record was final approved on 8/18/2020 6:13:07 PM. (This statement was added by the PRIME system upon its validation)

From: Drake, Jason <Jason.Drake@nrc.gov>
Sent: Monday, August 19, 2019 2:09 PM
To: Holderbaum, Chad M. <holdercm@westinghouse.com>; Andrachek, James D <andracjd@westinghouse.com>
Cc: Morey, Dennis <Dennis.Morey@nrc.gov>
Subject: RE: For Review: Second Round RAIs for SSPS Topical Report PWROG-17018
Importance: High

[External Email]
Gents,

My management would like an update on the RAI review and responses. Based upon the 7/25 clarification call, your next actions were to submit the formal responses and identify scheduling options to hold a public meeting. Can you please provide me with targets for both?

Thanks,
Jason

From: Drake, Jason
Sent: Wednesday, June 19, 2019 3:00 PM
To: Holderbaum, Chad M. <holdercm@westinghouse.com>; Andrachek, James D <andracjd@westinghouse.com>
Cc: Morey, Dennis <Dennis.Morey@nrc.gov>
Subject: For Review: Second Round RAIs for SSPS Topical Report PWROG-17018
Importance: High

Chad,

By letter dated February 1, 2018 (ADAMS Accession No. ML18039A033), the Pressurized Water Reactor Owners Group (PWROG) requested review and approval of the subject topical report. The topical report proposes a modification that replaces 4 automatic partial (half) reactor trips with a Non-Urgent alarm. The topical presumes, but does not describe, that appropriate operator actions will be taken in the event of an alarm. The purpose of the modification is to eliminate possible sources of unnecessary reactor trips if one of a certain set half trip conditions already exist in the opposite train.

By letter dated March 13, 2018 (ADAMS Accession No. ML18057A080), the NRC accepted the topical report for review. By email from Mr. Brian Benney, NRG to Mr. Chad Holderbaum, PWR Owners Group dated April 2, 2018, the NRC requested additional information. By letter dated July 5, 2018 (ADAMS Accession No. ML18191B172), the PWROG responded to this request for additional information. The NRC staff has examined the response and has identified additional information (secure file link below) that is needed to complete its safety review under relevant regulations and implementing guidance for instrumentation and control safety.

https://usnrc.box.com/s/nkg9ludxdo07ewl5ffvp780gewbqilhb [usnrc.box.com]

The date of July 19, 2019 is requested for your response.

Please contact me with any questions.

Jason Drake
Project Manager
Licensing Processes Branch (PLPB)
Division of Licensing Projects
Office of Nuclear Reactor Regulation
Phone: (301) 415-8378
Location: O12-H20
Email: jason.drake@nrc.gov

NUCLEAR REGULATORY COMMISSION

SECOND REQUEST FOR ADDITIONAL INFORMATION

PWR OWNERS GROUP TOPICAL REPORT PWROG-17018-P/NP, REVISION 0,

"SOLID STATE PROTECTION SYSTEM GENERAL WARNING ALARM MODIFICATION."

By letter dated February 1, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18039A033), the Pressurized Water Reactor Owners Group (PWROG) requested review and approval of the subject topical report. The topical report proposes a modification that replaces 4 automatic partial (half) reactor trips with a Non-Urgent alarm. The topical presumes, but does not describe, that appropriate operator actions will be taken in the event of an alarm. The purpose of the modification is to eliminate possible sources of unnecessary reactor trips if one of a certain set half trip conditions already exist in the opposite train.

By letter dated March 13, 2018 (ADAMS Accession No. ML18057A080), the NRC accepted the topical report for review. By email from Mr. Brian Benney, NRG to Mr. Chad Holderbaum, PWR Owners Group dated April 2, 2018, the NRC requested additional information. By letter dated July 5, 2018 (ADAMS Accession No. ML18191B172), the PWROG responded to this request for additional information. The NRC staff has examined the response and has identified the enclosed additional information that is needed to complete its safety review under relevant regulations and implementing guidance for instrumentation and control safety.

Background

The NRC approval of a facility change on a generic basis through a topical report focuses on the acceptance criteria related to safety and compliance in the standard review plan. NRC has examined the previous response to the request for additional information and has identified the following additional information that is needed to complete its safety review under relevant instrumentation and control regulations and guidance.

The NRC is not evaluating whether implementation of the associated modification by each licensee will satisfy the requirements of 10 CFR 50.59(c)(2). Each licensee must consider its licensing basis in whole as provided in the final safety analysis report and plant specific configurations involving the SSPS in its 10 CFR 50.59 evaluation. More specifically 50.59(c)(2) states a licensee shall obtain a license amendment pursuant to Sec. 50.90 prior to implementing a proposed change if the change meets any of the eight criteria related to potential malfunctions, accidents, and methods established within (c)(2).

Therefore, the safety evaluation of the topical report cannot generically preapprove an outcome of each licensee's evaluation against specific 10 CFR 50.59 criteria. The safety evaluation of this topical report will only address only the generic safety issues associated with making the proposed change. These generic technical findings may be referenced in site-specific 50.59 evaluations, to the extent that NRC approves the specific design configurations and operations in the TR as an acceptable way of generically meeting regulatory requirements.

Second Request for Additional Information

(1) The original, NRC topical report on the SSPS system (i.e., WCAP-7488-L, "Solid State Logic Protection System Description" - Proprietary) identified that removing a logic card from a division of the SSPS (when the other division is inoperable due to certain specific conditions) was a malfunction explicitly considered and was addressed by implementing an automatic reactor trip if this malfunction occurred (i.e., per GDC 23, fail safe when disconnected).

The proposed change appears to remove the "fail safe" behavior of the SSPS when a portion of the system is disconnected.

(a) Clarify if the proposed change permanently substitutes a manual action for automatic action for performing a UFSAR-described design function.

(b) Please describe any new actions and compare the reliability of these actions to the reliability of current "fail safe" feature.

(2) The topical report allows several possible Non-Urgent Alarm main control board annunciator window configurations. The topical report states:

> "The design for the MCB annunciator can be implemented via the use of a separate annunciator window, or to parallel the signal with an existing annunciator window."

Please describe the annunciator window configuration that will be implemented with the proposed modification and the basis for the configuration chosen.

This information is needed to understand how the proposed change will continue to meet GDC 23 for licensees referencing the topical.

(3) For each main control board annunciator window configuration, please provide a list of all possible system states as a result of SSPS alarm combinations (e.g.: SSPS GW-x, Non-Urgent-x, SSPS GW-x & Non-Urgent-x, SSPS GW-x Non-Urgent-y, Non-Urgent-x Non-Urgent-y…). It appears that possible states could include (assuming one SSPS General Warning Alarm per train, One Non-Urgent Alarm per train, and two trains of SSPS):

(a) Initial Condition: Both Trains Operable

(1) SSPS General Warning Alarm in one train

(2) SSPS Non-Urgent Alarm in one train

(b) Initial Condition: One Train Inoperable

(1) SSPS General Warning Alarm in Inoperable train

(2) SSPS Non-Urgent Alarm in Inoperable train

(3) SSPS General Warning Alarm in the operable train

(4) SSPS Non-Urgent Alarm in the operable train

This information is needed to understand how the proposed change will continue to meet GDC 23 for licensees referencing the topical.

(4) The proposed change removes the "fail safe" behavior of the SSPS when a portion of the system is disconnected but does not adequately define the basis for why this is acceptable. By letter dated July 5, 2018 (ADAMS Accession No. ML18191B172), the PWROG responded to this request for additional information in Question No. 1 by stating:

> "administrative controls are in place that prevent testing or maintenance to be performed on both SSPS trains at the same time. These administrative controls address the potential of two inoperable SSPS trains due to a pulled ULB, SGD, or UVD card in rows 2 - 5. These cards would be inserted in the card frame and could only be removed during maintenance or testing activities in the SSPS train."

In addition, the response, to Question No. 1, also stated:

> "Administrative controls will be implemented after the non-urgent alarm modification is installed and will require inspecting the card edge LEDs in the affected SSPS train(s) when a non-urgent alarm exists on the MCB to confirm that no ULB, SGD, or UVD has been pulled and that the non-urgent alarm is not associated with a card selftest alarm (E 10) or Watchdog Error (WOE). The inspection of the card edge LED is required, as an initial response to the non-urgent alarm, because the non-urgent alarm is not reflashed."

The response implies that current existing administrative controls for each licensee using the SSPS card are adequate for preventing a card from being removed from the only operable train of SSPS. However, no details were provided on the administrative controls.

(a) If administrative controls are the only means to eliminate the possibility of pulling a card in another division when the first division is inoperable, then please describe these administrative controls in detail and how the new configurations and administrative controls continue to meet GDC 23.

(b) Please confirm that the three conditions in the response to Question No. 1 are the only conditions, that can cause a Non-Urgent alarm, and cause that train of the SSPS to be inoperable.

(c) As proposed, the modification could result in a Non-Urgent Alarm for conditions where there is a loss of protective function in a safety division. Please provide a complete list of each condition that will result in an Non-Urgent Alarm, indicate whether this condition is a loss of function for a single division (or would otherwise make that train of the SSPS be considered inoperable), and describe how the licensee will determine which specific condition(s) resulted in the Non-Urgent Alarm.

