

Attachment 5 and 11 are to be withheld from public disclosure under 10 CFR § 2.390.  
When separated from these attachments, this letter is decontrolled.



Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

December 22, 2011

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant, Unit 2  
NRC Docket No. 50-391

10 CFR 50.4

**Subject: WATTS BAR NUCLEAR PLANT (WBN) UNIT 2 – INSTRUMENTATION AND CONTROLS STAFF INFORMATION REQUESTS**

Reference: 1. Supplemental Safety Evaluation Report (SSER) 22, 23 and 24 Appendix HH  
Watts Bar Unit 2 Action Items Table

The purpose of this letter is to provide TVA's responses to NRC's information requests on:

- NRC to TVA letter dated November 18, 2011, "Watts Bar Nuclear Plant, Unit 2 - Request for Additional Information Regarding Supplemental Safety Evaluation Report Open Items 80, 81, 94, 105, and 108 (TAC NO. ME0853)" (ML113130218)
- TVA to NRC letter, "Watts Bar Nuclear Plant (WBN) Unit 2 – Status of Regulatory Framework for the Completion of Construction and Licensing for Unit 2 - Revision 5 (TAC No. MD6311), and Status of Generic Communications for Unit 2 - Revision 5 (TAC No. MD8314)," dated January 21, 2011 (Enclosure 1, SER 11.5.0)
- NRC to TVA e-mail (J. Poole, NRC to G. Arent, TVA), "Draft Request for Additional Information Regarding Open Item 98," sent December 12, 2011
- Various commitments

Enclosure 1 to this letter provides TVA's responses to the information requested by NRC. Enclosure 2 contains the supporting documents for TVA's responses to NRC's requests/questions provided in Enclosure 1. Enclosure 3 contains a list of references on which TVA's responses are based. Enclosure 4 contains a list of new regulatory commitments.

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Attachment 11 contains information proprietary to General Atomics Electronic Systems, Inc., (GA-ESI). TVA requests that the GA-ESI proprietary information be withheld from public disclosure in accordance with 10 CFR § 2.390.

Attachment 5 contains information proprietary to Westinghouse Electric Company LLC (WEC). TVA requests that the WEC proprietary information be withheld from public disclosure in accordance with 10 CFR § 2.390.

If you have any questions, please contact Gordon Arent at (423) 365-2004.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 22<sup>nd</sup> day of December 2011.

Respectfully,



David Stinson  
Watts Bar Unit 2 Vice President

Enclosures:

1. TVA Responses to Instrumentation and Controls Staff Information Requests
2. List of Attachments
3. List of References
4. List of New Regulatory Commitments

cc (Enclosures):

U. S. Nuclear Regulatory Commission  
Region II  
Marquis One Tower  
245 Peachtree Center Ave., NE Suite 1200  
Atlanta, Georgia 30303-1257

NRC Resident Inspector Unit 2  
Watts Bar Nuclear Plant  
1260 Nuclear Plant Road  
Spring City, Tennessee 37381

**Enclosure 1**  
**TVA Letter Dated December 22, 2011**  
**TVA Responses to Instrumentation and Controls Staff Information Requests**

**Acronyms and Abbreviations**

The following acronyms/abbreviations are used in this letter:

ac	Alternating Current
AC 160	<sup>1</sup> Advant® Controller 160
AIR	Auxiliary Instrument Room
BSI	British Standards Institute
CCAP	Critical Characteristic Acceptance Plan
CET	Core Exit Thermocouple
CGIEE	Commercial Grade Item Engineering Evaluation
CIT/FAT	Channel Integration Test/Factory Acceptance Test
Common Q	Common Qualified Platform
CRC	Cyclic Redundancy Check
EDMS	Enterprise Document Management System
EL	Elevation
EMI	Electro-Magnetic Interference
<sup>2</sup> EPRI®	Electric Power Research Institute®
ESD	Electro-Static Discharge
FE	Function Enable
FPD	Flat Panel Display
FSAR	Final Safety Analysis Report
GA	General Atomics
GA-ESI	General Atomics-Electronic Systems, Inc.
HVAC	Heating Ventilating and Air Conditioning
Hz	Frequency in Cycles per Second
<sup>3</sup> IEEE™	Institute of Electrical and Electronics Engineers
ICCM	Inadequate Core Cooling Monitor
ICRDS	Integrated Cable and Raceway Design System
ICS	Integrated Computer System
IIS	In-Core Instrumentation System
IITA	In-Core Instrument Thimble Assembly
IV&V	Independent Verification and Validation
kHz	Thousands of Cycles per Second
LOCA	Loss of Coolant Accident
MCR	Main Control Room
MI	Mineral Insulated
MTP	Maintenance and Test Panel
NRC	Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
OM	Operators Module
PAMS	Post Accident Monitoring System
PC	Personal Computer
PLC	Programmable Logic Controller
QA	Quality Assurance

<sup>1</sup> Advant is registered trademark of ABB Automation Technology Products Management AG

<sup>2</sup> EPRI and Electric Power Research Institute are registered service marks of the Electric Power Research Institute Inc.

<sup>3</sup> IEEE is a registered trademark of the Institute of Electrical and Electronics Engineers Inc.

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**Acronyms and Abbreviations (continued)**

QMS	Quality Management System
RAI	Request for Additional Information
RFI	Radio Frequency Interference
RG	Regulatory Guide
RH	Relative Humidity
SDOE	Secure Development and Operating Environment
SER	Safety Evaluation Report
SLE	Software Load Enable
SPND	Self Powered Neutron Detector
SPS	Signal Processing System
SSER	Supplemental Safety Evaluation Report
TCP/IP	Transmission Control Protocol/Internet Protocol
TR	Topical Report
TRM	Technical Requirements Manual
TS	Technical Specifications
TVA	Tennessee Valley Authority
Vac	Volts alternating current
V&V	Verification and Validation
WBN	Watts Bar Nuclear Plant
WEC	Westinghouse Electric Corporation
<sup>4</sup> WINCISE™	Westinghouse In-Core Information Surveillance & Engineering
WRD	Water Reactor Division

**Notes**

1. In some instances, the abbreviation GA is used to refer to General Atomics. In some instances, the abbreviation GA-ESI is used to refer to General Atomics-Electronic Systems Inc. GA and GA-ESI are the same company and the abbreviations can be used interchangeably.
2. For some NRC requests for additional information (RAIs), this letter provides TVA's initial response. For the other NRC RAIs in this letter, a response has been provided in previous TVA letters to the NRC, and the NRC has subsequently requested additional information. For these requests, the initial TVA response is not repeated below. The additional NRC information requests are identified in this letter as "**Follow-up NRC Requests.**" TVA responses to these items are identified as "**TVA Response to Follow-up NRC Request.**"

