

February 24, 2003

Mr. Dennis M. Popp
Manager of Regulatory Compliance
Nuclear Automation
Westinghouse Electric Company, LLC
1740 Golden Mile Highway
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SUBJECT: ACCEPTANCE OF THE CHANGES TO TOPICAL REPORT CENPD-396-P,
REV. 01, "COMMON QUALIFIED PLATFORM," AND CLOSEOUT OF
CATEGORY 2 OPEN ITEMS (TAC NO. MB2553)

Dear Mr. Popp:

By letter dated August 14, 2002, Westinghouse (formerly Combustion Engineering Nuclear Power (CENP)) submitted supplemental information for review by the NRC staff to (1) close five of the six remaining generic open items (GOIs) from the review of the Westinghouse Common Qualified (Common Q) digital instrumentation and control (I&C) platform, and (2) approve changes that Westinghouse has proposed to the Common Q Topical Report (TR) CENPD-396-P, the Software Program Manual (SPM) and Appendix 1 (Post Accident Monitoring System [PAMS]) and Appendix 2 (Core Protection Calculator System [CPCS]).

Westinghouse submitted the initial Common Q TR, the SPM, and four Appendices for staff review and approval by letter dated June 5, 2000. The staff issued the initial safety evaluation (SE), which identified ten GOIs to be closed at a later time, by letter dated August 11, 2000. (See ADAMS ML003740165). By letter dated May 11, 2001, Westinghouse submitted additional information to closeout four of the GOIs (GOIs 7.4, 7.7, 7.9, and 7.10). The staff issued the first supplemental SE that closed those four GOIs by letter dated June 22, 2001. (See ADAMS ML011690170).

The staff has completed its review of the Westinghouse submittal dated August 14, 2002, and concluded that the five GOIs (GOIs 7.1, 7.2, 7.3, 7.5 and 7.6) are acceptably addressed and should be closed and that the proposed changes revising the initial Common Q TR, the SPM, and Appendices 1 and 2 are acceptable. The enclosed SE documents the staff's evaluation of the Westinghouse justifications for the proposed actions, except for GOI 7.8 regarding the future integration of multiple Common Q safety systems, which Westinghouse proposes to keep open until it is needed.

Pursuant to 10 CFR 2.790, we have determined that the enclosed SE does not contain proprietary information. However, we will delay placing the SE in the public document room for a period of ten working days from the date of this letter to provide you with the opportunity to comment on the proprietary aspects only. If you believe that any information in the enclosure is proprietary, please identify such information line by line and define the basis pursuant to the criteria of 10 CFR 2.790.

D. Popp

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In accordance with established NRC procedure, the NRC requests that the WOG publish an accepted version within 3 months of receipt of this letter. The accepted version shall incorporate (1) this letter and the enclosed SE between the title page and the abstract, (2) all requests for additional information from the staff and all associated responses, and (3) a "-A" (designating "accepted") following the report identification symbol.

Should our criteria or regulations change so that our conclusions as to the acceptability of the report are invalidated, Westinghouse and/or the applicants referencing the TR will be expected to revise and resubmit their respective documentation, or submit justification for the continued applicability of the TR without revision of their respective documentation.

If you have any questions regarding this matter, please contact Girja Shukla at (301) 415-8439.

Sincerely,

/RA/

William H. Ruland, Director
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 692

Enclosure: Safety Evaluation

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-2-

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO THE WESTINGHOUSE COMMON Q PLATFORM
CLOSEOUT OF GENERIC OPEN ITEMS AND APPROVE CHANGES TO TOPICAL REPORT
CENPD-396-P, REV. 01, "COMMON QUALIFIED PLATFORM"
PROJECT NO. 692

1.0 INTRODUCTION

By letter dated August 14, 2002, Westinghouse (formerly Combustion Engineering Nuclear Power [CENP]) submitted the five documents listed below for review by the NRC staff. Westinghouse intends to achieve two objectives: (1) close five of the six remaining generic open items (GOIs) from the review of the Westinghouse Common Qualified (Common Q) digital instrumentation and control (I&C) platform, and (2) have the staff review and approve changes that Westinghouse has made to the Common Q topical report (TR), the Software Programming Manual (SPM), and Appendices 1 and 2. The five documents are:

1. "Summary Qualification Report of Hardware Testing for Common Q Applications" 0000-ICE-37764, Revision 02 (proprietary)
2. "Changes to the Westinghouse Common Qualified Platform Topical Report, CENPD-396-P, Rev.01" (proprietary)
3. "Changes to the Westinghouse Software Program Manual for Common Q Systems, CE-CES-195, Revision 1" (nonproprietary)
4. "Changes to the Westinghouse Common Qualified Platform Post Accident Monitoring Systems, CENPD-396-P, Appendix 1, Revision 1" (proprietary)
5. "Additional Information Regarding the Westinghouse Common Qualified Platform Core Protection Calculator System, CENPD-396-P, Appendix 2, Revision 1" (proprietary)

Westinghouse submitted the "Summary Qualification Report of Hardware Testing for Common Q Applications" (Summary Qualification Report) to close GOIs 7.1, 7.2, 7.3, 7.5, and 7.6. These five GOIs required that Westinghouse submit additional information to document that the flat panel display system (FPDS), Common Q power supplies and the hardware watchdog timer module either have been manufactured to 10 CFR Part 50, Appendix B, quality assurance requirements or are commercial-grade items that have been dedicated and qualified to assure quality equivalent to that required in Appendix B. Westinghouse proposes to allow the still-open GOI 7.8 regarding the future integration of multiple Common Q safety systems to remain open until it is needed.

