PWROG
PWR Owners Group

Program Management Office
1000 Westinghouse Drive
Cranberry Township, Pennsylvania 16066

Project Number 694

June 18, 2014

OG-14-207

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

Subject: PWR Owners Group Transmittal of the Non-Proprietary Summary of WCAP-17867-P, "Westinghouse SSPS Board Replacement Licensing Summary Report", PA-LSC-1170 R1

References:

1. OG-14-41, Submittal of WCAP-17867-P, Revision 0, "Westinghouse SSPS Board Replacement Licensing Summary Report," PA-LSC-1170
2. NRC Letter from Anthony J. Mendiola to Mr. W. Anthony Nowinowski, "Acceptance for Review of Pressurized Water Reactor Owners Group (PWROG) Topical Report WCAP-17867-P, Revision 0 "Westinghouse SSPS [Solid State Protection System] Board Replacement Licensing Summary Report" (TAC NO. MF3550)
3. OG-14-136, "Request for Exemption from NRC Fees to Review WCAP-17867-P "Westinghouse SSPS Board Replacement Licensing Summary Report," dated January 2014
4. NRC Letter from Jonathan G. Rowley to Mr. Nowinowski, "Request For Additional Information RE: Pressurized Water Reactor Owners Group Topical Report WCAP-17867-P, Revision 0, "Westinghouse SSPS Board Replacement Licensing Summary Report" (TAC NO. MF3550), dated May 7, 2014

The purpose of this letter is to transmit the Non-Proprietary Summary of WCAP-17867-P, "Westinghouse SSPS Board Replacement Licensing Summary Report."

The PWROG submitted WCAP-17867-P to the NRC for review and approval in PWROG letter OG-14-41 (Reference 1).

The NRC issued a Request for Information (RAI) letter to the PWROG on May 7, 2014 which contained the following information per RAI #3 (Reference 4).

> "The TR contains mostly proprietary information, and a non-proprietary version would not be very readable. The NRC is obligated to keep the public informed about the

D048
NRR

activities that it performs. Please provide a non-proprietary summary of the material in the TR."

Enclosed please find the non-proprietary summary of the material contained in Topical Report, WCAP-17867-P.

If you have any questions, please do not hesitate to contact me at (205) 992-7037 or Mr. W. Anthony Nowinowski, Program Manager of the PWR Owners Group, Program Management Office at (412) 374-6855.

Sincerely yours,

Norman J. Stringfellow

Jack Stringfellow, Chief Operating Officer and Chairman
PWR Owners Group

CMH:NJS:rfn

Enclosure 1: Non-Proprietary Summary of WCAP-17867-P, "Westinghouse SSPS Board Replacement Licensing Summary Report

cc: PWROG Management Committee
PWROG Licensing Subcommittee
PWROG Steering Committee
PWROG I&C Working Group
PWROG PMO
J. Gresham, Westinghouse
J. Andrachek, Westinghouse
J. Moorehead, Westinghouse
D. Olinski, Westinghouse
T. Gruber, Westinghouse
M. Ryan, Westinghouse
M. Ackman, Westinghouse
L. Erin, Westinghouse
K. Altemus, Westinghouse
D. Stiffler, Westinghouse
M. Stofko, Westinghouse
S. Arndt, US NRC
N. Carte, US NRC
P. Hiland, US NRC
J. Rowley, US NRC

Non-Proprietary Summary of WCAP-17867-P, "Westinghouse SSPS Board Replacement Licensing Summary Report"

Introduction

The continued operation of the Solid State Protection System (SSPS) depends on the availability of replacement circuit boards that contain logic devices that will be available or easily replaced until scheduled end of plant life including the current plant life extensions. The SSPS boards have been redesigned and the technology used in the redesign uses configured logic devices (Complex Programmable Logic Device – CPLD) to operate the new circuit boards. The focus of this program is a card for card replacement that can be implemented under a 10 CFR 50.59, requiring no prior approval from the United States (U.S.) Nuclear Regulatory Commission (NRC). The CPLD-based replacement board is intended to be treated as a spare part specific for SSPS digital cards in operating plants.

Purpose

The purpose of WCAP-17867-P, "Westinghouse SSPS Board Replacement Licensing Summary Report" is to document the design process, design details, analyses, manufacturing controls, and verification process with results to provide a comprehensive summary of evidence concluding that the installation of the new design SSPS circuit boards maintain or improve upon the existing reliability and functional requirements for the SSPS, and does not introduce any unanalyzed failures or the potential for software common cause failure (CCF) that would compromise SSPS equipment operations.

Request for U.S. NRC Review and Approval

The PWROG submitted WCAP-17867-P to the U.S. NRC for review and approval in order to implement the new design SSPS circuit boards under 10 CFR 50.59 at individual plant sites. Sites would implement the new design SSPS circuit boards under a 10 CFR 50.59 program and reference this approved topical report as the basis for assurance that installation of the new design circuit boards does not result in any unanalyzed safety questions.