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<sup>4</sup> WINCISE is a registered trademark of the Westinghouse Electric Corporation LLC

**Enclosure 1**  
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**Responses**

**1. NRC Request (SSER 23 Appendix HH Item Number 80)**

*TVA should provide clarification to the staff on how TVA Standard Specification SS-E18-14.1 meets the guidance of RG 1.180, and should address any deviations from the guidance of the RG. (SSER 23, Section 7.5.2.3, pg 7-115).*

**Follow-up NRC Request**

- a. *Tennessee Valley Authority (TVA) tests used a frequency range of 30 Hz to 50 kHz for low frequency conducted susceptibility testing instead of the required 30 Hz to 150 kHz. In letter dated September 30, 2011, under Item Number 8, TVA stated that the TÜV tests were conducted with test frequencies from 30 Hz to 150 kHz. Staff has noted that the TÜV tests were conducted on the older model of RM-1000 processors and not the models for which credit is taken. TVA is requested to provide its justification for using the TÜV tests for the new RM-1000 processors.*
- b. *In response to staff request for an explanation for using an alternate method for high frequency radiated emissions tests, TVA in its September 30, 2011, letter under Item Number 15, stated that the alternate method EN 55022 is more restrictive than the Regulatory Guide 1.180 and Electric Power Research Institute (EPRI) suggested methods. This statement is not backed by specific examples of how the EN 55022 is more restrictive for the test levels and the frequency ranges. Therefore, TVA is requested to provide further explanation of how the test method is more restrictive over the test levels and frequencies.*

**TVA Response to Follow-up NRC Request**

- a. *Justification for using the TÜV test report (GA-ESI document 04038800, "RM-1000 EMC Test Report TVA," dated November 11, 1999) is provided in GA-ESI document 04038800-1SP, "RM-1000 EMC Test Report Supplement 1," Revision A. GA-ESI document 04038800-1SP, "RM-1000 EMC Test Report Supplement 1," Revision A was submitted in TVA to NRC letter dated October 13, 2011 (Reference 1)*
- b. *Specific examples of how EN 55022 is more restrictive than RG 1.180 and EPRI TR102323 are provided in Attachment 1. Attachment 1 contains TVA white paper "Comparison of British Standards Institute (BSI) EN 55022, 'Information technology equipment. Radio disturbance characteristics. Limits and methods of measurement' and Electric Power Research Institute (EPRI) TR102323, 'Guidelines for Electromagnetic Interference Testing in Power Plants' Suggested Electromagnetic Compatibility Test Methods," dated December 5, 2011.*

**2. NRC Request (SSER 23 Appendix HH Item Number 81)**

*The extent to which TVA's supplier, General Atomics (GA), complies with EPRI TR-106439 and the methods that GA used for its commercial dedication process should be provided by TVA to the NRC staff for review. (SSER 23, Section 7.5.2.3, pg 7-117)*

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**Follow-up NRC Request**

*Item Number 1 of the letter dated September 30, 2011, provided a revised General Atomics (GA) procedure, OP-7.3-240, Safety-Related Commercial Grade Item Parts Acceptance, Revision K, to demonstrate compliance with EPRI Topical Report (TR)-106439. EPRI TR-106439 has been previously reviewed and accepted by the Nuclear Regulatory Commission (NRC) by letter dated July 17, 1997, therefore the revised procedure OP-7.3-240, Revision K is acceptable to staff. Further, TVA committed to provide a white paper to describe the commercial dedication program and how it conforms to the current regulations in a subsequent submittal.*

*In its October 13, 2011, letter, TVA provided a "White Paper" describing the General Atomics (Sorrento Electronics), "GA-ESI Qualification of RM-1000 Processors," which includes a description of the commercial dedication processes. In part this White Paper states, "For example, the RM-1000 High Range Area Monitors supplied to Watts Bar utilize a commercial grade 120 Vac Filter (subcomponent), which is dedicated in accordance with procedure GA-ESIOP-7.3-240. Per procedure requirements, GA-ESI performs a complete Receipt Inspection of the component. Additionally, per procedure requirements, a Quality Control Critical Characteristic Acceptance Plan (CCAP) was developed, which included identification of all critical characteristics, and a Commercial Grade Item Engineering Evaluation (CGIEE) was conducted to verify the critical characteristics. The procedure also required that the vendor provide a Certificate of Conformance certifying the component was fully manufactured, tested, and inspected to ensure compliance with all applicable specifications and requirements. GA-ESI also performs Supplier Surveys of the component vendor. The attachment to this White Paper includes the Receipt Inspection Documentation, including the CCAP and the CGIEE for the AC Filter." Attachment 1 to this White Paper (25402-011-V1A-HARA-00204-001) includes the commercial dedication package including the receipt inspection for an AC Filter (IsotrollC+105) as an example.*

*After reviewing the receipt inspection documents, staff observed that no functional test results for the AC Filter are enclosed in this package. TVA is requested to provide the functional test documentation to enable the staff to complete its evaluation of this package. If the functional test document is not available, then TVA needs to justify why the requested document is not available and submit a complete inspection documentation package for another component to demonstrate compliance to commercial dedication processes and procedures.*

**TVA Response to Follow-up NRC Request**

As stated in GA-ESI letter 010-01038-001, "The AC Filter is subjected to functional testing by the vendor. GA-ESI documentation indicates the testing was verified during a previous GA-ESI vendor audit. Recent follow up conversations with the vendor indicate the functional test is performed using an automated testing machine, and the results are Pass/Fail. A test report is not produced during the test, rather, the Certificate of Conformance is provided to certify successful completion of the testing.

Attached is a documentation package for a different component, a power supply, which is tested by GA-ESI during receipt inspection."

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Attachment 10 contains non-proprietary GA-ESI letter 010-01038-001, "Response to AC Filter Question," dated December 20, 2011. Attachment 11 contains proprietary GA-ESI letter 010-01038-001, Attachment: "04502050-001 Receipt Inspection." A non-proprietary version of the GA-ESI letter 010-01038-001, Attachment: "04502050-001 Receipt Inspection" and affidavit for withholding will be submitted within two weeks of receipt from GA-ESI.