(d) Please describe the administrative controls or procedures for when:

(1) testing or maintenance is being performed in one division (or that division is otherwise inoperable),
(2) a Non-Urgent alarm occurs in the other division, and
(3) when that other division is determined to be inoperable.

(e) Since, "the non-urgent alarm is not reflashed," please describe the administrative controls or procedures for identifying/addressing additional emergent conditions.

This information is needed to understand how the proposed change will continue to meet GDC 23 for licensees referencing the topical.

3

(5) The proposed modification will involve new or modified operator actions to perform a design function currently performed by SSPS card. For each proposed Non-Urgent Alarm main control board annunciator window configuration, please describe:

(a) the new or modified operator action(s)

(b) how the action(s) (including required completion time) will be reflected in plant procedures and operator training programs.

(c) how the licensee will demonstrate that the action(s) can be completed in the time required (i.e., assure the actions are feasible and reliable) considering the aggregate affects, such as workload or environmental conditions, expected to exist when the action is required.

(d) the consequence of failure to perform each action (i.e., credible errors in performance of manual actions)

(e) how the evaluation of the change at each NPP will consider the ability to recover from credible errors in performance of manual actions and the expected time required to make such a recovery

This information is needed to understand how the proposed change will continue to meet GDC 23 for licensees referencing the topical.

4

PWROG
PWR Owners Group

Program Management Office
1000 Westinghouse Drive, Suite 172
Cranberry Township, Pennsylvania 16066

WCAP-17018-P/NP, Revision 0
Docket Number 99902037
Project 694

March 13, 2020

OG-20-85

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: PWR Owners Group
Transmittal of the Response to the Second NRC Request for Additional Information for WCAP-17018-P/NP, Revision 0, "Solid State Protection System General Warning Alarm Modification." (PA-LSC-1366)

References:

1. Letter Submittal of PWROG-17018-P/NP, "Solid State Protection System General Warning Alarm Modification," PA-LSC-1366 dated February 1, 2018 (ADAMS Accession No. ML18039A033)
2. NRC Acceptance for Review of the Pressurized Water Reactor Owners Group Topical Report PWROG-17018-P/NP, "Solid State Protection System General Warning Alarm Modification," dated March 13, 2018 (ADAMS Accession No. ML18057A080)
3. Request for Additional Information Email from Mr. Brian Benney, NRC to Mr. Chad Holderbaum, PWR Owners Group dated April 2, 2018
4. OG-18-162, Transmittal of the Response to NRC Request for Additional Information Email for WCAP-17018-P/NP, Revision 0, "Solid State Protection System General Warning Alarm Modification", dated July 5, 2018 (ADAMS Accession No. ML18191B172)
5. Second NRC Request for Additional Information Email from Mr. Jason Drake, NRC to Mr. Chad Holderbaum, PWR Owners Group dated August 19, 2019

On February 1, 2018, in accordance with the Nuclear Regulatory Commission (NRC) Topical Report (TR) program for review and acceptance, the Pressurized Water Reactor Owners Group (PWROG) requested formal NRC review and approval of PWROG-17018-P/NP, Revision 0, "Solid State Protection System General Warning Alarm Modification" for referencing in regulatory actions (Reference 1).

The NRC Staff accepted the Topical Report for review on March 13, 2018 (Reference 2).

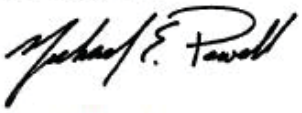
The PWROG was notified on April 2, 2018 of the NRC staff's determination that additional information was necessary to complete the review (Reference 3). On July 5, 2018 the PWROG provided a response (Reference 4).

The PWROG was notified on August 19, 2019 of the NRC staff's second request that additional information was necessary to complete the review (Reference 5).

Enclosure 1 to this letter responses to the NRC's Second Request for Additional Information (RAIs) on PWROG-17018-P/NP, "Solid State Protection System General Warning Alarm Modification" (Reference 5). The enclosure also contains the revisions to PWROG-17018-NP, Revision 0, that are associated with the RAI responses. Please note that revisions were only provided for the non-proprietary version of PWROG-17018, Revision 0, because the text that was revised does not contain any proprietary information. The NRC approved version of the proprietary version of PWROG-17018, Revision 0 that will be issued after the NRC issues the Final Safety Evaluation will also include these revisions.

If you have any questions, please do not hesitate to contact me at (602) 999-2080 or Mr. W. Anthony Nowinowski, Executive Director of the PWR Owners Group, Program Management Office at (412) 374-6855.

Sincerely yours,



Michael Powell
Chairman and COO
PWR Owners Group

Enclosure: Responses to Second Round of NRC RAIs on PWROG-17018-P / PWROG-17018-NP (Non-Proprietary)

cc: PWROG Steering and Management Committee
PWROG Licensing Committee
PWROG I&C Working Group
PWROG PMO
L. Fields, US NRC
N. Carte, US NRC
J. Andrachek, WEC
J. Moorehead, WEC

Electronically Approved Records are Authenticated in the Electronic Document Management System

ATTACHMENT 1

Response to the NRC's Second Request for Additional Information on PWR Owners Group Topical Report PWROG-17018-P/NP, Revision 0, "Solid State Protection System General Warning Alarm Modification." (Non-Proprietary)

NUCLEAR REGULATORY COMMISSION

SECOND REQUEST FOR ADDITIONAL INFORMATION

PWR OWNERS GROUP TOPICAL REPORT PWROG-17018-P/NP, REVISION 0,

"SOLID STATE PROTECTION SYSTEM GENERAL WARNING ALARM MODIFICATION."

By letter dated February 1, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18039A033), the Pressurized Water Reactor Owners Group (PWROG) requested review and approval of the subject topical report. The topical report proposes a modification that replaces 4 automatic partial (half) reactor trips with a Non-Urgent alarm. The topical presumes, but does not describe, that appropriate operator actions will be taken in the event of an alarm. The purpose of the modification is to eliminate possible sources of unnecessary reactor trips if one of a certain set half trip conditions already exist in the opposite train.

By letter dated March 13, 2018 (ADAMS Accession No. ML18057A080), the NRC accepted the topical report for review. By email from Mr. Brian Benney, NRG to Mr. Chad Holderbaum, PWR Owners Group dated April 2, 2018, the NRC requested additional information. By letter dated July 5, 2018 (ADAMS Accession No. ML18191B172), the PWROG responded to this request for additional information. The NRC staff has examined the response and has identified the enclosed additional information that is needed to complete its safety review under relevant regulations and implementing guidance for instrumentation and control safety.

Background

The NRC approval of a facility change on a generic basis through a topical report focuses on the acceptance criteria related to safety and compliance in the standard review plan. NRC has examined the previous response to the request for additional information and has identified the following additional information that is needed to complete its safety review under relevant instrumentation and control regulations and guidance.

The NRC is not evaluating whether implementation of the associated modification by each licensee will satisfy the requirements of 10 CFR 50.59(c)(2). Each licensee must consider its licensing basis in whole as provided in the final safety analysis report and plant specific configurations involving the SSPS in its 10 CFR 50.59 evaluation. More specifically 50.59(c)(2) states a licensee shall obtain a license amendment pursuant to Sec. 50.90 prior to implementing a proposed change if the change meets any of the eight criteria related to potential malfunctions, accidents, and methods established within (c)(2).

Therefore, the safety evaluation of the topical report cannot generically preapprove an outcome of each licensee's evaluation against specific 10 CFR 50.59 criteria. The safety evaluation of this topical report will only address only the generic safety issues associated with making the proposed change. These generic technical findings may be referenced in site-specific 50.59 evaluations, to the extent that NRC approves the specific design configurations and operations in the TR as an acceptable way of generically meeting regulatory requirements.

Second Request for Additional Information

(1) The original, NRC topical report on the SSPS system (i.e., WCAP-7488-L, "Solid State Logic Protection System Description" - Proprietary) identified that removing a logic card from a division of the SSPS (when the other division is inoperable due to certain specific conditions) was a malfunction explicitly considered and was addressed by implementing an automatic reactor trip if this malfunction occurred (i.e., per GDC 23, fail safe when disconnected).

The proposed change appears to remove the "fail safe" behavior of the SSPS when a portion of the system is disconnected.

(a) Clarify if the proposed change permanently substitutes a manual action for automatic action for performing a UFSAR-described design function.

Response to RAI (1) (a):

The general warning alarm (GWA) is a subsystem, which provides a monitoring function of the SSPS trains. The general warning circuits are actuated if an undesirable SSPS train condition occurs due to the improper alignment due to testing, a circuit malfunction, or a failure. A general warning condition is indicated on a separate annunciator window for each SSPS train on the Main Control Board (MCB), and results in a partially tripped state for the affected SSPS train. If a general warning exists in both SSPS trains, a reactor trip will occur.

The GWA circuitry is not credited for initiating a protective function, and is therefore not contained in the Technical Specifications, rather the partial reactor trip in one SSPS train associated with the input conditions to the GWA, e.g., the pulled card interlock, was the approach used to meet GDC 23.

The operator response to the current GWA annunciator on the MCB is addressed in an Alarm Response Procedure (ARP). If a GWA annunciator window is illuminated, the affected SSPS train would be declared inoperable, and the applicable Technical Specification Condition(s) and Required Action(s) would be entered, and the Required Action(s) followed in the associated Completion Time(s). The cause of the GWA would be investigated to determine if the affected SSPS train is inoperable.