Westinghouse submitted items 2 through 5 to document the changes that they had made to the Common Q TR, the SPM, and Appendices 1 and 2 since the staff issued its initial safety evaluation (SE) for the Common Q platform on August 11, 2000. Westinghouse stated that the need for these changes became apparent during the ongoing development of plant-specific Common Q applications. Westinghouse submitted the documentation of these changes because the staff requires that changes to the approved version of the Common Q TR, the SPM, and appendices be reviewed by the staff.

2.0 BACKGROUND

By letter dated June 5, 2000, Westinghouse submitted Revision 1 of the Common Q TR, the SPM, and four appendices. By letter dated August 11, 2000, the staff sent Westinghouse its initial SE of the Common Q TR, the SPM and four appendices (Accession No. ML003740165). The initial SE identified ten GOIs to be closed at a later time.

By letter dated May 11, 2001, Westinghouse submitted additional information to close four of the GOIs (GOIs 7.4, 7.7, 7.9, and 7.10). On June 22, 2001, the NRC issued its supplemental SE (Accession No. ML011690170) closing the four GOIs.

2.1 Background for the Five GOIs Addressed in this SE

These five GOIs result from the fact that most of the non-AC160 components and some AC160 components were not ready for evaluation when the staff issued its initial SE on August 11, 2000.

2.1.1 Regulatory Framework for Closing the Five GOIs

The staff required in these five GOIs that Westinghouse submit additional information to verify that these components have been manufactured to 10 CFR Part 50, Appendix B, requirements, or are commercial-grade items dedicated to Appendix B equivalent quality, and that they have been qualified to meet the electromagnetic compatibility (EMC), environmental, and seismic requirements for safety systems in nuclear power plants. The regulatory requirements for closing the five GOIs are a subset of those listed in Section 3.1, "Review Criteria," of the initial Common Q SE. The following regulatory guides (RGs) and standards are applicable to the review to close these five GOIs:

- RG 1.152-1996, "Criteria for Digital Computers in Safety Systems of Nuclear Power Plants" (endorses IEEE Std 7-4.3.2-1993, "IEEE Standard for Digital Computers in Safety Systems of Nuclear Power Generating Stations").
- RG 1.153-1996, "Criteria for Power Instrumentation and Control Portions of Safety Systems," (endorses IEEE Std 603-1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations").
- EPRI [Electric Power Research Institute] Topical Report TR-102323-R1, "Guidelines for Electromagnetic Interference Testing in Power Plants," approved by the NRC on April 17, 1996.

- EPRI Topical Report TR-106439, "Guideline on Evaluation and Acceptance of Commercial Grade Digital Equipment for Nuclear Safety Applications," approved by the NRC in April, 1997.
- EPRI Topical Report TR-107330, "Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants," approved by the NRC on July 30, 1998.
- IEEE Std 344-1987, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations."

2.1.2 Westinghouse Rationale to Close the Five GOIs

The five GOIs are listed below as they appear in the initial SE followed by the Westinghouse rationale for closing each. The section reference found in each GOI refers to that section in the initial SE.

GOI 7.1:

"CENP has committed to develop a new I/O [input/output] module or re-design some of those already considered for use in the Common Q platform in order to meet the performance requirements of EPRI TR-107330. The staff's review of the design and qualification of the new or re-designed I/O module is discussed in Section 4.1.1.1.2."

Westinghouse stated that it has addressed this issue by developing and qualifying a new analog input module (AI685) that meets the guidance of EPRI TR-107330.

GOI 7.2:

"CENP has not yet finalized the selection of the Common Q power supplies. The staff's review of the design and commercial-grade dedication of the power supplies is discussed in Section 4.1.4."

Westinghouse stated that it has addressed this issue by designing and qualifying a series of Common Q power supplies. Power supply qualification testing is addressed in the Summary Qualification Report. The design, manufacture, and commercial-grade dedication of the Common Q power supplies are part of the Westinghouse 10 CFR Part 50, Appendix B, quality assurance program.

GOI 7.3:

"CENP has not submitted information on the design or dedication of the hardware watchdog timer and it has not yet been subjected to testing for environmental qualification. The staff's review of the design and commercial-grade dedication of the hardware watchdog timer is discussed in Section 4.1.5."

Westinghouse has withdrawn the separate hardware watchdog timer module from the qualification process. Westinghouse has instead qualified the PM646A built-in hardware watchdog timer function.

GOI 7.5:

"CENP will perform additional EMC tests and measurements on the PM646. The staff's review of the PM646 testing is discussed in Section 4.2.2.1.3."

Westinghouse stated that it has addressed this requirement by qualifying the PM646A to the guidance of EPRI Topical Report TR-102323.

GOI 7.6:

"CENP has not yet conducted seismic and environmental qualification testing on the non-AC160 hardware components. Items not yet tested include the FPDS, watchdog timer and power supply modules. The staff's review of the FPDS, watchdog timer and power supply modules qualification testing is discussed in Section 4.2.2.2."

Westinghouse stated that it has addressed this item by performing environmental, seismic, and EMC testing on the complete complement of Common Q equipment, including those components that were previously qualified for the initial SE.

In summary, the Westinghouse rationale for closing the five GOIs is as follows. Westinghouse, an Appendix B approved supplier, has designed, built, and qualified the supplemental Common Q hardware under its 10 CFR Part 50, Appendix B, quality assurance program, that includes the dedication of commercial-grade items in accordance with the guidance in the EPRI Topical Reports TR-106439 and/or TR-107330. Westinghouse submitted the Summary Qualification Report to summarize the results of the Common Q supplemental hardware qualification program. The supplemental equipment consisted of the FPDS, the Common Q power supplies, the watchdog timer function in the PM646A module, and miscellaneous support equipment. The objective of this supplemental program is to qualify this set of equipment to the same levels as the previously qualified AC160 portions of the Common Qualified platform and, thereby, to close these five GOIs. Because all of the Common Q components must operate together and interact with each other to prove performance during the qualification testing, Westinghouse performed the supplemental environmental, seismic and EMC testing on the complete complement of Common Q components. Therefore, Common Q components that were previously qualified before the initial SE was issued underwent qualification testing again with the supplemental Common Q hardware.