**3. NRC Request (SSER 23 Appendix HH Item Number 98)**

*TVA should demonstrate that the WBN Unit 2 Common Q PAMS is in conformance with RG 1.152, Revision 2, or provide justification for not conforming. (Section 7.5.2.2.3)*

**Follow-up NRC Request**

*The following RAIs are regarding the Watts Bar 2 Common Q PAMS Secure Development and Operational Environment. The action associated with this review area is captured in SSER 23 Appendix HH, Action Item 98 (ML11270A306). TVA submitted documents (reference below) on September 1, 2011 to address this item.*

1. Platform Development – *The US Nuclear Regulatory Commission staff notes that the Common Q platform was subject to commercial grade dedication and that a topical report on the platform was reviewed and approved by the staff (ML003740165). However, at the time of the staff's previous review, no evaluation was performed regarding the secure development environment for the Common Q platform and the staff is aware that the platform has undergone changes. Regulatory Guide 1.152, Revision 3, which is cited by the licensee as being used to conform to establishing a secure development environment, contains regulatory positions related to ensuring that superfluous features are not present in software-based safety systems that could present the potential for degrading the reliable operation of the system.*
  - a) *Since the Common Q platform was originally designed to potentially serve in several different plant applications, please provide references for and a description of any analyses that were performed to determine if there are any superfluous functions or features resident on the platform (i.e., in any of the platform software or software-driven components, such as PLCs) that are not utilized by the Common Q platform or post accident monitoring system (PAMS) application, as well as a summary of the results of such analyses. If any unnecessary functions or features were identified, please explain what measures were taken to resolve any potential impact on the Common Q platform or PAMS application operation (i.e., were features disabled, removed or determined by analysis not to have potential to impact operations?). [e.g., the staff notes that in Attachment 9 of the September 1, 2011, Request for Additional Information responses (ML11257A050), it is stated that the Function Enable keyswitch on the Operators Module was not installed for the Watts Bar Unit 2 PAMS application, and that the Operator's Module has no connection to a printer.]*

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- b) *It is essential that the Common Q platform operating system software be maintained in a fashion that protects it from unauthorized changes. Please confirm that WNA-LI-00058-WBT-P, Rev. 3, Sections 2.2.1 and 2.2.2 (ML110950334) describe the changes made to the platform. If not, please provide a description of changes made (including removal of unnecessary features) to the Common Q operating system software since it was initially subject to commercial grade dedication and analyses were performed of the features resident on the platform. Please describe the processes followed to ensure that only authorized changes have been made.*
  - c) *WCAP-17427-P, Revision 1 (ML11257A061) states that the approved version of the QNX software is protected by a CRC stamp to ensure that the correct configuration is used. For the WBN Unit 2 PAMS application, provide documentation indicating your confirmation that the CRC stamp for QNX was verified to be the correct version intended for use.*
  - d) *WCAP-17427-P, Revision 1 states that the AC160 software is under strict configuration controls and that any changes are jointly approved by Westinghouse and ABB. Please confirm that the summary of changes provided in Section 2.2.2 of WNA-LI-00058-WBT-P, Revision 3 (ML110950334) accurately reflects modifications since dedication. Also, please describe what measures were taken to ensure that the correct, commercially-dedicated version of AC160 software is installed on the WBN Unit 2 PAMS system.*
- 2) Application Development – *Staff reviewed WCAP-17427-P, Revision 1 and found it to be largely consistent with APP-GW-J0R-012, Revision 1 (ML102170268 dated June 2010). However, much of the processes described are in future-tense and it is not clear to the staff what actions were accomplished for this particular Watts Bar Unit 2 PAMS application development to establish a secure development environment. WCAP-17427-P, Rev 1 (ML11257A061 dated August 2011) describes the security assessment for the Common Q PAMS for Watts Bar Unit 2.*
- a. *In Section 2.2.3.1.1.a, the statement is made that the Westinghouse Quality Management System (QMS) “will be” followed to ensure documents from hardware and software development efforts are adequately protected. Specifically, the section states that documents are to be stored in the Enterprise Document Management System (EDMS).*
    - i) *Please identify what documents related to the Common Q platform development (relevant to the Watts Bar 2 PAMS) are protected under the QMS / EDMS.*
    - ii) *Please identify what documents related to the Watts Bar 2 PAMS development are protected under the QMS/EDMS.*
  - b. *In Section 2.2.3.1.1.b, discussions of controls contained in the Software Program Manual are detailed. Please provide a confirmatory statement that the Watts Bar 2 PAMS development process conformed to these controls.*



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- c. In Section 2.2.3.2, items 2. and 3. are identical. Please clarify if one of these items is intended to state something else.*
- d. In Section 2.2.3.2, the statement is made that during the implementation phase, software "shall be" code reviewed by IV&V using a defined checklist for adherence to coding standards and application requirements. Please clarify if this step was performed for the Watts Bar Unit 2 PAMS application. Please clarify if WNA-VR-00283-WBT-P, Rev.4 (ML110770540) contains this record. If not, please provide a reference for the code review results and provide a statement indicating the findings of the review.*
- e. In Section 2.3.1.5, the statement is made that the security requirements "shall be" verified and validated as part of the overall system requirements. Please clarify if this step was performed for the Watts Bar Unit 2 PAMS application. Please clarify if WNA-VR-00283-WBT-P, Rev. 4 (ML110770540) contains this record. If not, please provide a reference for the results of the V&V of the security requirements and provide a statement indicating the findings of the V&V.*
- f. In Section 2.4.1, the statement is made that an assessment of the PAMS "will be" performed to verify that requirements for security controls are implemented correctly in the design. Please clarify if this step was performed for the Watts Bar Unit 2 PAMS application. Please clarify if WNA-VR-00283-WBT-P, Rev.4 (ML110770540) contains this record. If not, please provide a reference for the results of the V&V of the security requirements and provide a statement indicating the findings of the assessment.*
- g. In Section 2.5.1.1, the statement is made that an IV&V assessment "will be" performed of the security requirements during the implementation phase and that any anomalies will be documented. Please clarify if this step was performed for the Watts Bar Unit 2 PAMS application. Please clarify if WNA-VR-00283-WBT-P, Rev.4 (ML110770540) contains this record. If not, please provide a reference for the results of the IV&V of the security requirements. Please provide a brief summary of any anomalies found and, if there were any, please confirm that they were resolved in accordance with the Software Program Manual processes.*
- h. In Section 2.5.3, IV&V Phase Summary Report and Software Release Records are given as outputs of the implementation phase. Please confirm if WNA-VR-00283-WBT P, Rev. 4 (ML110770540) is the appropriate IV&V Phase Summary Report Record. Please provide a reference for Software Release Records documents and submit on docket.*
- i. In Section 2.5.3, the statement is made that the code is maintained in a "locked" area of the configuration control system. Please provide further detail regarding the "locked" area of the configuration control system. (e.g., is the code stored on a removable media and physically locked somewhere? Or, is the code on an isolated computer or network and protected by software controls?).*