If the affected SSPS train is determined to be inoperable, and not restored to Operable status within the associated Completion Time, the unit would be shutdown, as required by the Technical Specifications. Note that the unit shutdown would be a controlled shutdown, as allowed by the Technical Specifications, and not an automatic reactor trip.

If the affected SSPS train is determined to not be inoperable, the applicable Technical Specification Condition(s) would be exited.

After the general warning alarm circuit modification (GWACM) is implemented, the following four inputs will be moved to a separate, new non-urgent alarm annunciator window on the MCB, and will not result in a partially tripped condition in the affected SSPS train.

1) The loss of one 15 VDC power supply
2) The loss of one 48 VDC power supply
3) The multiplexer test switch in the "Inhibit" position

4) The pulled card (Rows 2-5) interlock

The purpose of the GWACM is to reduce the potential for an unnecessary reactor trip and the associated plant transient, while still providing an indication of a potential SSPS train inoperability.

The benefit of a controlled shutdown, as opposed to an automatic reactor trip is discussed in the Bases for LCO 3.0.3 in NUREG-1431, Revision 4, Volume 2 which states:

"The time limits specified to reach lower MODES of operation permit the shutdown to proceed in a controlled and orderly manner that is well within the specified maximum cooldown rate and within the capabilities of the unit, assuming that only the minimum required equipment is OPERABLE. This reduces thermal stresses on components of the Reactor Coolant System and the potential for a plant upset that could challenge safety systems under conditions to which this Specification applies."

The key points in this discussion are that a shutdown in accordance with LCO 3.0.3 allows a shutdown to proceed in a controlled and orderly manner, which reduces thermal stresses on components of the Reactor Coolant System and the potential for a plant upset that could challenge safety systems.

The SSPS GWA provides an indication that there is something wrong with the SSPS; the GWA is not an indication of degrading plant conditions. With no imminent challenge to nuclear safety, it is preferable to perform a controlled shutdown in accordance with LCO 3.0.3 because the operators can assess plant conditions and stop work in progress or restore equipment to service, as necessary, to support the shutdown. If the reactor automatically trips, current plant conditions could complicate plant stabilization.

The new non-urgent alarm annunciator window on the MCB will be capable of identifying if any of the above (4) conditions occurs in either SSPS train. A new ARP will be prepared and implemented to respond to the new non-urgent alarm.

If a non-urgent alarm annunciator window on the MCB is illuminated, the affected SSPS train would be declared inoperable, and the applicable Technical Specification Condition(s) and Required Action(s) would be entered, and the Required Action(s) followed in the associated Completion Time(s). The cause of the non-urgent alarm would be investigated to determine if the affected SSPS train is inoperable.

If the affected SSPS train is determined to be inoperable, and not restored to Operable status within the associated Completion Time, the unit would be shutdown, as required by the Technical Specifications. Note that the shutdown would be a controlled shutdown, as allowed by the Technical Specifications, and not an automatic reactor trip.

If the affected SSPS train is determined to not be inoperable, the applicable Technical Specification Condition(s) would be exited.

If a non-urgent alarm is received in both SSPS trains, the new ARP would be followed, both SSPS trains would be declared inoperable, and a unit shutdown would be initiated, as required by the Technical Specifications. Note that the unit shutdown would be a controlled shutdown, as allowed by the Technical Specifications, and not an automatic reactor trip.

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Therefore, the GWACM utilizes a manual action to perform a unit shutdown, i.e., for performing an UFSAR-described design function, the new non-urgent alarm, new ARP, and Technical Specifications continue to satisfy GDC 23, when a portion of the system is disconnected, as discussed below.

Criterion 23—Protection system failure modes. The protection system shall be designed to fail into a safe state **or into a state demonstrated to be acceptable on some other defined basis** if conditions such as disconnection of the system, loss of energy (e.g., electric power, instrument air), or postulated adverse environments (e.g., extreme heat or cold, fire, pressure, steam, water, and radiation) are experienced.

(b) Please describe any new actions and compare the reliability of these actions to the reliability of current "fail safe" feature.

Response to RAI (1) (b):

With respect to GDC 23, the protection system is designed to provide two, three, or four instrumentation channels for each protective function and two logic train circuits. The redundant channels and trains are electrically isolated and physically separated. Therefore, any single failure within a channel or train will not prevent protective action at the system level, when required. A loss of input power to a channel or logic train, which is the most likely failure mode, will result in a reactor trip signal. This design meets the requirements of GDC 23.

The reactor trip discussion above regarding GDC 23, is also applicable to the engineered safety feature actuation system (ESFAS), with exceptions, e.g., for containment spray.

The proposed GWACM does not affect the redundant SSPS power supplies (15VDC and 48VDC), functional diversity, or physical separation. After implementation of the GWACM, a loss of both 48 VDC supplies will still result in a reactor trip from the affected train, and loss of both 15 VDC supplies or if the 15 VDC bus drops below 12.7 VDC will also result in a reactor trip from the affected train.

WCAP-7706 Section 3.4.4 discussed the inclusion of safe failure modes in the SSPS design to address common-mode failure, in particular, for the reactor trip logic to function upon loss of power. Also, as discussed in WCAP-7488-L, if trouble developed in both trains simultaneously, the GWA would automatically trip the reactor. The conditions (inputs being relocated to the new non-urgent alarm) that currently result in a GWA, include conditions that impact the Operability of the SSPS and conditions that do not impact the Operability of the SSPS, as discussed in PWROG-17018.

The "fail safe" aspects of the SSPS are not impacted by the GWACM because the redundant power supplies are not impacted. The conditions that initiate the "fail safe" response of the SSPS when a portion of the system is disconnected associated with the redundant power supplies are not being changed.

Section 4.1 of PWROG-17018 discusses all of the inputs to the non-urgent alarm. The loss of one 15 VDC power supply, loss of one 48 VDC power supply, and the multiplexer test switch in the "Inhibit" position do not result in the SSPS train being inoperable.

WCAP-17867-P-A, Revision 1, "Westinghouse SSPS Board Replacement Licensing Summary Report," states the following regarding compliance with GDC 23:

"*The protection system is designed with consideration of the most probable failure mode, which, in the case of the SSPS boards, the system is to not initiate any ESF protective action on loss of power, and is to generate a reactor trip function on loss of power. The SSPS, because of the design of the UVD, will initiate a reactor trip upon loss of power. Further, the SSPS, by virtue of the design of the SGD, will not initiate any ESFAS upon loss of power.*"

The operator actions associated with the current GWA annunciator are addressed in an ARP, and the operator response to the new non-urgent alarm annunciator will be addressed in a new ARP, as discussed in the response to RAI (1) (a) above. After the GWACM is implemented and a non-urgent alarm is received in one SSPS train, the affected SSPS train would be declared inoperable, the cause of the non-urgent alarm would be investigated to determine if the SSPS train is inoperable. If the SSPS train is determined to be inoperable, it would be restored to Operable status or a unit shutdown initiated as required by the Technical Specifications.

If an SSPS train is declared inoperable due to the receipt of a non-urgent alarm, the applicable Technical Specification Condition(s) and Required Action(s) would be entered. If the cause of the SSPS inoperability is associated with a card self-test alarm (E10 self-test failure or Watchdog Error [WDE]) from a Universal Logic Board (ULB), Safeguards Driver Board (SGD), or Under Voltage Driver Board (UVD) printed circuit board (PCB), corrective maintenance would be performed to replace the affected PCB.

The GWACM does not increase the likelihood of a pulled card (PCB) occurring simultaneously in both SSPS trains. Plant procedures define "Protected" SSPS train administrative controls that prevent any concurrent activities which could result in an SSPS PCB being pulled from the card frames in both SSPS trains. Therefore, the GWACM does not decrease the overall SSPS reliability.

If both SSPS trains are inoperable due to the receipt of a non-urgent alarm in both SSPS trains, the new ARP would be followed, and a unit shutdown would be initiated as required by the Technical Specifications, as discussed in the response to RAI (1) (a) above. The operator actions in response to the new non-urgent alarm, associated ARP, and Technical Specifications would be consistent with the actions in current ARPs that are associated with the Technical Specifications.

The current administrative controls, new ARP, and associated response to the new non-urgent alarm, decrease the likelihood of a pulled card in both trains, and therefore decreases the likelihood of a malfunction. The self-diagnostic capability of the ULB, SGD, and UVD PCBs provides prompt identification via the new non-urgent alarm, to identify a potential SSPS train degradation or inoperability, as opposed to the condition being identified during the next surveillance, which increases the reliability of the system. The new ARP to address the response to the new non-urgent alarm will provide prompt response to address malfunctions or potentially degraded conditions, thus improving the overall reliability of the system. It should be noted that a pulled card does not impact the loss of one 15 VDC power supply, loss of one 48 VDC power supply, or the multiplexer test switch in the "Inhibit" position inputs to the new non-urgent alarm.

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As discussed in the response to RAI (1) (a) above, the new non-urgent alarm, new ARP, and Technical Specifications continue to satisfy GDC 23, when a portion of the system is disconnected, i.e., **into a state demonstrated to be acceptable on some other defined basis.**

(2) The topical report allows several possible Non-Urgent Alarm main control board annunciator window configurations. The topical report states:

> "The design for the MCB annunciator can be implemented via the use of a separate annunciator window, or to parallel the signal with an existing annunciator window."