2.2 Background for the Changes to the TR, the SPM, and Appendices

2.2.1 Regulatory Framework for the Changes to the TR, SPM, and Appendices

The basic requirement of the framework is that the changes do not compromise the characteristics of the Common Q platform that were critical to its acceptability in the initial SE. Therefore, the regulatory requirements for the changes are essentially all of the requirements that applied to the initial SE for the Common Q platform. These requirements are identified in

Section 3.1, "Review Criteria," in the initial SE. For the current review, the staff has determined that the following subset of regulatory guides and standards applies to the acceptability of the changes:

- RG 1.75-1978, "Physical Independence of Electrical Systems" (endorses IEEE Std 384, "Criteria for Separation of Class 1E Equipment and Circuits").
- RG 1.97-1983, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident."
- RG 1.152-1996, "Criteria for Digital Computers in Safety Systems of Nuclear Power Plants" (endorses IEEE Std 7-4.3.2, "IEEE Standard for Digital Computers in Safety Systems of Nuclear Power Generating Stations").
- RG 1.153-1996, "Criteria for Power Instrumentation and Control Portions of Safety Systems," (endorses IEEE Std 603, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations").
- RG 1.168-1997, "Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants" (endorses ANSI/IEEE Std 1012, "IEEE Standard for Software Verification and Validation Plans," and IEEE Std 1028, "IEEE Standard for Software Reviews and Audits").
- RG 1.170-1997, "Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Power Plants" (endorses IEEE Std 829, "IEEE Standard for Software Test Documentation").
- RG 1.171-1997, "Software Unit Testing for Digital Computer Software Used in Safety Systems of Nuclear Power Plants" (endorses ANSI/IEEE Std 1008, "IEEE Standard for Software Unit Testing").
- RG 1.173-1997, "Developing Software Life Cycle Processes for Digital Computer Software Used in Safety Systems of Nuclear Power Plants" (endorses IEEE Std 1074, "IEEE Standard for Developing Software Life Cycle Processes").

2.2.2 Westinghouse Rationale in Support of the Changes

During the ongoing development of plant-specific implementations of Common Q safety systems at nuclear power plants, Westinghouse engineers discovered some changes that they propose to make to the Common Q TR, the SPM, and Appendices 1 and 2. Westinghouse stated that these changes are needed to reflect:

- Changes related to the PM646A and AI685 AC160 hardware modules;
- Changes to the Common Q architecture and configuration;
- Completion of the supplemental qualification testing of Common Q hardware components;
- Clarification of the software development process;

- Changes to the Post Accident Monitoring System (PAMS) architecture and configuration; and
- Changes to the Core Protection Calculator System (CPCS) architecture and configuration.

The supplemental hardware testing will qualify all Common Q components to the same levels that the AC160 components were qualified to in the initial Common Q SE. The proposed safety-related algorithms for the PAMS and CPCS will remain the same as in the initial submittal of the TR, however, the configuration of the individual modules will be changed to enhance system performance. Items 2 through 5 in the Westinghouse submittal described the proposed design changes that alter the content of the TR, the SPM and Appendices 1 and 2 from that accepted in the initial SE. Westinghouse concludes that none of the changes compromise the characteristics of the Common Q platform that were critical to its acceptability in the initial SE.

3.0 TECHNICAL EVALUATION

The documents listed in Section 1.0 of this SE closeout the five GOIs and document the changes to the TR, the SPM, and Appendices 1 and 2. The staff's safety evaluation of this submittal is in three parts:

1. The evaluation for closing the five GOIs (Section 3.1).
2. The evaluation of the changes to the Common Q TR, the SPM, and Appendices 1 and 2 (Section 3.2).
3. The summary of the staff's conclusions (Section 3.3).

In the following evaluation, the term "initial configuration" refers to Revision 1 of the Common Q platform as evaluated in the initial SE dated August 11, 2000. The term "revised configuration" refers to Revision 2 of the Common Q platform as proposed in the present submittal. The term "legacy system" refers to systems (pre-Common Q) that are currently installed and operating at nuclear power plants.

3.1 Closeout of the Five GOIs

3.1.1 Description of Hardware Being Qualified

The Common Q platform is based on the Advant® AC160 line of processors and S600 input/output (I/O) modules. The following AC160 system components that have been previously qualified and were found acceptable in the initial SE:

- Processor 19-inch subrack
- Expansion 19-inch subrack
- PM645C processor module
- PM646 processor module
- CI631 communication interface module

- Eight models of S600 I/O modules to include:
 - AI620 analog input module
 - AI635 analog input module
 - AO650 analog output module
 - DI620 digital input module
 - DO620 digital output module
 - DO625 digital output module
 - DO630 digital output module
 - DP620 digital pulse-counting module
- TC630 fiber-optic modem
- TC514 fiber-optic modem
- OZDV 114 fiber-optic modem
- TC625 wire modem

The Westinghouse supplemental hardware qualification program includes the previously qualified AC160 components and adds the following:

- Additional AC160 components
 - PM646A processor module (identical with the PM646 except for one resistor)
 - AI685 analog input module
 - AO610 analog output module
 - CI257W communication interface module
- Flat panel display system
 - PC node box (Intel computer module)
 - 12.1" flat panel display
 - 15" flat panel display
 - 18" flat panel display
- Power supply modules
 - Core protection calculator system power supply
 - Post accident monitoring system power supply
 - 230 VAC power supply
- Watchdog timer function
 - Watchdog timer function in PM646 or PM646A processor module

Westinghouse included the previously qualified AC160 components in the equipment under test configurations to simulate the worst-case hardware configuration to envelope all expected applications for the Common Q platform. In addition, to create the worst-case operating conditions during the tests and measurements, all the modules were continuously exercised and monitored for proper operation.