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- j. *In Section 2.6 (and its subsections), testing activities are described in future-tense. Please provide a brief summary of the testing results as they pertain to security requirements for the system. Do WNA-TR-02451-WBT (ML110950332) and WNA-VR-00283-WBT-NP, Rev.4 (ML110770538) represent this evidence? If not, please provide references for the documents identified in Section 2.6.3 and submit on docket.*
3. *Secure Operational Environment* – *In order to establish compliance with IEEE-603 Clauses 5.6.3 and 5.9, the staff needs to ensure that a secure operational environment has been established for the proposed digital safety system. Regulatory Guide 1.152, Revision 3 - which the licensee has indicated it used to conform to these requirements - provides applicable regulatory positions.*
- a. *Please provide a description of the analyses performed to establish what digital systems are connected to the PAMS, what behaviors those systems are capable of either in a normal or failed operating state and what measures were taken in the PAMS design or Watts Bar operations to ensure its reliable operation in the presence of those potentially adverse behaviors.*
- b. *Please provide a description of the analyses performed to establish what points of physical and logical access are present to allow interaction with the PAMS and what measures were taken in the PAMS design or Watts Bar operations to provide assurance that only authorized personnel can access the system.*
- c. *The “Watts Bar Nuclear Unit 2 Common Q Post Accident Monitoring System Conformance to the Secure Development and Operational Environment Requirements of Regulatory Guide 1.152 Revision 3” document (ML11257A050 dated September 1, 2011) describes the licensee’s activities relative to SDOE.*
- i) *In Section 1.e (on page 7), it is noted that the testing of the Maintenance and Test Panel (MTP) software data diode function was included in the CIT/FAT and that the software data diode is the “qualified” isolation device. Please provide a summary of testing performed for this software data diode (i.e., did the testing consist of just the “data storm” testing or were there other tests?). Also, please elaborate on what is intended by the term “qualified” (i.e., Does it indicate that it has been formally tested? Or is there some other pedigree implied by the term?)*
- ii) *In Section 2.a.i.(1) (on page 8), the statement is made that the touch screen on the Operators Modules could change constants or alarm setpoints if the Function Enable keyswitch was placed in the ‘enable’ position. In Section 1. b of the same document, it is noted that the Function Enable keyswitch was not installed on the Operators Module for the PAMS. Please confirm that the Operators Panel does not possess a Function Enable keyswitch. [Note: Sections 2.a.i.(2) and 2.a.vi.(1) also mention the Function Enable keyswitch in regard to the Operators Module.]*

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- iii) *In Section 2.a.v (on page 9), use of a hardware data diode is noted. Please clarify if this is the device referenced in the response to RAI 14b submitted on July 30, 2010 (ML102160349). If not, please provide information on the specific hardware used (i.e., vendor and model number).*

**TVA Partial Response to Follow-up NRC Request**

Responses to “Draft Request for Additional Information Regarding Open Item 98,” sent December 12, 2011, Items 1 and 2 will be provided within two weeks of receipt from WEC. Item 3 is addressed as follows:

**3. Secure Operational Environment**

The design for the Common Qualified Platform (Common Q) PAMS is to replicate as closely as possible the design and functionality of the Unit 1 Inadequate Core Cooling Monitor (ICCM) 86 system. This was done to minimize the impact on the control room operators moving between units.

- a. The only PAMS digital interface is between the MTP PC Node Box and the Integrated Computer System (ICS). All other interfaces are analog.

The original PAMS design included an interface from the OM PC Node Box to the ICS. In the WBN Unit 2 design, the OM display is the safety-related PAMS display. Keeping the OM interface to the ICS would have required installation of a safety-related isolation device between the OM PC Node Box and the ICS. The purpose of the OM PC Node Box to ICS interface was to allow printing of OM information using an ICS printer. Printing of PAMS information is available via the MTP to ICS interface. Based on the above, the decision was made to delete the OM PC Node Box to ICS interface.

OM information during maintenance can be done via a local port on the OM PC Node Box. The OM print function is only available when the FE key keyswitch is installed and placed in the “Enable” position.

The functions of the MTP PC Node Box to ICS digital interface are:

- Allow the ICS to serve as a non-qualified backup to the PAMS for display of Core Exit Thermocouple information
- Allow the ICS to serve as a non-qualified backup to the PAMS for Subcooling Margin calculations
- Record PAMS data, status and alarm information
- Print information from the MTP during maintenance

The risks from the ICS digital interface to the PAMS are a datastorm or corrupted information being sent to the PAMS. The PAMS is protected from interference generated on the ICS network by two isolation devices.

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The first is a non-safety-related hardware data diode that connects via a fiber-optic cable to the MTP PC Node Box fiber-optic modem. Because the hardware data diode is non-safety-related, it does not meet the requirements of IEEE 384 for isolating a safety-related system from a non-safety-related system. The hardware data diode consists of two servers connected by a unidirectional fiber-optic cable that physically allows only data from the PAMs to be sent to the ICS network.

The second is the MTP PC Node Box software data diode. The software functions to limit incoming communications from the hardware data diode to only those TCP/IP commands necessary to support data transmission from the PAMS to the hardware data diode.

In accordance with IEEE 384, the MTP PC Node Box is the isolation device credited with protecting the safety-related PAMS functions from interference from the non-safety-related hardware data diode. The MTP PC Node Box and its software are procured and qualified as safety-related so it functions as a "qualified-isolation-device." Electrical isolation is provided by the fiber-optic cable interface from the MTP PC Node Box to the hardware data diode.

The arrangement described above is shown on Figure 2.2-1, "Watts Bar Unit 2 PAMS Hardware Architecture" in WNA-LI-00058-WBT-P, "Post-Accident Monitoring System (PAMS) Licensing Technical Report," Revision 3, submitted in TVA to NRC letter dated March 31, 2011 (Reference 2).