Factors for SSPS Board Redesign

The original design circuit boards were developed in the late 1960s using Motorola High Threshold Logic (HTL/MHTL) devices to implement the logic applications. The MHTL logic was discontinued in the mid-1990s and Westinghouse supplied new MHTL components based on distributor stock. Without the availability of MHTL devices, Westinghouse would not be able to support continued SSPS operation, which could force units to shut down based on inability to provide spare parts to support system operation. Because distributor stock has a finite availability, it was determined to redesign the SSPS boards with new technology to allow support of operating plants until the end of projected plant life.

The objective of the new design was to create a board replacement that does not require SSPS system wiring and cabinet changes or require a complete replacement of SSPS cards. The new design cards design shall be able to operate along with the original design cards.

Redesign Solution

Westinghouse determined to redesign the SSPS boards and proposed a limited partnership with the Pressurized Water Reactor Owners Group (PWROG) at that time. As a result, a Beta group was established that consisted of operating plants that have SSPS installed as the voter logic subsystem. The Beta group would be involved with design reviews, inputs to design, and testing of design prototypes.

Approach to Redesign

Westinghouse Electric Company LLC used its extensive system knowledge and experience to develop, manufacture, and demonstrate operation and operability of the CPLD-based replacement SSPS circuit boards. Westinghouse sought and received input from PWROG plants and implemented their suggestions

and reviews in the development and testing process. The sharing of the design process became an alliance in the development of the replacement boards used in the SSPS. The development program addressed obsolescence issues associated with the Westinghouse original SSPS hardware. The CPLD-based replacement board design is a form (physical interfaces), fit, and function replacement that contains software developed programmable device configuration code. The CPLD is configured during printed circuit board manufacturing by loading a configuration file that configures the logic gates in the non-volatile memory device.

The re-design of the SSPS boards was accomplished on an individual board basis. Each individual board has its own board specific design requirements and specification document, its own individual test plan, its own specific set of test cases and specific functional test and system test processes. Each individual board is considered a standalone subset of the SSPS and the re-design of each specific board has its own processes and procedures that were used to complete the re-design of the board.

The alliance between the PWROG and Westinghouse System Engineering defined a design program that would minimize the impact on the plant procedures, system wiring, design basis, and licensing basis. The program objective was to design the replacement board to meet the current design and licensing basis requirements, allowing utilities to replace their boards with the CPLD-based boards under their current replacement part programs. The following elements of the design program support this objective:

1. The CPLD-based replacement board allows utilities to maintain the SSPS mature system design and architecture. The replacement design is built on proven system performance via testing. The system design and licensing bases are well known. Both the design basis and licensing basis are preserved with the replacement boards. The new design boards can be inserted as an equivalent form (physical interfaces), fit, and function replacement board, and therefore become an equivalent spare part.

2. A program-specific design, verification, and validation plan was developed. This plan captured the rigorous Westinghouse design process and 10 CFR 50 Appendix B requirements. The design, verification, and validation process promotes that proper design analyses have been conducted, reviews have been performed, and the board has been tested to verify compliance to all performance and environmental requirements.

3. Original equipment manufacturer (OEM) experience with the new design SSPS boards is extensive. Westinghouse is the OEM and the supplier of the SSPS. Westinghouse developed all specifications associated with the original design and licensing of the system and the redesigned board.

4. End-user utility involvement has been significant throughout the various stages of the program. The end users have hundreds of years of operating experience with these systems. The design specifications were based on Westinghouse and end-user input. The direct involvement of the utilities in this program significantly strengthens the vendor-utility interface.

5. The design process included the provision for selection of highly reliable mil-spec components. The design of the replacement SSPS boards, based on CPLD technology, achieved a mean time between failures (MTBF) that is greater than that of the original design SSPS boards.

6. The CPLD-based replacement board is hardware-based and utilizes configuration code (software) to configure the device. Configuration code is distinguished from software by the degree of testability. The CPLD-based board does not have the characteristics associated with microprocessor-based systems such as modifiable code, branches or interrupts, decision-making

capability, lockups, and common-mode software failure susceptibility. The main CPLD operates as a fixed logic device. The TEST CPLD operation is deterministic and sequential. Thus, failures can be treated as single random hardware failures.

7. The degree of testability of the design promotes proper operation and provides confidence that no new failure modes will be introduced. Testability is obtained through the simplicity of the CPLD based board design. The new design board has pin-for-pin compatibility with the original design board it replaces and requires no cabinet wiring changes. The CPLD performs simple logic functions that are easily tested. Process functions built from combinations of the CPLD logic functions are thoroughly tested in the validation test program.

8. The configuration of the CPLD-based board is controlled such that it cannot be reconfigured in the field.

9. A Core Beta group that consisted of several utility members from the PWROG reviewed the initial design and tested the board prototypes. The Beta group also reviewed final design documents and conducted beta testing of the final designs in SSPS test systems and using plant test apparatus. The group provided comments and test results to Westinghouse. Westinghouse evaluated the comments and test results and executed changes as necessary.