3.1.2 Staff Analysis to Close the Five GOIs

3.1.2.1 Supplemental Hardware Manufactured to 10 CFR Part 50, Appendix B, Requirements

Westinghouse is an approved 10 CFR Part 50, Appendix B, supplier. During the initial review of the Common Q platform, the staff did not attempt to renew Westinghouse's status as an approved 10 CFR Part 50, Appendix B, supplier. However, during the initial review of the Common Q platform, the staff audited a sampling of Westinghouse's manuals for

commercial-grade dedication. On the basis of that audit, the staff found that the procedures and processes in the manuals correspond to the requirements of IEEE 7-4.3.2 and the guidance of EPRI TR-106439 and EPRI TR-107330 and, therefore, provide an acceptable program for the dedication of commercial-grade items.

The staff has audited the development of the supplemental Common Q hardware and finds that Westinghouse has continued to follow its prescribed procedures. The staff concludes on that basis, that the supplemental Common Q hardware components included in the Supplemental Qualification Report are manufactured and/or dedicated in accordance with the applicable regulatory 10 CFR Part 50, Appendix B, quality assurance requirements.

Westinghouse changed a resistor in the PM646 module to suit configuration requirements in specific applications. Westinghouse designates the changed module as PM646A. The staff has reviewed the change and concurs in the Westinghouse conclusion that the resistor change is inconsequential and is, therefore, acceptable. The staff concludes that the PM646 and PM646A processor modules may be used interchangeably to suit the configuration requirements of the specific application.

3.1.2.2 Evaluation of Hardware Qualification Testing

Table 3-1, "Qualified Equipment List," (Westinghouse proprietary) in the Summary Qualification Report provides a description of the equipment that was qualified. The equipment qualified in the test program included power supplies, flat panel displays (FPDs), modems, and other peripheral equipment such as relays and terminal blocks. Table 6-1, "Summary of Common Q Qualification Test Results," (Westinghouse proprietary) in the Summary Qualification Report lists the Common Q equipment qualified by this program and their status with respect to the qualification requirements. Westinghouse has withdrawn the Brentek hardware watchdog timer module shown in Table 6-1 from the Common Q platform because Westinghouse determined that the watchdog timer function in the PM646 or PM646A processor module is adequate for all Common Q applications. The Summary Qualification Report provides a summary of the hardware qualification testing which Westinghouse performed to certify various equipment as Class 1 for use in Common Q systems. The testing was conducted from August 2001 to April 2002. The bulk of the testing was performed at WYLE Laboratories in Huntsville, Alabama. Some followup electromagnetic interference (EMI) testing was conducted at Retlif Testing Laboratories in Ronkonkoma, New York. The NRC staff traveled to the test laboratories to witness about half of the testing at each test facility. The following three sections detail the staff's evaluation of the EMC, environmental, and seismic testing.

3.1.2.2.1 EMC Qualification Testing

Westinghouse performed EMC tests and measurements on the Common Q test specimen in accordance with the guidance in EPRI TR-102323. Westinghouse performed the following tests:

- Low-Frequency Conducted Emissions, 100 Hz to 50 kHz (Test Method CE101)
- High-Frequency Conducted Emissions, 10 kHz to 400MHz (Test Method CE102)
- Radiated Magnetic Field Emissions, 1 kHz to 100 kHz (Test Method RE101)
- Radiated Electric Field Emissions, 10 kHz to 1 GHz (Test Method RE102)

- Low-Frequency Conducted Susceptibility, 30 Hz to 50 kHz (Test Method CS 101)
- High-Frequency Conducted Susceptibility, 50 kHz to 30 MHz (Test Method CS 114)
- Radiated Electric Field Susceptibility, 10 kHz to 1GHz (Test Method RS 103)
- Electrostatic Discharge Susceptibility (Test Method IEC 801-2)
- Conducted Electrical Fast Transient Susceptibility (Test Method IEC 801-4)
- Injected Surge Pulse Susceptibility (Test Method IEC 801-5)

The Summary Qualification Report identifies one operational anomaly that failed to satisfy the guidance of TR-102323. During test RE102, the radiated emissions exceeded the specified limits over a narrow band of frequencies. Therefore, before installing Common Q equipment in a nuclear power plant, the licensee needs to perform an analysis to ensure the EMI emissions from the Common Q system do not affect the surrounding equipment. Westinghouse explains this requirement in Section 7, "Installation Limitations," of the Summary Qualification Report.

The Summary Qualification Report also identifies several limitations on equipment installation that are required to maintain the reported performance. These installation requirements are stated in Table 6-1 and Section 7 of the Summary Qualification Report.

Based on the foregoing review, the Common Q platform did not meet the radiated electric fields emissions guidance of TR-102323, however, if used according to the limitations in Table 6-1 and Section 7 of the Summary Qualification Report, the staff finds that it is acceptable for use in safety systems in nuclear power plants. On this basis, the staff closes GOIs 7.1, 7.2, 7.3, and 7.6 with regard to the EMC requirements.