- b. The physical and logical interfaces to the PAMS are limited to those required for maintenance of the system or to access the PAMS information in the Main Control Room (MCR). The access points are limited to the MTP in the Auxiliary Instrument Room and the OM in the MCR. Of these, only the MTP has permanently installed Function Enable (FE) and Software Load Enable (SLE) (MTP only) keyswitches to allow system maintenance.

The original PAMS design included permanently mounting the OM FE keyswitch on the main control panel with the display. Due to the location of the OM displays inside the horseshoe in the MCR, it is unlikely system maintenance would be routinely performed from this location. Based on this analysis and the limited space on the main control boards, the decision was made to not permanently install the OM FE keyswitch. When required for maintenance, the OM FE keyswitch can be connected via a pigtail to a port on the OM PC Node Box.

The only digital connection to the PAMS is the ICS and it cannot impact the PAMS safety-related functions (see a. above).

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- c. The "Watts Bar Nuclear Unit 2 Common Q Post Accident Monitoring System Conformance to the Secure Development and Operational Environment Requirements of Regulatory Guide 1.152," Revision 3 submitted in TVA to NRC letter dated September 1, 2011 (Reference 3) section 2, "Secure Operational Environment," items a., b. and c. describe the design and operational controls used by WBN Unit 2 to provide assurance that only authorized personnel can access the PAMS.
- d. Secure Development and Operating Environment
  - i. A non-proprietary summary of the MTP software data diode testing was submitted as letter item 15 in TVA to NRC letter dated May 6, 2011 (Reference 4). A "qualified isolation device" is an isolation device that meets the same or higher safety-related qualification criteria as the system it is protecting.
  - ii. As shown on Figure 2.2-1, "Watts Bar Unit 2 PAMS Hardware Architecture" in WNA-LI-00058-WBT-P, "Post-Accident Monitoring System (PAMS) Licensing Technical Report," Revision 3, submitted in TVA to NRC letter dated March 29, 2011 (Reference 2), the OM FE keyswitch is not permanently installed. To allow maintenance on the OM, the FE keyswitch can be attached to the PC Node Box via a pigtail to a port on the box. This requires physically accessing the PC Node Box inside the control panel.
  - iii. The hardware data diode described in Section 2.a.v (on page 9), is the device referenced in the response to RAI 14b submitted in TVA to NRC letter dated July 30, 2010 (Reference 5).

**4. NRC Request (SSER 23 Appendix HH Item Number 108)**

*TVA should demonstrate to the NRC staff that there are no synergistic effects between temperature and humidity for the Common Q PAMS equipment. (SSER 23, Section 7.5.2.2.3.5.2, pg 7-75).*

**Follow-up NRC Request**

*Upon review of the response to Action Item Number 94, it was noticed that TVA's response to these two action items provided different environmental conditions in each response (see Action Item Number 94 Clauses 4.5.3 and 4.7). It is no longer clear, in what environment the Common Q PAMS is required to operate or how qualification to this environment is demonstrated.*

- a. *Please provide EPM-MCP-071689, "Cooling/Heating Load & Equipment/Component Performance Analysis for the Control Building Electrical Board Room Areas (EL. 692.0 and 708.0)," Revision 19.*
- b. *Please provide EPM-LCP-072489, "Cooling and Heating Load Analysis, Main Control Room HVAC [Heating, Ventilating, and Air Conditioning]," Revision 13.*

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- c. *Please provide the maximum temperature and the associated maximum relative humidity in which the Common Q PAMS is required to be operable.*
- d. *Please provide the minimum temperature and the associated minimum relative humidity in which the Common Q PAMS is required to be operable.*
- e. *Please explain why the relative humidity during a loss of coolant accident event is lower than the humidity during summer or winter.*
- f. *Please describe how it is demonstrated that the Common Q PAMS equipment is qualified to the environments in which that equipment is required to operate. Please pay particular attention to the potential synergistic effects of temperature and humidity.*

**TVA Partial Response to Follow-up NRC Request**

It is not possible to state whether or not there are any synergistic effects between temperature and humidity on the Common Q PAMS equipment. The NRC-approved qualification methods in WCAP-16097-P-A, "Common Qualified Platform Topical Report," Revision 0, do not perform or require such testing. What can be shown is that the WBN Unit 2 operating conditions are bounded by the Common Q PAMS hardware qualification testing.

- a. The requested calculation has been revised. The current revision is 21. Attachment 3 contains TVA calculation EPM-MCP-071689, "Cooling/Heating Load & Equipment/Component Performance Analysis for the Control Building Electrical Board Room Areas (EL. 692.0 & 708.0)," Revision 21.
- b. The requested calculation has been revised. The current revision is 14. Attachment 4 contains TVA calculation EPM-LCP-072489, "Cooling and Heating Load Analysis, Main Control Room HVAC," Revision 14.
- c. The tables below summarize the calculated temperature and humidity conditions for the MCR (from EPM-LCP-072489) and Auxiliary Instrument Room (AIR) (from EPM-MCP-071689). Where the calculations do not include relative humidity during abnormal or accident conditions, an online humidity calculator (Reference 7) was used to convert the humidity ratio and dry bulb temperature from the calculations to a relative humidity (RH) value. The values were independently verified by Bechtel Mechanical Engineering using a psychrometric chart.

**Main Control Room (MCR)**

<b>Operating Condition</b>	<b>Cooling Normal</b>	<b>Cooling Abnormal</b>	<b>Cooling LOCA</b>	<b>Heating Normal</b>	<b>Heating LOCA</b>
Single Unit	73.6°F / 48%RH	NA	76.5°F / 36%RH	75°F / 45.9%RH	75.3°F / 37.5%RH
Dual Unit	78.1°F / 41%RH	78.1°F / 41%RH	80.3°F / 32%RH	74.9°F / 46%RH	75.6°F / 37%RH

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**Auxiliary Instrument Room (AIR)**

<b>Operating Condition</b>	<b>Summer 1</b>	<b>Summer 2</b>	<b>LOCA Summer 1</b>	<b>LOCA Summer 2</b>	<b>Winter Normal</b>	<b>Winter LOOP</b>
Single Unit	70.7°F / 54%RH	67.1°F / 59%RH	77.3°F / 34.6%RH	73°F / 39.9%RH	64.8°F / 63%RH	57.4°F / 68.8%RH
Dual Unit	84.7°F / 33%RH	81.8°F / 36%RH	88.4°F / 24%RH	83.7°F / 28%RH	69.2°F / 55%RH	72.3°F / 41%RH

