

March 9, 2016

James Powers
Vice President, Nuclear Island & Business Development
Toshiba America Energy Systems Corporation
3545 Whitehall Park Drive
Suite 500
Charlotte, NC 28273

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR "LICENSING TOPICAL REPORT FOR TOSHIBA NRW [NON RE-WRITABLE]-FPGA [FIELD PROGRAMMABLE GATE ARRAY]-BASED INSTRUMENTATION AND CONTROL SYSTEM FOR SAFETY-RELATED APPLICATION," UTLA 0020P, REVISION 2 (TAC NO. ME9861)

Dear Mr. Powers:

By letter dated February 23, 2015, Toshiba Corporation (Toshiba) submitted Revision 2 to "Licensing Topical Report For Toshiba NRW-FPGA-Based Instrumentation And Control System For Safety-Related Application" (Agencywide Documents Access and Management System Accession No. ML15062A183). Upon review of the information provided, the U.S. Nuclear Regulatory Commission (NRC) staff has determined that additional information is needed to complete the review.

In an email exchange with Mr. Dale Wuokko, representing Toshiba, it was agreed that the NRC staff will receive your response to the enclosed Request for Additional Information (RAI) questions by April 8, 2016.

If you have any questions regarding the enclosed RAI, please contact me at 301-415-7297 or Joseph.Holonich@nrc.gov.

Sincerely,

/RA/

Joseph J. Holonich, Sr. Project Manager
Licensing Processes Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 729

Enclosure:
RAI questions

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DATE	03/7/2016	02/24/2016	03/7/2016	03/8/2016	03/9/2016

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REQUEST FOR ADDITIONAL INFORMATION
TOSHIBA TOPICAL REPORT FOR FIELD PROGRAMMABLE GATE ARRAY-BASED
POWER RANGE MONITORING SYSTEM AND
OSCILLATION POWER RANGE MONITORING UNIT
Instrumentation and Controls Branch

Documents to be Docket

1. Please docket the documents identified below:
 - FA10-0501-0024, Software Program Plan
 - NICSD Verification and Validation Plan
 - P-101, NICSD Manufacture of FPGA-based equipment
 - FPG-PLN-A70-0001, Project Quality Assurance Plan
 - FPG-PLN-C51-0003, NRW-FPGA-based PRM System Qualification Project Quality Assurance Plan

Equipment Qualification

2. (Open Item 39) The Power Range Monitoring (PRM) System Qualification Test Summary (FPG-TRT-C51-0101) does not identify the same local power range monitoring (LPRM) and analog output (AO) modules that were listed in other equipment qualification (EQ) tests. Clarify if the same LPRM and AO modules were used for all EQ tests. Also, please clarify if the same LPRM and AO modules with additional capacitors were used for all EQ tests.
3. (Open Item 40) There are some discrepancies related to the applicant's document quality control, which were found in the applicant's documents. Please clarify these inconsistencies:
 - a. The PRM System Qualification Test Summary (FPG-DRT-C51-0101, Rev. 0), Figure 5-1, "Actual Test Flow Diagram," does not match Figure 4-1, "Master Test Plan Flow Diagram," in the Master Test Plan (FPG-PLN-C51-0005, Rev. 3).
 - b. The cover page of the Qualification Test Summary Report identifies as document number "FPG-TRT-C51-0101." However, the pages inside (at the top of the page), identify this document as "FPG-DRT-C51-0101."
 - c. The Master Test Plan (FPG-PLN-C51-0005, Rev. 3) does not identify the achievable amplitudes for both Operation Basis Earthquake (OBE) and Safe Shutdown Earthquake (SSE) seismic events.
 - d. The PRM System Qualification Test Summary (FPG-DRT-C51-0101, Rev. 0), page 25, references Table 4-1 and Figure 4-5, but these references were not included in the document.