GOI 7.5 required CENP (now Westinghouse) to perform additional EMC testing on the PM646 module. When CENP conducted the initial EMC qualification testing (before the initial SE), CENP used four PM645C modules and one PM646 module in the initial test specimen. Including both models in the qualification process did not affect the physical configuration because PM646 and PM645C have the same physical configuration. However, the staff concluded in the initial SE that using PM646s instead of PM645Cs might affect how the Common Q equipment responds with regard to EMC. Therefore, to resolve any issues that might arise from replacing PM645Cs with PM646s, CENP stated that it would perform additional EMC tests and measurements on the PM646 during the EMC testing of the supplemental hardware. The staff documented this requirement in the initial SE as GOI 7.5. The staff has reviewed the Summary Qualification Report and agrees with the Westinghouse conclusion that the EMC test results show that substituting four PM646 (or PM646A) modules in place of four PM645C modules does not affect how the Common Q equipment responds with regard to EMC. In Section 3.1.2.1 of this SE, the staff determined that the PM646s and PM646As may be used interchangeably. On the basis of the foregoing, the staff closes GOI 7.5.

3.1.2.2.2 Environmental Qualification Testing

For the environmental testing, the test specimen was configured in a worst-case configuration for the proposed Common Q applications. The configuration consisted of four processor modules, a full complement of I/O modules, internal watchdog timers, FPDs, PC node boxes, power supplies, and other miscellaneous hardware. The power supplies were loaded with a nominal load. Application programs exercised all applicable functions and monitoring software tracked the performance of the equipment.

The Common Q test specimen was subjected to the testing profile of Table 5-2, "Common Q Equipment Environmental Design Requirements," (Westinghouse proprietary) in the Supplemental Qualification Report. This testing profile enveloped the testing profile requirements that were applied during the initial qualification of the AC160 equipment. Westinghouse has included in the testing profile of Table 5-2, the requirements in Westinghouse TR WCAP-8587, Revision 6-A (NP), "Methodology for Qualifying Westinghouse WRD Supplied NSSS Safety Related Equipment," 1983. As a result, the applied testing profile is more conservative than that which was used in the qualification of the AC160 equipment for the initial SE. Westinghouse made this change to make the Common Q platform compatible with a broader range of Westinghouse implementations.

During the tests, there were several anomalies associated with the chamber temperature control and some of the monitoring equipment. The test specimen suffered only one failure. The 18-inch FPD lost its video output at elevated temperatures. The test series was repeated to further study the anomalies. A different 18-inch FPD was included in the repeat test and it functioned properly.

Westinghouse returned the faulty circuit board to the manufacturer and obtained a root cause analysis. The manufacturer reported that the failure was due to a faulty integrated circuit chip. The manufacturer tested several additional circuit boards at elevated temperatures and was unable to duplicate the failure. Westinghouse concluded that this was a random failure and not a generic issue.

Westinghouse concluded that none of the Common Q components failed to function as a result of the environmental conditions imposed by the test. Based on its review of the Summary Qualification Report, the staff agrees with the Westinghouse conclusion.

The staff concludes, therefore, that the Common Q platform has successfully completed the environmental test program and is qualified for use in safety systems in nuclear power plants to the conditions specified in Figure 5-1, "Common Q Environmental Test Profile," (Westinghouse proprietary) and Table 5-2, "Common Q Equipment Environmental Design Requirements," (Westinghouse proprietary). On this basis, the staff concludes that GOs 7.1, 7.2, 7.3, and 7.6 are closed with regard to environmental qualification of the Common Q components.

3.1.2.2.3 Seismic Qualification Testing

The Common Q supplemental hardware qualification program included the testing of digital processors, I/O modules, power supplies, display systems and miscellaneous support equipment. Testing was performed in accordance with the guidelines of IEEE Std 344-1987. The test response spectra (TRS) are described in Section 6.6.3, "Seismic Conclusion," of the Summary Qualification Report (Westinghouse proprietary).

Westinghouse made the following conclusions with respect to the Common Q supplemental hardware seismic qualification program:

(1) Common Q FPDs and PC Node Box

All three versions of the Common Q FPDs and PC node box (a single-board Intel-based computer) functioned properly and are qualified to the TRS described in the Summary Qualification Report with some field modifications of the equipment. The field modifications on these displays are being incorporated into the display design by the vendor. The staff was present for the testing and reviewed the field modifications and the successful retesting and concluded that the modifications to be incorporated by the vendor are acceptable.

(2) Common Q Power Supplies

All three versions of the Common Q power supply assemblies functioned properly and are qualified to the TRS described in the Summary Qualification Report.

(3) AC160 Modules

All AC160 modules and related equipment with the exception of the PM646A and AI685 analog input modules functioned properly and are qualified to the TRS described in the Qualification Summary Report.

The PM646A processor module and the AI685 analog input module successfully met the five operating basis earthquake (OBE) mechanical aging criteria, but failed to perform satisfactorily at the safe shutdown earthquake (SSE) levels. Therefore, for these two modules, the sixth OBE performed represents the SSE qualification level for these two items of equipment, as is described in the TRS in the Summary Qualification Report.

On the basis of this review, the staff agrees with Westinghouse's conclusions regarding seismic qualification testing as described above. The staff found that Westinghouse configured the test specimen using dummy modules to fill all the used rack slots, and configured the test specimen to represent the loading conditions of the anticipated Common Q applications. Therefore, the staff finds that, as stated in the initial SE as a plant-specific action item No. 6.4, before installing the plant-specific Common Q equipment, a licensee needs to verify that its Common Q system does not have any unfilled rack slots and that the loading condition of the system is consistent with the test specimen loading condition. Additionally, for the application of this qualification result, a licensee should verify that the required response spectra for the Common Q equipment are enveloped by the TRS.