Based on the above tables, the following are the maximum temperature and maximum relative humidity conditions for PAMS operation:

Maximum Temperature/Relative Humidity (AIR, Dual Unit Operation, LOCA Summer 1)	88.4°F/24%RH
Maximum Relative Humidity/Temperature (AIR, Single Unit Operation, Winter LOOP)	68.8%RH/57.4°F

- d. To protect the PAMS Flat Panel Displays (FPD) from damage caused by electro-static discharge (ESD), there is a requirement in EQ-QR-68-WBT-P, "Qualification Summary Report for Post-Accident Monitoring System (PAMS)," Revision 0, (Attachment 5) that requires the Common Q PAMS FPDs to be installed in an environment with a relative humidity no less than 20% or else anti-static flooring material must be installed in the area where the FPDs will be installed or grounded ESD wrist straps must be worn when touching/handling the FPDs. The 20% RH limit is independent of temperature. Based on the tables in response c. above, the following are the minimum temperature and minimum RH conditions for PAMS Operation:

Minimum Temperature/Relative Humidity (AIR, Single Unit Operation, Winter LOOP)	57.4°F/68.8%RH
Minimum Relative Humidity/Temperature (AIR, Dual Unit Operation, LOCA Summer 1)	24%RH/88.4°F

While the WBN Unit 2 design shows that the AIR will not go below 20%, it is not necessary to maintain the 20% RH limit for the PAMS to perform its safety-related function. The limit applies to the FPD on the MTP. The MTP FPD is for the PC Node Box in the MTP. The MTP PC Node Box is the qualified isolation device and as such cannot be credited as a safety-related display device. In addition, the MTP FPD is located behind a locked cabinet door, where it cannot be inadvertently touched, and is therefore protected from inadvertent ESD damage during potential low humidity conditions in the AIR. Based on the above, it is not required to maintain the AIR humidity greater than or equal to 20% to protect the MTP FPD from damage due to ESD.

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Attachment 5 contains WEC proprietary document EQ-QR-68-WBT-P, "Qualification Summary Report for Post-Accident Monitoring System (PAMS)," Revision 0. Attachment 6 contains WEC non-proprietary document EQ-QR-68-WBT-NP, "Qualification Summary Report for Post-Accident Monitoring System (PAMS)," Revision 0. Attachment 7 contains WEC document CAW-11-3118, "Application for Withholding Proprietary Information from Public Disclosure EQ-QR-68-WBT-P, 'Qualification Summary Report for Post-Accident Monitoring System (PAMS),' Revision 0, (proprietary)," dated February 28, 2011.

- e. During a LOCA, the humidifiers are assumed to be out of service. This results in a lower RH during a LOCA.
- f. A response to SSER 23, Open Item 108, "Please describe how it is demonstrated that the Common Q PAMS equipment is qualified to the environments in which that equipment is required to operate," will be provided by January 19, 2012.

**5. NRC Request (SSER 24 Appendix HH Item Number 127)**

**NOTE:** The response to this NRC item was included in TVA to NRC letter dated November 14, 2011 (Reference 6). However the response to sub-item 2 was unintentionally omitted from the letter. For clarity, the complete question and response is repeated in this letter.

*TVA should provide a summary to the NRC staff of the electro-magnetic interference/radio-frequency interference (EMI/RFI) testing for the MI cable electro-magnetic compatibility (EMC) qualification test results. (SSER 24, Section 7.7.1.9.5)*

**Follow-up NRC Request**

*Action Item No. 127 identified in the NRC NUREG-0847 Supplement 24 (ADAMS Accession No. ML1277A148), SSER Section 7.7.1.9, "In-Core Instrumentation System," [IIS] requires TVA to "provide a summary to the NRC staff of the electro-magnetic interference/radio-frequency interference (EMI/RFI) testing for the MI cable electro-magnetic compatibility (EMC) qualification test results."*

*In TVA's September 30, 2011 letter (ADAMS Accession No. ML11287A254), TVA provided a response for this item. To complete our review on this item, the NRC requires TVA to confirm the NRC staff's understanding regarding the validity of the following descriptions about the EMI, RFI and EMC protection:*

- (1) *Within the Incore Instrumentation Thimble Assembly (IITA), the Core Exit Thermocouple (CET) is insulated with crushed Alumina (Al<sub>2</sub>O<sub>3</sub>) contained in an overall stainless steel tubular sheath. Each individual Self-powered Neutron Detector (SPND) consists of a Vanadium emitter wire, surrounded by crushed Alumina, which is surrounded by a grounded stainless steel tubular sheath. The thermocouple sheath, the SPND sheaths, and the overall IITA sheath are all electrically grounded at the reactor vessel.*



**Enclosure 1**  
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- (2) *The Mineral Insulated (MI) cable assembly consists of aluminum oxide (AL<sub>2</sub>O<sub>3</sub>) insulation, enclosing the SPNDs and core exit thermocouples, each one surrounded by a separate grounded stainless steel tubular sheath. The combination of the stainless steel sheath material joined to the stainless steel connectors provides for 100 percent shielding coverage. The exterior surfaces of the IIS MI Cable Assemblies are post accident qualified, and as such, are required to be 100 percent hermetic. This hermeticity of the MI Cable Assembly design and construction also demonstrates the absence of any apertures or seams that would compromise the shielding effectiveness of the assemblies, and thus providing the necessary protection against EMI/RFI interferences. To provide the necessary grounding of the MI cable, the cable assemblies are to be directly secured to seismically qualified in-containment cable supports at regular intervals along the length of the cable run. The frequency of this support arrangement provides multiple low impedance paths to ground for the cable assemblies to effectively divert EMI/RFI.*
- (3) *Westinghouse explained that the maximum current from a Vanadium detector is sufficiently low which, in the event of a short circuit from emitter to sheath within the cable, restricts the energy available to an amount that will preclude melting or other damage to the protective sheath. In case of breakage to the sheath, the detector leakage current will be shunted to common (plant ground) via the detector sheath. Further, the design maximum emitter current is sufficiently low that any short within the IITA will so restrict the energy available that further damage is precluded. Thus, the dual barrier design combined with the low detector current provides inherent EMI/RFI protection.*

**TVA Response to Follow-up Request**

- (1) TVA and WEC concur with the NRC staff's understanding.
- (2) TVA and WEC concur with the NRC staff's understanding with the corrections shown below:

The ~~ex-vessel~~ Mineral Insulated (MI) cable assembly consists of ~~aluminum oxide (AL<sub>2</sub>O<sub>3</sub>)~~ silicon dioxide (SiO<sub>2</sub>) insulation, enclosing the SPNDs signal leads and core exit thermocouples lead wires, each one surrounded by a separate grounded stainless steel tubular sheath.