Please describe the annunciator window configuration that will be implemented with the proposed modification and the basis for the configuration chosen.

This information is needed to understand how the proposed change will continue to meet GDC 23 for licensees referencing the topical.

Response to RAI (2):

The non-urgent alarm inputs discussed in the response to RAI (1) (a) and (1) (b) above, will be moved from the current SSPS Train A and Train B GWA annunciator windows, to a separate, new non-urgent alarm annunciator window. The new non-urgent alarm annunciator window will be capable of identifying the non-urgent alarm conditions in either SSPS train.

The following Sections of PWROG-17018 will be revised to state that there will be a separate, new non-urgent alarm annunciator window, and that it will be capable of identifying the non-urgent alarm conditions in either SSPS train.

- Section 1.1: "*or a shared alarm window*" will be deleted as shown in the attached PWROG-17018 markup pages.
- Section 4.2: "*or shared with*" will be deleted, as well as the following text as shown in the attached PWROG-17018 markup pages:

  "*However, the existing MCB alarm windows can be configured to indicate on both the GW alarm and the non-urgent alarm. This minimizes the impact on the MCB alarm panel configuration.*"

  "*A shared non-urgent alarm indication is currently implemented at another plant for the loss of SSPS output relay AC power. Therefore, both shared and separate MCB alarm panel configurations are currently implemented for SSPS alarm indications.*"
- Section 4.3: "*For a shared MCB alarm window, the SSPS GW alarm and non-urgent alarm circuit inputs share common outputs, and any subsequent input condition is not alarmed, consistent with the current GW alarm (no reflash).*" will be deleted as shown in the attached PWROG-17018 markup pages.
- Section 5.3 will be revised to: "*The design for the MCB annunciator ~~can~~ will be implemented via the use of a separate annunciator window~~, or to parallel the signal with an existing annunciator window~~.*" as shown in the attached PWROG-17018 markup pages.

- Section 10: "*or a shared with a GW alarm window*" will be deleted, and the following text will be inserted, as shown in the attached PWROG-17018 markup pages:

  "*The separate annunciator window configuration for the GWACM will provide an indication on the MCB of the status of the SSPS train. The operator response to the annunciator will be in accordance with the new ARP. The new annunciator window will have the capability to identify a non-urgent alarm condition in each SSPS train.*"

(3) For each main control board annunciator window configuration, please provide a list of all possible system states as a result of SSPS alarm combinations (e.g.: SSPS GW-x, Non-Urgent-x, SSPS GW-x & Non-Urgent-x, SSPS GW-x Non-Urgent-y, Non-Urgent-x Non-Urgent-y…). It appears that possible states could include (assuming one SSPS General Warning Alarm per train, One Non-Urgent Alarm per train, and two trains of SSPS):

(a) Initial Condition: Both Trains Operable

(1) SSPS General Warning Alarm in one train

(2) SSPS Non-Urgent Alarm in one train

(b) Initial Condition: One Train Inoperable

(1) SSPS General Warning Alarm in Inoperable train

(2) SSPS Non-Urgent Alarm in Inoperable train

(3) SSPS General Warning Alarm in the operable train

(4) SSPS Non-Urgent Alarm in the operable train

This information is needed to understand how the proposed change will continue to meet GDC 23 for licensees referencing the topical.

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Response to RAI (3):

Initial Condition	SSPS Impact[1]
(a) Both SSPS Trains Operable (1) SSPS General Warning Alarm in one SSPS train	The other SSPS train remains Operable, and restore the inoperable SSPS train to Operable status
(a) Both SSPS Trains Operable (2) SSPS Non-Urgent Alarm in one SSPS train	The other SSPS train remains Operable, and restore the inoperable SSPS train to Operable status
(b) One SSPS Train Inoperable (1) SSPS General Warning Alarm in the Inoperable train	The other SSPS train remains Operable, and restore the inoperable SSPS train to Operable status
(b) One SSPS Train Inoperable (2) SSPS Non-Urgent Alarm in the Inoperable train	The other SSPS train remains Operable, and restore the inoperable SSPS train to Operable status
(b) One SSPS Train Inoperable (3) SSPS General Warning Alarm in the Operable SSPS train	Both SSPS trains are inoperable, enter TS LCO 3.0.3 and initiate a unit shutdown[2]
(b) One SSPS Train Inoperable (4) SSPS Non-Urgent Alarm in the Operable SSPS train	Both SSPS trains are inoperable, enter TS LCO 3.0.3 and initiate a unit shutdown

(1) After receipt of a GW or non-urgent alarm, the affected SSPS train will be declared inoperable, and the applicable Technical Specifications Condition(s) and Required Action(s) will be entered. The condition will be investigated to determine if the affected SSPS train is inoperable. If the affected SSPS train is determined to be inoperable, actions will be taken to restore the SSPS train to Operable status.

(2) If the SSPS train is inoperable due to a GWA, and a GWA occurred in the other SSPS train, a reactor trip would occur.

(4) The proposed change removes the "fail safe" behavior of the SSPS when a portion of the system is disconnected but does not adequately define the basis for why this is acceptable. By letter dated July 5, 2018 (ADAMS Accession No. ML18191B172), the PWROG responded to this request for additional information in Question No. 1 by stating:

> "administrative controls are in place that prevent testing or maintenance to be performed on both SSPS trains at the same time. These administrative controls address the potential of two inoperable SSPS trains due to a pulled ULB, SGD, or UVD card in rows 2 - 5. These cards would be inserted in the card frame and could only be removed during maintenance or testing activities in the SSPS train."

In addition, the response, to Question No. 1, also stated:

> "Administrative controls will be implemented after the non-urgent alarm modification is installed and will require inspecting the card edge LEDs in the affected SSPS train(s) when a non-urgent alarm exists on the MCB to confirm that no ULB, SGD, or UVD has

been pulled and that the non-urgent alarm is not associated with a card selftest alarm (E 10) or Watchdog Error (WDE). The inspection of the card edge LED is required, as an initial response to the non-urgent alarm, because the non-urgent alarm is not reflashed."

The response implies that current existing administrative controls for each licensee using the SSPS card are adequate for preventing a card from being removed from the only operable train of SSPS. However, no details were provided on the administrative controls.

(a) If administrative controls are the only means to eliminate the possibility of pulling a card in another division when the first division is inoperable, then please describe these administrative controls in detail and how the new configurations and administrative controls continue to meet GDC 23.

Response to RAI (4) (a):

When testing and maintenance activities are performed on an SSPS train, the Operator or I&C technician would confirm that all SSPS PCBs are fully inserted into the card cage by confirming that card status LEDs are consistent with existing plant conditions prior to completing the activity (i.e., that no red LEDs and the green power status LEDs are illuminated and the green "OK" LED is flashing (note that a green "OK" LED is not applicable to the Isolation PCB). This confirmation would be required to be performed procedurally.

Even if the SSPS cabinet door was closed, and an SSPS PCB(s) was not fully inserted into its card cage, the new non-urgent alarm would identify it, and the operators would respond to the alarm consistent with the new ARP for the new non-urgent alarm. The other "Protected," SSPS train would still be Operable, and there would be no loss of safety function in the "Protected," SSPS train.

A new and separate non-urgent alarm will be added as part of the GWACM, and procedures will be revised to verify that no non-urgent alarm exists in the opposite SSPS train, prior to performing any testing or maintenance activities on an SSPS train (e.g., a procedure to confirm that no SSPS general warning/non-urgent alarm exists prior to performing testing or maintenance on an SSPS train). Please note that the capability to identify to the operator that a card self-test error has occurred does not currently exist, since there is no non-urgent alarm for this condition in any SSPS train. The card self-test error signals will be used in conjunction with the pulled card interlock signals for this non-urgent alarm input, which requires the removal of the pulled card interlock signals from the current GW circuit. An ARP for the SSPS train's non-urgent alarm annunciator window will be implemented and will contain actions to determine the impact on the Operability of the affected SSPS train and to determine the cause of the non-urgent alarm.

It should be noted that during Surveillance testing at some plants, e.g., during the performance of a Channel Operational Test (COT), Channel Calibration or Trip Actuating Device Operational Test (TADOT), some plants may place the Multiplexer Test Switch in the A+B mode to ensure that the channel that is being tested goes into a tripped condition (the A+B mode of operation with a mismatch between SSPS trains would cause a flashing status panel lamp in both SSPS trains).

This activity, i.e., the Multiplexer Test Switch in the A+B mode is limited to a switch manipulation and verification in the SSPS cabinet which is not a "test or maintenance"

activity within the SSPS cabinet that would result in an SSPS PCB that would be pulled in both SSPS trains.

The SSPS TADOTs are also performed under "Protected," SSPS train provisions. However, the Surveillance procedures require access to both SSPS trains for verifications and switch manipulations to ensure that no GWA or non-urgent alarms (after the GWACM is implemented) exist. These "Protected," SSPS train administrative controls would prevent any concurrent activities which could result in an SSPS PCB being pulled from the card frames in both SSPS trains. Therefore, the manipulation of a pre-engineered test switch (i.e., the Multiplexer Test Switch in the A+B mode) in support of the TADOT test activity is also not associated with a test or maintenance activity that would result in an SSPS PCB that would be pulled in both SSPS trains.