Enclosure

4. (Open Item 43) The Environmental Qualification Report for Oscillation Power Range Monitoring (OPRM) unit (FC51-7513-1000) summarizes the test results from EQ testing. This report does not include the results from the 1E to non-Class 1E isolation test.
5. Please explain why this report does not include Class 1E to non-Class 1E isolation test for the OPRM unit.
- 5a. (Open Item 44) It is not clear in the applicant's EQ document whether the required burn-in test with a minimum 352 hours was conducted on the assembled test specimen for the OPRM system or not. If not, justifications should be provided.
6. (Open Item 45) Electric Power Research Institute (EPRI) Topical Report (TR)-1077330, "Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants," requires vendors to perform response time test during EQ testing. The Equipment Design Specification for Power Range Neutron Monitor (FC51-3002-1000, Rev.4) defines the OPRM trip response time requirements. However, the Environmental Qualification Report (FC51-7513-1000) does not include results of such test. Please explain why the response time test was not performed.
7. (Open Items 46 , 61, and 62) Toshiba documents are not consistent when identifying the modules qualified during EQ testing for the PRM system and those identified in the TR for review and approval of the PRM system. Please identify all modules qualified for the PRM system and OPRM unit for which Toshiba is requesting review and approval in its TR. Please include name, model number, and brief description for each module. If references to possible module substitutes and old modules are included in the response, please provide clear explanation and justification of why these modules are referenced.

For modules listed in the EQ testing documents that are not part of the review scope (e.g., MUX module HNS260) but were necessary for testing, please identify them as out of scope.

8. (Open Item 63) (Note this item is related to Open Items 46 and 61) The Master Configuration List (FPG-CFM-C51-0001), Section 2, lists the Hardware Configuration for the test specimen. This information is presented in table format, which includes a "date" column. Please explain what the purpose of the information provided in the column "date" is referring. In addition, please clearly identify the hardware configuration that corresponds to the test specimen described in Appendix 1 of the Master Test Plan (FPG-PLN-C51, Rev. 3), and for which Toshiba is requesting approval in its TR.
9. (Open Item 47) The Qualification Test Summary Report (FPG-TRT-C51-0101) documents the result of environmental qualification test and qualification analysis performed on the PRM system. This document does not identify the standards used to calibrate the test specimen, measuring and test equipment used for the EQ of the PRM system. Clarify what standards were used.
10. (Open Item 48) Table 5-1 of the EPRI TR-107330 specifies operability and prudency tests for the test specimen. Please clarify whether these tests were performed for the

PRM system during the qualification tests. In addition, Sections 5.3 and 5.4 of the EPRI TR-107330 identify the test requirements for the operability and prudency tests. Please also identify the test requirements included in these tests for the qualification of the PRM system.

11. (Open Item 53) Toshiba has implied that a Dedication Plan was created for the commercial grade acceptance of the PRM system. However, a dedication plan was not identified in the Qualification Plan for the PRM system. Please confirm if Toshiba created a Dedication Plan for the PRM system.
12. (Open Item 55) In the Qualification Test Summary Report (FPG-TRT-C51-0101), Toshiba justifies not performing aging test for the OPRM unit because of the design conditions in the Advance Boiling Water Reactor (ABWR) Design Control Document. However, it is not clear how this justification applies to the generic system described in the TR. Therefore, please explain why Toshiba did not conduct the radiation aging test for the OPRM unit.
13. (Open Item 36) Superseded versions of numerous Regulatory Guides (RGs) and their endorsed Institute of Electrical and Electronics Engineers (IEEE) standards are used in Enclosure 2 of the TR and other Toshiba's documents, especially for the PRM system. Examples include RG 1.28, RG 1.168 through RG 1.173, IEEE Std. 323, IEEE Std. 344, etc. Justifications should be provided for using previous versions of RGs and endorsed IEEE standards if the current versions are not used.
14. (Open Item 56) Section 9.1.8 of the EQ Test Plan for Safety-Related OPRM (FC51-7012-1000, Rev. 2) states the operability and prudency test are not performed during seismic testing. According to Table 5-1 of EPRI TR-107330, the operability test and prudency test should be conducted during SSE. Please provide justifications for not conducting the operability and prudency test during the seismic test.
15. (Open Item 57) EPRI TR-107330 requires testing of the (watchdog) timer during the operability test. Please provide justifications for not including the (watchdog) timer test as one of the operability test items for the OPRM system.
16. (Open Item 58) The Electromagnetic Compatibility (EMC) Qualification Report for Safety-Related OPRM (FC51-7513-1001, Rev. 0) was issued on Nov. 8, 2013. However, Section 9.2.5.4 of this document states that the RS101 testing was performed in Fuchu Complex on December 28, 2013. Clarify this discrepancy. In addition, the EMC qualification tests were conducted from December 3, 2012, through January 7, 2013. But, Table 7-3 in this document states that calibration due date is July 31, 2013, for the measuring and test equipment. Please clarify why the calibration was conducted later than the tests.
17. (Open Item 59) Sections 9.2.5 and 11.2 of the EMC Qualification Report for the OPRM (FC51-7513-1001) mention that varistors and noise filters were used during the EMC tests to improve the quality of the power source in order to comply with the EMC requirements. But, the varistors and noise filters were not included as part of the OPRM unit. If varistors and noise filters are not used, clarify what specific quality of the power

source should have in order to meet the EMC requirements. In addition, if the power source is of poor quality, describe what technical specifications the varistors and noise filters should have in order to meet the EMC requirements.