- (3) TVA and WEC concur with the NRC staff's understanding.

**6. NRC Request**

*Enclosure 1, SER Section 11.5.0 of TVA to the NRC letter "Watts Bar Nuclear Plant (WBN) Unit 2 – Status of Regulatory Framework for the Completion of Construction and Licensing for Unit 2 - Revision 5 (TAC No. MD6311), and Status of Generic Communications for Unit 2 - Revision 5 (TAC No. MD8314)" dated January 21, 2011, contains the following Unit 2 action:*

**Enclosure 1**  
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*In SSER16, the staff updated its review to Amendment 89, and TVA's submittal dated February 17, 1995. The staff concluded that the process and effluent radiological monitoring and sampling system for Watts Bar Unit 1 complied with 10 CFR 20.1302 and GDCs 60, 63, and 64. The staff also concluded that the system design conformed to the guidelines of NUREG-0737, RGs 1.21 and 4.15, and applicable guidelines of RG 1.97 (Rev. 2). Thus, the system met the acceptance criteria of SRP Section 11.5 and was, therefore, acceptable.*

*In SSER20, the staff agreed that TVA did not commit to RG-4.15, Revision 1 as reflected in TVA's July 21, 1995 letter. In that letter, TVA had stated that the radiation monitoring system generally agrees with and satisfies the intent of the RG 4.15 except for specific calibration techniques and frequencies. The staff then reiterated its earlier finding stated in SSER16, Section 11.5.1, that the radiation monitoring system for Watts Bar Unit 1 meets the intent and purpose of RG 4.15, with respect to quality assurance provisions for the system. The staff modified one sentence from SSER16 and then concluded by stating that the other conclusions given in SSER16 continued to be valid.*

*Unit 2 Action:*

*Provide system description and information on QA provisions for the Unit 2 Radiation Monitoring System.*

**TVA Response**

TVA does not publish a system description document for the Radiation Monitoring system. The information requested is contained in TVA design criteria document WB-DC-40-24, "Radiation Monitoring (Unit 1/Unit 2)." The document was recently revised to reflect the Unit 2 design. Attachment 8 contains TVA design criteria document WB-DC-40-24, "Radiation Monitoring (Unit 1/Unit 2)," Revision 24, dated November 30, 2011.

**7. TVA Commitment**

*The cable routes will be locked in the Integrated Cable and Raceway Design System (ICRDS) to prevent future cables greater than the maximum steady voltage allowed in WNA-CN-00157-WBT-P, Revision 0 from being routed with the SPS cabinet power supply cables.*

**Commitment Closure**

As committed to in Enclosure 4 of TVA letter to NRC dated October 13, 2011 (Reference 1), the WINCISE Signal Processing System (SPS) cabinets power supply cable routes have been locked in the ICRDS to prevent cables in excess of 264 Vac from being routed with them.

**Enclosure 1**  
**TVA Letter Dated December 22, 2011**  
**TVA Responses to Instrumentation and Controls Staff Information Requests**

**8. TVA Commitment**

*TVA and Westinghouse committed to make available WINCISE documents for testing of the IITA assemblies at the Westinghouse Rockville office that were not releasable to the NRC.*

**Commitment Closure**

The following documents are available for NRC audit at the WEC Rockville office.

<b>Document Title</b>	<b>Document #</b>	<b>Revision</b>
Incore Instrument Thimble Assembly (IITA) Insulation Resistance	LTR-NO-11-109	October 11, 2011
Quality Release & Certificate of Conformance	QR-121284-01	01
Westinghouse Certificate of Qualification Report	CQ-121284-01	01
Packing List	N/A	N/A
Quality Release & Certificate of Conformance	QR-QR-10-192	00
Quality Release & Certificate of Conformance	QR-10-351	00
Quality Release & Certificate of Conformance	QR-4500298582-001	00
Class 1E Qualification of the Incore Instrument (Core Exit Thermocouple Portion) and Mineral Insulated Cable Assembly	CE-NPSD-240-P	0
Design And Fabrication Specification For Electrical Connectors Supplied By Whittaker With And Without Integral Reference Junctions (Proprietary)	00000-FEA-6101	5
Engineering Specification for In-core Instrumentation Thimble Assembly (IITA) (Proprietary)	418A28	2

**9. TVA Commitment**

*During the meeting held between TVA, NRC and WEC, on December 14, 2011 to discuss Common Q PAMS open regulatory issues, the participants agreed to change the TVA FSAR commitment to RG 1.168, "Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," from Revision 1 to Revision 0. To agree with the change to the RG 1.168 revision, it was agreed that:*

- *The commitment to IEEE Standard 1012-1998, "IEEE Standard for Software Verification and Validation" would be changed to 1986*
- *The commitment to IEEE Standard 1028-1997, "IEEE Standard for Software Reviews" would be changed to 1988*

**Enclosure 1**  
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**Partial Commitment Closure**

A review of the WBN Unit 2 Final Safety Analysis Report (FSAR) Amendment 107, Technical Specifications (TS), Revision F, TS Bases, Revision F, Technical Requirements Manual (TRM), Revision B and TRM Bases Revision B, found the only reference to RG 1.168 and IEEE Standards 1012 and 1028 are contained in FSAR Amendment 107, Table 7.1-1, "Watts Bar Nuclear Plant NRC Regulatory Guide Conformance."

Based on the results of the review, the changes to FSAR Table 7.1-1 for RG 1.168, IEEE 1012 and IEEE 1028 shown in Attachment 9 will be incorporated into Amendment 108 of the FSAR.

This item will remain open until the FSAR is amended and submitted to the NRC showing the changes in Attachment 9.

**Enclosure 2**  
**TVA Letter Dated December 22, 2011**  
**List of Attachments**

**Note:** While project coversheets have not been included, the attachments have been reviewed and approved by Engineering prior to submittal.