During the performance of maintenance or Surveillance testing (COTs, Channel Calibrations, and TADOTs) discussed above, the "Protected" SSPS train remains Operable.

As discussed in the response to RAIs (1) (a) and (1) (b) above, the new non-urgent alarm, new ARP, and Technical Specifications continue to satisfy GDC 23, when a portion of the system is disconnected, i.e., **into a state demonstrated to be acceptable on some other defined basis.**

The following Sections of PWROG-17018 will be revised to discuss the new ARP for the operator response to the new non-urgent alarm:

- Section 1.1, the following text will be revised as shown in the attached PWROG-17018 markup pages, from:

  "*The non-urgent alarm will provide indications for conditions that do and do not involve a potential loss of safety function; therefore, the operator response to the new non-urgent alarm will be the same as the response to the current GW alarm.*"

  to:

  "*The non-urgent alarm will provide indications for conditions that do and do not involve a potential inoperability in the affected SSPS train; therefore, the operator response to the new non-urgent alarm will be in accordance with a new non-urgent alarm response procedure (ARP).*"

- Section 4.1, the following text will be revised as shown in the attached PWROG-17018 markup pages, from:

  "*The new non-urgent alarm would require operator action that is the same as the operator response to a GW alarm response.*"

  to:

  "*The operator response to the new non-urgent alarm will be in accordance with the new ARP.*"

- Section 4.2, the following text will be revised as shown in the attached PWROG-17018 markup pages, from:

  "*The operator response for the SSPS non-urgent alarm will be the same as the response to the current SSPS GW alarm response.*"

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to:

"*The operator response to the new non-urgent alarm will be in accordance with the new ARP.*"

- Section 7.2, the following text will be revised as shown in the attached PWROG-17018 markup pages, from:

  "*For the GWACM, all failures will be considered equal for the purpose of SSPS alarm response and diagnostics.*"

  to:

  "*The operator response to the new non-urgent alarm will be in accordance with the new ARP.*"

- Section 7.2, the following text will be revised as shown in the attached PWROG-17018 markup pages, from:

  "Therefore, the change in human-system interface from the GWACM would require a change to the SSPS alarm response procedure for operators to respond to an SSPS non-urgent alarm condition to determine if a loss of safety function has occurred in the affected SSPS train."

  to:

  "*The operator response to an SSPS non-urgent alarm condition will be in accordance with the new ARP to determine the impact on operability of the affected SSPS train.*"

- Table 7-2, the following additional changes will be made for clarity, as shown in the attached PWROG-17018 markup pages, from:

  "*Failure of the module (PCB), potential loss of safety function*"

  to:

  "*Failure of the module (PCB), potential inoperability of an RTS or ESFAS function*"

  and from:

  "*Capability to perform the safety function is maintained by the redundant train.*"

  to:

  "*Capability to perform an RTS or ESFAS actuation is maintained by the redundant SSPS train.*"

(b) Please confirm that the three conditions in the response to Question No. 1 are the only conditions, that can cause a Non-Urgent alarm, and cause that train of the SSPS to be inoperable.

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Response to RAI (4) (b):

If a non-urgent alarm is annunciated, the affected SSPS train will be declared inoperable, the applicable Technical Specification Condition(s) and Required Action(s) would be entered, and the cause of the non-urgent alarm will be investigated.

The GWACM will move the SSPS Rows 2-5 pulled card interlock (for the Universal Logic Board (ULB), Safeguards Driver Board (SGD), and Under Voltage Driver Board (UVD) PCBs) to the non-urgent alarm. A pulled card would result in the inoperability of the affected RTS or ESFAS function(s) in the affected SSPS train.

A pulled card in any SSPS row would be caused by physically removing or not fully re-inserting an SSPS PCB during testing or maintenance activities.

The following excerpt from PWROG response to RAI Question No.1 (ADAMS Accession No. ML18191B172) will be revised as shown below to state that in addition to the pulled card interlock input, the PCB self-test alarm input to the non-urgent alarm could indicate the potential inoperability of the affected RTS or ESFAS function(s) in the affected SSPS train.

> "*Section 7.2 of PWROG-17018-P discusses that the response to the non-urgent alarm will be the same as the response to the receipt of the current GW Alarm (which currently results in a partial trip condition). Aside from the non-urgent alarm associated with the pulled card interlock* ***and the PCB self-test alarm input****, the other non-urgent alarm inputs do not impact the Operability of the SSPS Train. Therefore, if a non-urgent alarm is initiated on the MCB, the following administrative controls will confirm the status of each SSPS train.*"

A PCB self-test alarm (due to either an E10 self-test failure or WDE), and a pulled card interlock would also result in a non-urgent alarm indicating the inoperability of the affected RTS or ESFAS function(s) in the affected SSPS train. Therefore, the affected SSPS train would be declared inoperable, the applicable Technical Specification Condition(s) and Required Action(s) would be entered, and the cause of the non-urgent alarm will be investigated.

Section 4.1 of PWROG-17018 discusses all of the inputs to the non-urgent alarm. The following non-urgent alarm inputs do not result in an inoperable SSPS train as discussed in the response to RAI (1) (b):

- Loss of a single +48V1 or +48V2 power supply
- Loss of a single +15V1 or +15V2 power supply
- Multiplexer Test Switch in the INHIBIT position

(c) As proposed, the modification could result in a Non-Urgent Alarm for conditions where there is a loss of protective function in a safety division. Please provide a complete list of each condition that will result in an Non-Urgent Alarm, indicate whether this condition is a loss of function for a single division (or would otherwise make that train of the SSPS be considered inoperable), and describe how the licensee will determine which specific condition(s) resulted in the Non-Urgent Alarm.

Response to RAI (4) (c):

As discussed in Section 4.1 of PWROG-17018, the following non-urgent alarm inputs will be implemented by the GWACM.

Loss of a single +48V1 or +48V2 power supply:

Each +48V power supply is redundant (+48V1 and +48V2), and the output is diode auctioneered, such that a loss of one power supply does not inhibit the SSPS train's ability to perform its Reactor Trip System (RTS) and Engineered Safety Feature Actuation System (ESFAS) functions. The SSPS train is Operable with a loss of power supply redundancy, and therefore, the RTS and ESFAS function(s) in the affected SSPS train are Operable.

- Section 4.1, the following text will be revised as shown in the attached PWROG-17018 markup pages, from:

  "The SSPS train is operable with loss of redundancy (Single Point Vulnerability [SPV] state), and therefore, there is no loss of safety function in the affected SSPS train."

  to:

  "The SSPS train is operable with loss of redundancy (Single Point Vulnerability [SPV] state), and therefore, there is no impact on the operability of any RTS or ESFAS function in the affected SSPS train."

Loss of a single +15V1 or +15V2 power supply:

Each +15V power supply is redundant (+15V1 and +15V2), and the output is diode auctioneered, such that a loss of one power supply does not inhibit the SSPS train's ability to perform its RTS and ESFAS functions. The SSPS train is Operable with a loss of power supply redundancy, and therefore, the RTS and ESFAS function in the affected SSPS train are Operable.

- Section 4.1, the following text will be revised as shown in the attached PWROG-17018 markup pages, from:

  "The SSPS train is operable with loss of redundancy (SPV state), and therefore, there is no loss of safety function of the affected SSPS train."

  to:

  "The SSPS train is operable with loss of redundancy (SPV state), and therefore, there is no impact on the operability of any RTS or ESFAS function in the affected SSPS train."

Multiplexer Test Switch in the INHIBIT position:

The multiplexer test switch is a three-position switch with the following three switch positions: "NORMAL," "INHIBIT," and "A+B." When the multiplexer test switch is in the "INHIBIT" position, multiplexing status information is blocked from the associated SSPS train by inhibiting data inputs, resulting in a loss of the SSPS train data to the MCB and plant computer. However, the loss of MCB and plant computer status indications do not impact

any RTS or ESFAS functions in the affected SSPS train. Additionally, the opposite SSPS train will continue to provide MCB and plant computer trip/logic status data when the multiplexer test switch is in the "INHIBIT" position.

- Section 4.1, the following text will be revised as shown in the attached PWROG-17018 markup pages, from:

  "*However, there is no loss of safety function in the affected SSPS train, since the opposite SSPS train will continue to provide MCB and plant computer trip/logic status data during this time.*"

  to:

  "*However, there is no impact on the operability of any RTS or ESFAS function in the affected SSPS train, only the MCB and plant computer indications in that SSPS train are affected. Additionally, the opposite SSPS train will continue to provide MCB and plant computer trip/logic status data when the Multiplexer Test Switch is in the INHIBIT position.*"

Pulled Card Interlock in Rows 2–5:

The SSPS ULB, SGD, and UVD PCBs are located in Rows 2–5. If it is determined that one of the SSPS ULB, SGD, or UVD PCBs were pulled or not fully inserted, the affected SSPS train's capability to provide an RTS or ESFAS actuation would be affected for a particular function or functions, depending on the PCB that was pulled or not fully inserted. The affected SSPS train would be declared inoperable and the applicable Technical Specification Condition(s) and Required Action(s) would be entered.