The staff concludes that the Common Q components have been qualified to meet the seismic requirements for digital I&C safety systems in nuclear power plants to the TRS described in the Summary Qualification Report, Section 6.6.3, "Seismic Conclusion" (Westinghouse proprietary). On this basis, the staff concludes that GOs 7.1, 7.2, 7.3, and 7.6 are closed with regard to seismic qualification of the Common Q components.

3.1.3 Summary of Conclusions Related to the Specific GOs

The staff concludes on the basis of the foregoing review, that the Common Q components either have been manufactured to 10 CFR Part 50, Appendix B, requirements or are

commercial-grade items dedicated to Appendix B equivalent quality. The staff concludes that the Common Q components have been qualified to meet the EMC, environmental, and seismic requirements for digital I&C safety systems in nuclear power plants to the conditions specified in Section 3.1.2.2 above. The staff concludes that Westinghouse has acceptably addressed the staff's concerns regarding the qualification of the Common Q components, both AC160 and non-AC160. The staff, therefore, closes GOIs 7.1, 7.2, 7.3, 7.5, and 7.6.

This evaluation supplements the initial Common Q platform SE dated August 11, 2000. Except as satisfied by the closing of nine of the ten GOIs, the limits of acceptability set forth in that SE still apply.

3.2 Changes to the TR, the SPM, and Appendices

3.2.1 Description of the Changes to the TR, the SPM, and Appendices

The staff's evaluation of the changes to the TR, the SPM, and appendices reflects the following considerations:

- Changes resulting from the closing of the five GOIs
- Equivalency of the PM646 and PM646A processor modules
- Use of the PM646/PM646A built-in hardware watchdog timer function in place of the external hardware watchdog timer
- Single instead of redundant CI631 communications modules to drive the AF100 communications buses
- Changes to the configuration of the modules and subracks in the TR and appendices
- Changes to clarify the SPM

The evaluations of most of the hardware changes relate to the closing of the five GOIs and are found in Section 3.1 of this SE. Those needing further review are evaluated in Section 3.2.2 below.

3.2.2 Staff's Analysis of the Changes to the TR, SPM, and Appendices

3.2.2.1 Changes to the Common Q TR

Many of the changes are editorial or are below the level of detail that was evaluated in the initial SE and are, therefore, not significant. The staff reviewed each of the proposed changes and finds that those that are not listed below are editorial in nature or are below the level of detail that was evaluated in the initial SE. The significant changes are listed below with summaries of the staff's findings and conclusions:

1. Insert a new reference, WCAP-8587, Revision 6-A (NP), "Methodology for Qualifying Westinghouse WRD Supplied NSSS Safety Related Equipment," 1983.

Westinghouse incorporated WCAP-8587, Revision 6-A to make the Common Q platform compatible with a broader range of Westinghouse environmental requirements. The environmental conditions required by WCAP-8587, Revision 6-A are more severe than those used in the qualification of the Common Q equipment for the initial SE. The

staff concludes that this is a change in the conservative direction and is, therefore, acceptable.

2. All references to the PM646 processor in the TR and appendices will be changed to the PM646A processor.

The staff concluded in Section 3.1.2.1 that the PM646 and PM646A processor modules may be used interchangeably to suit the configuration requirements in specific applications. The staff concludes that the change to the text in the TR and appendices is appropriate and acceptable.

3. All references to the external watchdog timer in the TR and its appendices are changed to reflect the PM646A built-in hardware watchdog timer function.

The PM646A processor module includes a built-in hardware watchdog timer function that Westinghouse has determined can be used as the hardware watchdog timer for all Common Q systems instead of the previously planned separate hardware watchdog timer module. The built-in hardware watchdog timer function consists of a relay driven by analog circuitry that must be reset regularly by the software it protects or the relay coil will de-energize and annunciate a software failure. Depending on the specific system application, the watchdog timer can be used to annunciate a failure, actuate a channel trip, or set output states to predefined conditions. In Section 3.1 of this SE, the staff concluded that Westinghouse has acceptably qualified the built-in hardware watchdog timer function in the PM646A processor module for use in safety systems in nuclear power plants. The staff has reviewed the substitution of the built-in hardware watchdog timer function for the previously planned separate hardware watchdog timer module and concludes that the substitution of the built-in watchdog timer function in the design continues to meet the applicable regulatory requirements. The staff concludes, therefore, that these changes to the text in the topical report and appendices are appropriate and acceptable.

4. The new AI685 analog input module is incorporated into the Common Q TR.

In Section 3.1 of this SE, the staff concluded that the AI685 analog input module is acceptable for use in safety systems in nuclear power plants. The staff has reviewed the changes that incorporate the AI685 into Revision 2 of the main body of the TR and concludes that these changes are appropriate and acceptable.

5. Westinghouse has changed the way that the AF100 communication bus is driven from the CI631 communication processor in the Common Q subracks (Westinghouse proprietary).

The design change uses only one CI631 instead of a redundant pair of CI631s to drive the AF100 bus. The staff has reviewed this proprietary design change and agrees with Westinghouse that it does not reduce the availability of the system. The staff concludes that the new design continues to meet the guidance of RG 1.152 and is, therefore, acceptable.

6. Section 6.5 of the Common Q TR main body contains an overview of the CPCS as an example of a typical Common Q implementation. The changes in this section reflect the changes Westinghouse has made to Appendix 2, "Westinghouse Common Qualified Platform Core Protection Calculator System." The staff's review of the changes to Appendix 2 is reported in Section 3.2.2.4 of this SE.

The staff has reviewed the changed pages in Section 6.5 and finds that they are editorial in nature. They reflect changes to the overview of CPCS found in Section 6.5 to make it consistent with the changes to Appendix 2. On this basis, the staff finds that these editorial changes are acceptable.