18. (Open Item 60) Qualification Test Summary Report (FPG-TRT-C51-0101) documents the result of environmental qualification test and qualification analysis performed on the PRM system. This document does not include the wear aging test. Please explain if the wear aging test was performed for the PRM system.
19. (Open Item 64) The OPRM Unit Detailed Specification (FC51-3702-1000) identifies a power factor correction module (PFC). This module is not included in the TR, Tables II-2-6 and II-B-1. However, Section II-A-3-1 of the TR lists two PFCs modules as part of the test specimen for the OPRM unit. Please clarify if the PFC module was part of the EQ testing. Additionally, confirm if the PFC module is part of the OPRM unit, and thus part of the system under review.

Commercial Grade Dedication

20. (Open Item 66) The Acceptance Checklist for Commercial Grade Item (ACLFPG-JOS-C51-0001-01) identifies the type of source verification for each critical characteristic. One of the method used is R (for Record Review). However, this checklist does not identify what specific record was reviewed to accept critical characteristics. Please describe what records were reviewed for accepting the critical characteristics of the PRM system.
21. (Open Item 69) The Acceptance Checklist for Commercial Grade Item (ACLFPG-JOS-C51-0001-01), Attachment 1, lists several references for the modules. Please explain what these references/documents are and how they were used for the acceptance of the PRM system.

Preliminary Technical Evaluation Report

22. (Open Item 72) Section 4 of the Preliminary Technical Evaluation Report (PTER) (FPG-DRT-C51-0001) includes the following statement: "There are no "safety functions" for the PRM Test System to be procured for this project, since the project involves creating a Test System for qualification..." Please confirm the test specimen used during EQ testing included the logic necessary to perform the functions required by the PRM system.
23. (Open Item 73) Section 4.3.2 of the PTER (page 21/60) identifies test equipment that were considered safety-related. Please confirm if this equipment was part of the test specimen.
24. (Open Item 74) In letter IM-2015-000152, action item 3, Toshiba agreed to provide in the responses explanations to the critical characteristics identified in Appendix A of the PTER. Please provide the information to supplement Appendix A of the PTER.

System Description and Configuration

25. (Open Item 75) In its letter TOS-CR-PG-2015-0007, Toshiba provided responses to the staff request for additional information (RAI) questions. The response provided to Item 11 states: "Each rotary switch allows setting one or a series of digits." Please explain where Toshiba will provide the information to set the rotary switches for each module in the PRM system and OPRM unit.
26. (Open Item 76) In its letter TOS-CR-PG-2015-0007, Toshiba provided responses to the staff RAI. The response provided to item 16 states: "TRN and RCV modules were qualified with the OPRM. These modules can be applied to the PRM." Since these modules were not included in the test specimen for the PRM qualification, please explain why these modules can be used with the PRM system for BWR-5.
27. (Open Item 77) Section II-A-2.7 of the TR describes self-diagnostic capabilities for the system. This section includes the following sentence: "If only a single value is being communicated, data update checks using refresh counts and timeout checks are provided." Please clarify the meaning of this sentence.
28. (Open Item 78) Section II-A-3.2 of the TR describes the OPRM configuration. This section includes the following sentence: "The logic inside each FPGA was identical to what would be shipped to a BWR." It is our understanding that there are differences between the OPRM configuration for the ABWR design and for the BWR design, and these differences will require modifications to the OPRM (e.g., number of LPRM). Therefore, it is not clear how the logic in the FPGA can be identical. Please clarify the meaning of this sentence.
29. (Open Item 79) Section II-A-7 of the TR describes the PRM system configuration for BWRs. This section includes the following sentence: "Replacement of the LPRM, APRM, and OPRM together is best performed using fiber optic communication and modules that have already been type tested." Please clarify the meaning of this sentence.