Section 2 of PWROG-17018 discusses the 4 times that a reactor trip has occurred due to a GWA in both SSPS trains. It should be noted that none of those reactor trips were caused by a pulled card in both SSPS trains.

New Design SSPS PCB Self-Test Alarm (WDE or an E10 self-test failure):

The SSPS ULB, SGD, and UVD PCBs have a self-test function that continuously tests the functions of the PCB's basic logic and output drivers. A self-test alarm indicates that an error that could prevent that SSPS train from providing an RTS or ESFAS actuation for a particular function or functions, depending on what PCB it is, has occurred. The affected SSPS train would be declared inoperable, and the applicable Technical Specification Condition(s) and Required Action(s) would be entered.

The remote indication of a PCB self-test alarm is not currently available, and the addition of the new non-urgent alarm enhances the reliability of the SSPS and improves plant safety by maximizing the SSPS availability via the new design SSPS ULB, SGD, and UVD PCBs that will alert the operator via an annunciator on the MCB, if an SSPS PCB fails a self-test. Currently, an SSPS PCB failed self-test would not be identified unless the SSPS cabinet door is opened for maintenance or Surveillance testing.

(d) Please describe the administrative controls or procedures for when:

(1) testing or maintenance is being performed in one division (or that division is otherwise inoperable),
(2) a Non-Urgent alarm occurs in the other division, and
(3) when that other division is determined to be inoperable.

This information is needed to understand how the proposed change will continue to meet GDC 23 for licensees referencing the topical.

Response to RAI (4) (d) (1) (2) and (3):

See the responses to RAIs (3) and (4) (a) for (d) (1) above.

See the response to RAI (3) for (d) (2) and (d) (3) above.

(e) Since, "the non-urgent alarm is not reflashed," please describe the administrative controls or procedures for identifying/addressing additional emergent conditions.

Response to RAI (4) (e):

After a non-urgent alarm is annunciated, the affected SSPS train will be declared Inoperable, the applicable Technical Specification Condition(s) and Required Action(s) would be entered, and the cause of the non-urgent alarm will be investigated according to the ARP. During the investigation of the initial non-urgent alarm, any potential additional emergent non-urgent conditions would be identified during the investigation of the initial non-urgent alarm condition.

(5) The proposed modification will involve new or modified operator actions to perform a design function currently performed by SSPS card. For each proposed Non-Urgent Alarm main control board annunciator window configuration, please describe:

(a) the new or modified operator action(s)

Response to RAI (5) (a):

See the responses to RAI (1) (a), (1) (b), (4) (a), and (4) (e).

(b) how the action(s) (including required completion time) will be reflected in plant procedures and operator training programs.

Response to RAI (5) (b):

See the responses to RAI (1) (a), (1) (b), (4) (a), and (4) (e) regarding the new ARP. The licensees will determine the applicable required operator training associated with the implementing the new ARP and GWACM.

(c) how the licensee will demonstrate that the action(s) can be completed in the time required (i.e., assure the actions are feasible and reliable) considering the aggregate affects, such as workload or environmental conditions, expected to exist when the action is required.

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Response to RAI (5) (c):

There are no manual actions associated with the response to a non-urgent alarm.

The affected SSPS train would declared inoperable, the applicable Technical Specification Condition(s) and Required Action(s) would be entered, and the cause of the non-urgent alarm investigated to determine whether it caused the affected SSPS train to be inoperable.

If the affected SSPS is confirmed to be inoperable, then the applicable Technical Specification Required Action(s) and associated Completion Time(s) must be followed, consistent with any other Technical Specification LCO that is not met.

(d) the consequence of failure to perform each action (i.e., credible errors in performance of manual actions)

Response to RAI (5) (d):

As discussed in the response to RAI (5) (c) above, there are no manual actions associated with the response to a non-urgent alarm, other than to investigate the cause of the non-urgent alarm.

If the SSPS is determined to be inoperable, the applicable Technical Specification Required Action(s) and associated Completion Time(s) must be complied with. A violation of the Technical Specifications would be reportable in accordance with 10CFR50.73.

(e) how the evaluation of the change at each NPP will consider the ability to recover from credible errors in performance of manual actions and the expected time required to make such a recovery

This information is needed to understand how the proposed change will continue to meet GDC 23 for licensees referencing the topical.

Response to RAI (5) (e):

As discussed in the responses to RAI (5) (c) and (d) above, there are no manual actions associated with the response to a non-urgent alarm, other than to investigate the cause of the non-urgent alarm.

If the affected SSPS train is confirmed to be inoperable, the applicable Technical Specification Required Action(s) and associated Completion Time(s) must be met, or the unit will be shutdown.

Please see the response to RAI (1) (a) with respect to meeting GDC 23.

ATTACHMENT 2

Revisions to PWROG-17018-NP, Revision 0

(Non-Proprietary)

1 INTRODUCTION AND PURPOSE

1.1 INTRODUCTION

This topical report (TR) was developed for the Pressurized Water Reactor Owners Group (PWROG) Licensing Committee and Instrumentation and Control Working Group (ICWG) to support implementation of Solid State Protection System (SSPS) reliability improvements by minimizing the potential of inadvertent plant reactor trips associated with the current SSPS General Warning (GW) alarm. The SSPS GW alarm generates a partial (half) reactor trip signal when an SSPS train is in the GW alarm condition, and inadvertent reactor trips have occurred due to simultaneous occurrence of a GW alarm in both SSPS trains. Implementation of the General Warning Alarm Circuitry Modification (GWACM) described in this TR would reduce the number of inputs that could lead to an inadvertent reactor trip. The inputs removed from the GW alarm would be moved to a new non-urgent alarm that does not cause a reactor trip signal in the affected SSPS train. The addition of a new non-urgent alarm enable the new design SSPS printed circuit board (PCB) self-test fu indication of a self-test alarm condition in the control room on the M

The non-urgent alarm will provide indications for conditions that do and do not involve a potential inoperability in the affected SSPS train; therefore, the operator response to the new non-urgent alarm will be in accordance with a new non-urgent alarm response procedure (ARP).

The GWACM involves removing the following inputs to the SSPS G

1) The loss of one 15 VDC power supply
2) The loss of one 48 VDC power supply
3) The multiplexer test switch selected to the "Inhibit" position
4) The pulled card (Rows 2-5) interlock

All of these GW alarm inputs will be moved to provide input to a new non-urgent alarm. The modification also enables the non-urgent alarm to indicate if a new design SSPS Universal Logic Board (ULB), Safeguards Driver (SGD), or Under Voltage Driver (UVD) PCB failed a self-test using the feature that continuously tests the functions of the PCB's basic logic and output drivers. The non-urgent alarm will interface with the MCB to indicate audibly and visually by using ~~either~~ a separate alarm window ~~or a shared alarm window for each SSPS train~~. It should also be emphasized that the term "non-urgent" was assigned to the new alarm, since it does not initiate a reactor trip input. ~~The non-urgent alarm will provide indications for conditions that do and do not involve a potential loss of safety function; therefore, the operator response to the new non-urgent alarm will be the same as the response to the current GW alarm~~.

The new annunciator window will have the capability to identify a non-urgent alarm condition in each SSPS train.

The GW alarm is not included in the plant Technical Specifications, and is not assume mitigate any accident in the plant safety analyses.

These circuitry changes will change the SSPS GW alarm design and licensing bases. SSPS GW alarm reactor trip function was installed as part of the SSPS design that wa approved by the United States (U.S.) Atomic Energy Commission (AEC) (Reference 1 system design basis is documented in WCAP-7672, "Solid State Logic Protection Sys Description" (Reference 2) and WCAP-7706, "An Evaluation of Solid State Logic Rea Protection in Anticipated Transients" (Reference 4). These TRs describe the inputs th a partial reactor trip signal in an SSPS train, including a loss of 15V and 48V power supplies, a pulled card (PCB), and the multiplexer test switch selected to the "Inhibit" position. ~~A 10 CFR 50.59 Evaluation that was prepared for the PWROG reviewed those SSPS design basis documents and determined that the proposed SSPS GWACM could not be implemented without prior NRC review and approval.~~

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The following sections identify the system performance, annunciator/alarm, physical/fabrication, and compliance requirements for the GWACM.

4.1 NON-URGENT ALARM INPUTS

The GWACM will remove the SSPS train-specific GW alarm reactor trip signal caused by the occurrence of any one of the following alarm inputs. These inputs will provide a remote alarm from each SSPS train as shown in Figure 4-1:

1. Loss of +48V1 power supply
2. Loss of +48V2 power supply
3. Loss of +15V1 power supply
4. Loss of +15V2 power supply
5. Multiplex Test Switch not in the NORMAL or A+B position
6. Pulled Card Interlock Row 2 is an open circuit (due to removed / loose PCB)
7. Pulled Card Interlock Row 3 is an open circuit (due to removed / loose PCB)
8. Pulled Card Interlock Row 4 is an open circuit (due to removed / loose PCB)
9. Pulled Card Interlock Row 5 is an open circuit (due to removed / loose PCB)
10. New Design ULB, SGD or UVD PCB self-test alarm (E10) or Watchdog Error (WDE) indicating an error in the PCB circuitry.