7. Westinghouse has deleted the table on pages 92 and 93 of the TR that assigns software quality assurance activities. This information is contained in the SPM, making this table redundant. The staff's review and approval of the changes to the SPM are reported in Section 3.2.2.2 of this SE.

The staff concurs in the deletion of this redundant table from the TR main body.

On the basis of the foregoing review, the staff concludes that the proposed changes to the Common Q components, configuration, architecture, and the text of the TR do not compromise the characteristics that were critical in the initial SE and are, therefore, acceptable.

3.2.2.2 Changes to the SPM

Westinghouse's "Software Program Manual for Common Q Systems," CE-CES-195, Revision 1, specifies plans for implementing a structured software life cycle process for application software and provides guidance for configuration management of commercial-grade hardware and previously developed software. As stated in the initial SE, licensees using the Common Q platform for plant-specific applications are required to implement the application software in accordance with Westinghouse's SPM. The staff reviewed the changes to Revision 1 of the SPM to assure that the changes do not compromise the characteristics that were critical to the successful evaluation of the SPM during the initial SE.

During the ongoing development of plant-specific application software Westinghouse has found that changes to the SPM were necessary. As the staff requires that changes to the topical report, its appendices, and the SPM be submitted for staff review, Westinghouse submitted changes to the SPM from Revision 1 to Revision 2 for the staff review. Many of the changes were editorial in nature and have no safety significance. The following are the staff's findings and conclusions regarding the changes that have safety significance:

1. Section 3.3.1, page 20, last paragraph, item 4 will state, "Support the QA department on any audits within the purview of its responsibilities." Previously item 4 stated, "Participate with the QA department on any audits within the purview of its responsibilities."

The staff considers this distinction of the responsibility of the verification and validation (V&V) team leader to "support" rather than "participate with" the quality assurance (QA) to be a meaningful distinction that emphasizes the independence of Westinghouse V&V

activities as found acceptable in Section 4.3.1.j in the initial SE. The initial SE requires that the QA organization have both managerial and budgetary independence from a cognizant engineering organization that includes either the software design team or the software V&V team. On this basis the staff approves this change to the SPM.

2. In several instances functions that are called "audit" in Revision 1 are called "review" in the proposed Revision 2.

The staff has reviewed each of these instances and finds that the change more correctly defines the function needed in each instance. On this basis, the staff approves these changes to the SPM.

3. In the proposed revision, there are several clarifications of which entities are responsible for V&V inputs and outputs.

The staff has reviewed each of these clarifications and finds that each is in agreement with the guidance of RG 1.168 and is, therefore, acceptable.

4. In Exhibit 4-1 (page 144), "Core Protection Calculator," Revision 2, Westinghouse proposes to list and classify two additional subsystems, i.e., "CEAC Software" as "Protection Class" and "CEAPDS" as "Important to Availability." (CEAC is an acronym for control element assembly calculator. CEAPDS is an acronym for control element assembly position display system.)

The staff finds these additions to be properly classified and, therefore, acceptable.

5. In Exhibit 5-1 (pages 150 and 151), Westinghouse proposes several changes to the assignments of software life cycle tasks for the lower two classes of software, i.e., "Important to Availability" and "General." No changes are proposed for the higher two classes of software, i.e., "Protection" and "Important to Safety."

The staff has reviewed these changes and finds that they conform to the guidance in RG 1.168, "Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants." On this basis, the staff finds these changes to be acceptable.

6. Westinghouse proposes to replace the CENP form, "Condition Alert," with the Westinghouse form, "Issue Report," for Exhibit 9-2, "Corrective Action Process."

The staff has reviewed the proposed change and finds that the replacement form serves the same purpose as the original form and is, therefore, acceptable.

On the basis of this review, the staff concludes that the proposed changes to the Westinghouse Software Program Manual for Common Q Systems, CE-CES-195, Revision 1, do not compromise the characteristics that were critical in the initial SE and are, therefore, acceptable.

3.2.2.3 Changes to Appendix 1 - PAMS

Westinghouse proposes to change the configuration of the Common Q modules and communications buses in the PAMS instrumentation subracks. No change is proposed for the PAMS algorithms.

1. All references to the processor type in Appendix 1 are changed from PM646 to PM646A.

The staff has reviewed each change to PM646 to PM646A in Appendix 1 and concludes that each is appropriate and, therefore, acceptable.

2. In Section A1.1.2.2.9, "Interlocks and Permissives," page 28, second paragraph, first and second bullets; there are changes to the discussion of the implementation of thermocouples.

The staff concludes that these design changes are below the level of detail that was evaluated as generic in the initial SE. The actual implementation may depend upon the plant-specific design, as is provided for in the initial SE. On this basis, the staff concludes that these changes to the text are acceptable.

3. On page 56, Section A1.2.1.4, "PAMS Watchdog Timer," there are changes to the discussion of the implementation of the PM646A watchdog timer function. The only design change specifies an interlock to provide a PAMS alarm contact. The rest of the changes are editorial in nature.

The staff concludes that the design change is below the level of detail that was evaluated as generic in the initial SE in that the actual implementation may depend upon the plant-specific design. The editorial changes do not affect the design. On this basis, the staff concludes that these changes to the text are acceptable.

4. On pages 59 through 73 several changes are indicated.

The staff has reviewed each of these changes and has concluded that each is either a design change that is below the level of detail that was evaluated as generic in the initial SE or an editorial change that does not appear to affect the design. On this basis, the staff concludes that these changes are acceptable.

The staff has reviewed the changes proposed for Appendix 1 and finds that they are editorial in nature or are below the level of detail that was evaluated in the initial SE. On this basis, the staff concludes that each of the proposed changes to Appendix 1 is acceptable.