In the original SSPS design, Items 1 through 9 above provide GW alarm inputs, which annunciate a local alarm at the SSPS cabinet and an alarm on the MCB, and the initiation of a partial reactor trip signal in the affected SSPS train consistent with the AEC-approved SSPS design described in References 2 and 3. Item 10 is an additional function that was added to the new design SSPS PCBs. The self-test alarm did not exist with the original SSPS design that was approved by the AEC. The following non-urgent alarm inputs will be implemented with the GWACM:

impact on the operability of any RTS or ESFAS function

1&2. Loss of a single +48V1 or +48V2 power supply: Each +48V power supply is redundant (+48V1 and +48V2), and the output is diode auctioneered, such that a loss of one power supply does not inhibit the SSPS train's ability to perform its Reactor Trip System (RTS) and Engineered Safety Feature Actuation System (ESFAS) functions. The SSPS train is operable with loss of redundancy (Single Point Vulnerability [SPV] state), and therefore, there is no ~~loss of safety function~~ in the affected SSPS train. This condition would be indicated to the operator with the SSPS non-urgent alarm on the MCB, similar to the indication already in place with the current GW alarm. A loss of a +48V power supply is sensed by the SSPS SAT PCB. The loss of a single 48V power supply was removed from the three-train SSPS GW alarm design and a non-urgent alarm is sent through multiplexing to the MCB for indication. Therefore, this aspect of the GWACM, i.e., moving power supply monitoring from a GW alarm to a non-urgent alarm has previously been implemented.

3&4. Loss of a single +15V1 or +15V2 power supply: Each +15V power supply is redundant (+15V1 and +15V2), and the output is diode auctioneered, such that a loss of one power supply does not inhibit the SSPS train's ability to perform its RTS and ESFAS

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impact on the operability of any RTS or ESFAS function in

functions. The SSPS train is operable with loss of redundancy (SPV state), and therefore, there is no ~~loss of safety function of~~ the affected SSPS train. This condition would be indicated to the operator with the SSPS non-urgent alarm on the MCB, similar to the indication provided by the current GW alarm. A loss of a +15V power supply is sensed by the SSPS SAT PCB. The loss of a single 15V power supply was removed from the three-train SSPS GW alarm design and a non-urgent alarm is sent through multiplexing to the MCB for indication. Therefore, this aspect of the GWACM, i.e., moving power supply monitoring from the GW alarm to a non-urgent alarm has previously been implemented.

5. Multiplexer Test Switch in the INHIBIT position: The multiplexer test switch is a three-position switch with the following three switch positions: "NORMAL," "INHIBIT," and "A+B." Currently, a GW alarm is generated when this switch is placed out of the "NORMAL" or "A+B" position as it passes through the "INHIBIT" position, which removes the SSPS SAT PCB input path to ground causing an open circuit and a GW alarm signal. While the switch is in the "INHIBIT" position, multiplexing status information is blocked from the associated SSPS train by inhibiting data inputs, causing a loss of the SSPS train data to the MCB and plant computer. However, there is no ~~loss of safety function in the affected SSPS train, since the opposite SSPS train will continue to provide MCB and plant computer trip/logic status data during this time.~~ All safety functions within the SSPS train will continue to operate as required with the multiplexer test switch in the "INHIBIT" position. With the GWACM, the multiplexer test switch in the "INHIBIT" position will be indicated with a non-urgent alarm. This modification is considered to be an SSPS reliability improvement because it minimizes the potential of inadvertently having both SSPS trains in a GW alarm partial reactor trip condition, which would cause a reactor trip.

impact on the operability of any RTS or ESFAS function in the affected SSPS train, only the MCB and plant computer indications in that SSPS train are affected. Additionally, the opposite SSPS train will continue to provide MCB and plant computer trip/ logic status data when the Multiplexer Test Switch is in the INHIBIT position.

Pulled Card Interlock in Rows 2–5: The SSPS ULB, SGD, and UVD PCBs are located in Rows 2–5. In the current SSPS design, a GW alarm occurs and places the affected SSPS train in a partial reactor trip when an SSPS ULB, SGD, or UVD PCB is pulled or not inserted. If it is determined that one of the SSPS ULB, SGD, or UVD PCBs were pulled or not fully inserted, that particular SSPS train's ability to provide an RTS or ESFAS actuation may be affected. With the GWACM, a pulled or not fully inserted SSPS ULB, SGD, or UVD PCB will be indicated with a non-urgent alarm. ~~The new non-urgent alarm would require operator action that is the same as the operator response to a GW alarm response.~~ The redundant SSPS train would provide an RTS or ESFAS actuation, if required. The Row 1 pulled card interlock for the SSPS DEC, CCB, and SAT PCBs is not modified and is retained with the GW alarm inputs. The GWACM pulled card interlock change in Rows 2–5 is necessary for the SSPS ULB, SGD, and UVD PCB self-test alarm to be annunciated on the MCB as described below.

10. New Design SSPS PCB WDT or an E10 Self-Test Failure: The SSPS ULB, SGD, and UVD PCBs have a self-test function that continuously tests the functions of the PCB's basic logic and output drivers. [

The operator response to the new non-urgent alarm will be in accordance with the new ARP.

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]a,c Following the GWACM SSPS logic cabinet wiring modifications and on-board PCB jumper configuration changes, when a new design SSPS ULB, SGD, or UVD PCB generates a self-test error,
[
]a,c
and the SAT PCB will generate a non-urgent alarm without a partial reactor trip signal. This design feature requires the installation of the new design SSPS SAT, ULB, SGD, and UVD PCBs with the specific jumper configurations identified in this TR.

4.2 NON-URGENT ALARM SSPS/ANNUNCIATOR SYSTEM FUNCTIONAL INTERFACE

The operator response to the new non-urgent alarm will be in accordance with the new ARP.

The GWACM will provide a new remote annunciation (train-specific) interface (e.g., relay contact) to facilitate audible and visual MCB indication upon receipt of a non-urgent alarm. The new alarm can be implemented separately from, ~~or shared with~~ the existing GW alarm annunciation. ~~The operator response for the SSPS non-urgent alarm will be the same as the response to the current SSPS GW alarm response.~~

A separate indication for the non-urgent alarm identifies that the applicable SSPS train is not in a partial reactor trip condition, and also provides a GW alarm on the existing annunciation circuit. ~~However, the existing MCB alarm windows can be configured to indicate on both the GW alarm and the non-urgent alarm. This minimizes the impact on the MCB alarm panel configuration.~~ Additional annunciator windows are required for a separate indication. A separate non-urgent alarm indication is currently implemented at one plant for the loss of an SSPS output relay AC power supply. ~~A shared non-urgent alarm indication is currently implemented at another plant for the loss of SSPS output relay AC power. Therefore, both shared and separate MCB alarm panel configurations are currently implemented for SSPS alarm indications.~~

4.3 NON-URGENT ALARM MAIN CONTROL BOARD INTERFACE

The remote annunciation on the MCB will illuminate on the occurrence of any one of the following signals. The non-urgent alarm is not required to have a reflash capability. Conditions 1–4 result in a loss of redundancy. Condition 5 results in a loss of SSPS train data to the MCB and plant computer with no loss of RTS or ESFAS actuation function. Conditions 6–10 result in a potential degraded SSPS logic train and potential inoperable state. However the other SSPS train would be capable performing an RTS or ESFAS actuation, if required.

1. Loss of +48V1 power supply
2. Loss of +48V2 power supply

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3. Loss of +15V1 power supply
4. Loss of +15V2 power supply
5. Multiplexer Test Switch not in the NORMAL or A+B position
6. Pulled Card Interlock Row 2 is an open circuit (due to removed / loose PCB)
7. Pulled Card Interlock Row 3 is an open circuit (due to removed / loose PCB)
8. Pulled Card Interlock Row 4 is an open circuit (due to removed / loose PCB)
9. Pulled Card Interlock Row 5 is an open circuit (due to removed / loose PCB)
10. New Design SSPS ULB, SGD or UVD PCB self-test alarm (E10) or WDE indicating an error in the PCB circuitry.

The state of a non-urgent alarm in an SSPS train must be known by the operator in the control room. The operator must be aware that the SSPS train may be degraded when an alarm condition exists. ~~For a shared MCB alarm window, the SSPS GW alarm and non-urgent alarm circuit inputs share common outputs, and any subsequent input condition is not alarmed, consistent with the current GW alarm (no reflash).~~

[

]^{a,c}

4.4 QUALIFICATION OF NON-URGENT ALARM CIRCUIT PARTS

The GWACM will use only parts that are qualified as Class 1E safety-related for implementation within the SSPS.

The SSPS is a Class 1E safety-related system; therefore, only safety or safety-related parts that have been qualified can be used.

4.5 PCB CONFIGURATION REQUIREMENTS

The GWACM will be implemented with a new design SSPS SAT, ULB, UVD, and SGD PCB in each SSPS train.

The new design SAT PCB must be configured and installed for separation and interface with the GW alarm and non-urgent alarm inputs and outputs as described in Section 5.1. New design SSPS ULB, UVD, and SGD PCBs must be installed and configured to provide a remote non-urgent alarm upon detecting either a WDE or E10 self-test error signal.

4.6 SSPS QUALIFICATION IMPACTS

The GWACM does not impact the equipment qualification of the SSPS. The PCB components are qualified as discussed in WCAP-17867-P-A (Reference 9) and the master and slave relay qualifications are not impacted by this change.

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5.3 NON-URGENT ALARM MAIN CONTROL BOARD ANNUNCIATOR WINDOW

[will]a,c The design for the MCB annunciator ~~can~~ be implemented via the use of a separate annunciator window~~, or to parallel the signal with an existing annunciator window~~.

The field cable must be routed from each SSPS output relay cabinet (SSPS Trains A & B) to the MCB annunciator system.

5.4 OTHER CONSIDERATIONS FOR THE GWACM IMPLEMENTATION

5.4.1 MASTER RELAY

[ ]a,c

5.4.2 Slave Relay

[

]a,c

5.4.3 4-Bay SSPS General Warning Alarm Circuit

The 4-bay SSPS has different circuitry for the GW alarm than depicted in Figure 5-1 and Figure 5-2. The implementation of the non-urgent alarm circuitry is not impacted by the design difference in the 4-bay SSPS GW alarm circuitry.

5.4.4 Three-Train SSPS Alarm Circuit Design

The three-train SSPS has an existing non-urgent alarm for the loss of a single 15V or 48V power supply. The implementation of the non-urgent alarm for the pulled card interlock and E10 self-test error requires a modification to the current non-urgent alarm circuitry.

7 FAILURE MODES EVALUATION

Plant reliability can be improved by minimizing the potential of inadvertent reactor trips associated with the SSPS GW alarm. Plant safety can be improved by maximizing the SSPS availability via the new design SSPS ULB, SGD, and UVD PCBs that will immediately alert the operator with an audible and visual MCB alarm if an SSPS PCB fails a self-test, as opposed to being identified when the next surveillance test is performed to identify a degraded SSPS ULB, SGD, or UVD PCB.

7.1 IDENTIFICATION OF NEW FAILURE MODES

Reference 9

The failure modes and effects analyses (FMEAs) that were performed on the new design SSPS PCBs in ~~identify the WCAP~~ confirmed that the FMEA that was performed for the SSPS that is contained in WCAP-7706, remains valid. The new design SSPS ULB, SGD, and UVD PCB failure modes are the same as the original design SSPS ULB, SGD, and UVD PCBs. The similarity of the FMEA results for the new design SSPS ULB, SGD, and UVD PCBs when compared to the original design SSPS ULB, SGD, and UVD PCBs confirmed that there will be no malfunctions of an SSC important to safety with a different result than any previously evaluated in the Updated Final Safety Analysis Report (UFSAR).

Table 7-1 provides a summary of the current GW alarm design functions, the GWACM changes, and identifies those functions that are discussed in WCAP-7488-L and WCAP-7706 (References 3 and 4). The new design SSPS ULB, SGD, and UVD PCB self-test error is also included.

WCAP-7672 Section III.D, "Alarm System" states:

"*If trouble in both trains should develop simultaneously, the reactor will be tripped automatically by the alarm system.*"

Implementation of the GWACM will remove the GW alarm partial reactor trip inputs that are shown in Figure 4-1. Therefore, the changes to the SSPS GW alarm failure modes are identified in Table 7-1.

7.2 GWACM FAILURE EVALUATION

A failure modes and effects analysis was performed for the GWACM as shown in Table 7-2.

A traditional FMEA uses a weight rating that is based on multiplying the criticality (C), likelihood (L), and detectability (D) rankings together, with larger values normally used to indicate more critical failure modes. The combination of criticality and likelihood offers provides insight into the component's impact on the mission if it failed or was at risk. The combination of likelihood and detectability provides insight to the component's need for monitoring, inspection, or testing. This combination offers insight into the surveillance test frequency and other maintenance considerations. ~~For the GWACM, all failures will be considered equal for the purpose of SSPS alarm response and diagnostics.~~

The operator response to the new non-urgent alarm will be in accordance with the new ARP.

The multiplexer test switch to generate an inhibit position alarm is not a component failure; therefore, it is not included in Table 7-2. The multiplexer test switch inhibited alarm provides indication when one SSPS train is in test to prevent spurious alarms to the operator; while the opposite SSPS train provides indication during testing. Multiplexing is a non-safety-related function; therefore a partial reactor trip is not needed for the multiplexer test switch to generate an inhibit position alarm.

The loss of a redundant power supply does not affect an SSPS train's operability; therefore, a partial reactor trip is not needed. Also, note that a failure of both of the 15V or both of the 48V power supplies in an SSPS train causes a reactor trip; therefore, a second power supply failure is fail-safe.

The pulled-card interlock alarm is administratively controlled by limiting access to the SSPS train cabinets. Verification that the SSPS ULB, SGD, and UVD PCBs remain inserted is self-evident by the absence of an alarm from the pulled card interlock circuit. A non-urgent alarm condition will occur when a PCB is pulled, or not fully inserted for card interlock Rows 2-5. PCB insertion is confirmed prior to securing each SSPS train cabinet, by confirming there is no SSPS GW or non-urgent alarm condition.

The addition of a PCB self-test failure indication to the non-urgent alarm ensures that PCB failures are immediately detectable. Determination of the non-urgent alarm cause would require observation of local status indications at the affected SSPS logic cabinet. ~~Response to the non-urgent alarm will be the same as the response to the receipt of the current GW Alarm. Therefore, the change in human-system interface from the GWACM would require a change to the SSPS alarm response procedure for operators to respond to an SSPS non-urgent alarm condition to determine if a loss of safety function has occurred in the affected SSPS train.~~ Only after the cause of the non-urgent alarm has been determined, can an assessment be made regarding the affected SSPS train's operability.

The operator response to an SSPS non-urgent alarm condition will be in accordance with the new ARP to determine the impact on operability of the affected SSPS train.

Table 7-2 SSPS General Warning Alarm Circuit Modification FMEA Impacts

Failure	Symptoms/ Local Effects in the Affected SSPS Train	Mitigating Features	System Effects	Method of Detection
Failure of one 48 VDC power Supply	Loss of Power	Redundant power supply	None	Non-Urgent Alarm
Failure of one 15 VDC power Supply	Loss of Power	Redundant power supply	None	Non-Urgent Alarm
Failure of SSPS UVD, ULB, SGD PCB self-test (WDE or E10 self-test failure)	Failure of the module (PCB), potential ~~loss of safety function~~ inoperability of an RTS or ESFAS function	Opposite SSPS Train	Capability to perform ~~the safety function~~ is maintained by the redundant train.	Non-Urgent Alarm an RTS or ESFAS actuation
Pulled Card Interlock Rows 2-5	Failure of the module (PCB), potential ~~loss of safety function~~ inoperability of an RTS or ESFAS function	Opposite SSPS Train	Capability to perform ~~the safety function~~ is maintained by the redundant train.	Non-Urgent Alarm an RTS or ESFAS actuation

10-1

10 SUMMARY AND CONCLUSIONS

The separate annunciator window configuration for the GWACM will provide an indication on the MCB of the status of the SSPS train. The operator response to the annunciator will be in accordance with the new ARP. The new annunciator window will have the capability to identify a non-urgent alarm condition in each SSPS train.

Implementation of the GWACM [illegible] inadvertent plant reactor trips [illegible] the GW alarm will be moved to [illegible] al in the affected SSPS train. Pl[illegible] via the new non-urgent alarm [illegible]. The addition of a new non-urgent alarm will allow plants to enable the new design SSPS PCB self-test function to provide remote indication of a self-test alarm condition on the MCB. The GWACM will alert the operator with an audible and visual MCB alarm if an SSPS PCB fails a self-test, as opposed to being identified when the next surveillance test is performed to identify a degraded SSPS ULB, SGD, or UVD PCB.

The GWACM involves reducing the number of inputs to the SSPS GW alarm circuit by removing the loss of one 15 VDC power supply, the loss of one 48 VDC power supply, the multiplexer test switch selected to the "Inhibit" position, and the pulled card interlock. These inputs will be moved to a new non-urgent alarm. The non-urgent alarm will interface with the MCB annunciator system to indicate using a separate alarm window ~~or a shared with a GW alarm window for each SSPS train~~. The reduction of inputs to the SSPS GW alarm will reduce the likelihood of inadvertent reactor trips while maintaining plant safety with the remaining inputs to the GW alarm that will provide input for a partial reactor trip signal as originally designed.

The GWACM also enables the non-urgent alarm to indicate if a new design SSPS PCB failed a self-test. The new design SSPS ULB, SGD, and UVD PCBs all contain built in self-test features, including a self-test function that continuously tests the functions of the PCB's basic logic and output drivers. Protection channel trips and actuation signals received during the performance of self-test processes will result in a reactor trip or ESFAS actuation, when required, as originally designed. The SSPS PCB self-test feature does not impact the Technical Specification SSPS surveillance tests or impact the SSPS protection functions. The self-test feature provides early detection of a potential component failure, including logic operation and input power failure. The continuous PCB self-tests on the SSPS ULB, SGD, and UVD PCBs are designed to facilitate timely recognition and identification of equipment that is not performing as designed, so that maintenance can be performed. The addition of LED indications on the visible card edge of the new design SSPS PCBs provide signal status information that is not available on the original design SSPS PCBs. These features, in conjunction with the GWACM, will alert the operator with an audible and visual MCB alarm if an SSPS PCB fails a self-test, as opposed to being identified when the next surveillance test is performed to identify a degraded SSPS ULB, SGD, or UVD PCB.

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