3.2.2.4 Changes to Appendix 2 - CPCS

Westinghouse proposes to change the arrangement of the Common Q modules and communications buses in the CPCS instrumentation subracks. No change is proposed for the CPCS algorithms. The CPCS safety-related algorithms in the revised configuration will remain the same as in the initial configuration. These algorithms are also unchanged from the safety-related algorithms that run in the legacy CPCS in existing power plants. In the submittal,

Figure 1.1, "Existing Figure A2.1-1," shows the existing Common Q CPC/CEAC four-channel block diagram as presently shown in Appendix 2 and Figure 1.2, "Revised Figure A2.1-1," shows the proposed revised configuration.

1. Changes Reflected in the Common Q CPC/CEAC Four-Channel Block Diagram

Westinghouse proposes to change Figure A2.1-1, "Common Q CPC/CEAC Four-Channel Block Diagram," to reflect proposed changes to the physical configuration of the CPCS. Proposed Figure A2.1-1 shows changes to the number of subracks and disposition of PM646A processors and other components. Westinghouse stated that the safety-related algorithms of the CPCS revised configuration remain the same as were planned in the initial configuration and that these algorithms are also the same as in the CPCS legacy systems now found in operating nuclear power plants. The following is the list of the proposed changes to Appendix 2 that are reflected in Figure A2.1-1:

- CEAC availability
- Backplane loading considerations
- Core protection calculator (CPC) processor allocation
- Analog input module configuration
- CEAC to CPC penalty factor transmission
- Channel communications
- Power supply configuration
- Operator's module and maintenance test panel Ethernet connections
- Time synchronization
- Processor module model
- Changes in watchdog timer configuration

The staff has reviewed the above changes to the physical configuration against the guidance of RG 1.152 and RG 1.153 and concludes that none of these changes alter the staff's conclusions in the initial SE regarding the CPCS and that they are, therefore, acceptable.

2. Changes Not Reflected in the Common Q CPC/CEAC Four-Channel Block Diagram

Westinghouse describes several changes that are not apparent in an examination of the "Common Q CPC/CEAC Four-Channel Block Diagram." The staff has reviewed each of these changes and finds that they (1) are editorial in nature (in that they simply bring the text in Appendix 2 into agreement with the changes the staff has found to be acceptable in its review of the Common Q TR), or (2) are below the level of detail that was evaluated in the initial SE, or (3) affect the human-machine interface (HMI). As stated in the initial SE, the HMI is to be evaluated as a plant-specific action item and therefore, is not a part of this evaluation. On the basis of the foregoing review, the staff concludes that the proposed changes that are not reflected in the "Common Q CPC/CEAC Four-Channel Block Diagram" do not compromise the characteristics that were critical to the acceptability of the Common Q platform in the initial SE and that they, therefore, are acceptable.

3. Changes to the Failure Mode and Effects Analysis (FMEA)

Westinghouse has revised the CPCS FMEA in Appendix 2 to reflect the new configuration and its failure modes. In the initial SE, the staff found the format of the FMEA to provide an acceptable approach; however, the evaluation of the detailed FMEA is a plant-specific action item. The staff has examined the proposed changes to the FMEA in Appendix 2 and finds that they do not alter the staff's conclusion regarding the FMEA in the initial Appendix 2. The staff concludes, therefore, that the changes proposed to this example FMEA are acceptable.

On the basis of the above review, the staff concludes that the changes that Westinghouse proposes for the CPCS do not compromise the characteristics that were critical to the acceptability of the Common Q platform in the initial SE and are, therefore, acceptable.

4.0 CONDITIONS

In addition to the conditions specified in the initial safety evaluation, the following conditions must be met prior to the use of the Common Q platform in safety systems in nuclear power plants.

1. The Common Q platform shall be used according to the limitations in Table 6-1 and Section 7 of the Summary Qualification Report, before it is acceptable for use in safety systems in nuclear power plants.
2. The Common Q platform shall be used according to the conditions specified in Figure 5-1, "Common Q Environmental Test Profile," (Westinghouse proprietary) and Table 5-2, "Common Q Equipment Environmental Design Requirements," (Westinghouse proprietary) before it is qualified for use in safety systems in nuclear power plants.
3. The Common Q components shall be used according to the seismic conditions described in the TRS found in the Summary Qualification Report, Section 6.6.3, "Seismic Conclusion" (Westinghouse proprietary).

5.0 CONCLUSION

On the basis of the review documented in Section 3.1, the staff concludes that Westinghouse has acceptably addressed the staff's concerns regarding the qualification of the supplemental hardware, and the staff, therefore, closes GOIs 7.1, 7.2, 7.3, 7.5, and 7.6. There remains one open GOI (GOI 7.8), regarding the future integration of multiple safety systems using the Common Q platform.

On the basis of the review documented in Section 3.2, the staff concludes that the changes Westinghouse proposes to make to Revision 1 of the Common Q TR, the SPM, and Appendices 1 and 2 do not compromise the characteristics that were critical to the acceptability of the Common Q platform in the initial SE and are, therefore, acceptable.

The staff therefore concludes that the Common Q platform may be used for digital I&C implementations in nuclear power plants within the limits defined in the initial SE and the two supplemental SEs.

However, the staff's conclusions regarding acceptability of the changes to Appendices 1 and 2 are not to be interpreted as approval of the post accident monitoring functions in Appendix 1 or the core protection calculator functions in Appendix 2 for use in a specific nuclear power plant implementation. The staff's evaluation of the four appendices as stated in the initial SE, Section 4.4, "Evaluation of the Common Q Applications," still applies.

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