1. TVA white paper "Comparison of British Standards Institute (BSI) EN 55022, 'Information technology equipment. Radio disturbance characteristics. Limits and methods of measurement' and Electric Power Research Institute (EPRI) TR102323, 'Guidelines for Electromagnetic Interference Testing in Power Plants' Suggested Electromagnetic Compatibility Test Methods," dated December 5, 2011 (Letter Item 1, SSER 23 Appendix HH Item Number 80)
2. Not Used
3. TVA calculation EPM-MCP-071689, "Cooling/Heating Load & Equipment/Component Performance Analysis for the Control Building Electrical Board Room Areas (EL. 692.0 & 708.0)," Revision 21 (Letter Item 4, SSER 23 Appendix HH Item Number 108)
4. TVA calculation EPM-LCP-072489, "Cooling and Heating Load Analysis, Main Control Room HVAC," Revision 14 (Letter Item 4, SSER 23 Appendix HH Item Number 108)
5. WEC proprietary document EQ-QR-68-WBT-P, "Qualification Summary Report for Post-Accident Monitoring System (PAMS)," Revision 0 (Letter Item 4, SSER 23 Appendix HH Item Number 108)
6. WEC non-proprietary document EQ-QR-68-WBT-NP, "Qualification Summary Report for Post-Accident Monitoring System (PAMS)," Revision 0 (Letter Item 4, SSER 23 Appendix HH Item Number 108)
7. WEC document CAW-11-3118, Application For Withholding Proprietary Information From Public Disclosure EQ-QR-68-WBT-P, "Qualification Summary Report for Post-Accident Monitoring System (PAMS)," Revision 0, (proprietary), dated February 28, 2011 (Letter Item 4, SSER 23 Appendix HH Item Number 108)
8. TVA design criteria document WB-DC-40-24, "Radiation Monitoring (Unit 1/Unit 2)," Revision 24, dated November 30, 2011 (Letter Item 6)
9. Proposed FSAR Amendment changes to Table 7.1-1 (Letter Item 9)
10. Non-proprietary GA-ESI letter 010-01038-001, "Response to AC Filter Question," dated December 20, 2011 (Letter Item 2, SSER 23 Appendix HH Item Number 81)
11. Proprietary GA-ESI letter 010-01038-001, Attachment: "04502050-001 Receipt Inspection" (Letter Item 2, SSER 23 Appendix HH Item Number 81)

**Enclosure 3**  
**TVA Letter Dated December 22, 2011**  
**List of References**

1. TVA to NRC letter dated October 13, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 – Instrumentation and Controls Staff Information Requests" (Letter Item 1, SSER 23 Appendix HH Item Number 80)
2. TVA to NRC letter dated March 31, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 – Instrumentation and Controls Staff Information Requests" (Letter Item 3, SSER 23 Appendix HH Item Number 98)
3. TVA to NRC letter dated September 1, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 – Instrumentation and Controls Staff Information Requests" (Letter Item 3, SSER 23 Appendix HH Item Number 98)
4. TVA to NRC letter dated May 6, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 – Instrumentation and Controls Staff Information Requests" (Letter Item 3, SSER 23 Appendix HH Item Number 98)
5. TVA to NRC letter dated July 30, 2010, "Watts Bar Nuclear Plant (WBN) Unit 2 – Instrumentation and Controls Staff Information Requests" (Letter Item 3, SSER 23 Appendix HH Item Number 98)
6. TVA to NRC letter November 14, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 – Instrumentation and Controls Staff Information Requests" (Letter Item 5, SSER 24 Appendix HH Item Number 127)
7. Free Professional Relative Humidity Calculator as used in the national metrology institutions ([www.humcal.com](http://www.humcal.com)) (Letter Item 4, SSER 23 Appendix HH Item Number 108)

**Enclosure 4**  
**TVA Letter Dated December 22, 2011**  
**List of New Regulatory Commitments**

1. A non-proprietary version of the GA-ESI letter 010-01038-001, Attachment: "04502050-001 Receipt Inspection" and affidavit for withholding will be submitted within two weeks of receipt from GA-ESI. (Letter Item 2, SSER 23 Appendix HH Item Number 81)
2. Responses to "Draft Request for Additional Information Regarding Open Item 98," sent December 12, 2011, Items 1 and 2 will be provided within two weeks of receipt from WEC. (Letter Item 3, SSER 23 Appendix HH Item Number 98)
3. A response to SSER 23, Open Item 108 follow-up request item f. "Please describe how it is demonstrated that the Common Q PAMS equipment is qualified to the environments in which that equipment is required to operate," will be provided by January 19, 2012. (Letter item 4, SSER 23 Appendix HH Item Number 108)
4. The changes to FSAR Table 7.1-1 for RG 1.168, IEEE 1012 and IEEE 1028 shown in Attachment 9 will be incorporated into Amendment 108 of the FSAR. (Letter Item 9)

**Attachment 1**

**TVA white paper "Comparison of British Standards Institute (BSI) EN 55022, "Information technology equipment. Radio disturbance characteristics. Limits and methods of measurement" and Electric Power Research Institute (EPRI) TR102323, "Guidelines for Electromagnetic Interference Testing in Power Plants" Suggested Electromagnetic Compatibility Test Methods," dated December 5, 2011  
(Letter Item 1, SSER 23 Appendix HH Item Number 80)**



**TVA White Paper**

**Comparison of**

**British Standards Institute (BSI)**

**EN 55022**

**“Information technology equipment. Radio disturbance characteristics. Limits and methods of measurement”**

**And**

**Electric Power Research Institute (EPRI)**

**TR102323**

**“Guidelines for Electromagnetic Interference Testing in Power Plants”**

**Suggested Electromagnetic Compatibility Test Methods**

**Rick Brehm**

**Corporate Senior EMC Program Manager**

**December 5, 2011**

TVA White Paper  
 Comparison of British Standards Institute (BSI) EN 55022 and Electric Power Research Institute (EPRI) TR102323 Suggested Electromagnetic Compatibility Test Methods  
 December 5, 2011

**NRC Request**

*In response to staff request for an explanation for using an alternate method for high frequency radiated emissions tests, TVA in its September 30, 2011, letter under Item Number 15, stated that the alternate method EN 55022 is more restrictive than the Regulatory Guide (RG) 1.180 and Electric Power Research Institute (EPRI) suggested methods. This statement is not backed by specific examples of how the EN 55022 is more restrictive for the test levels and the frequency ranges. Therefore, TVA is requested to provide further explanation of how the test method is more restrictive over the test levels and frequencies.*

**TVA Response**

Comparison of EN55022 and EPRI TR102323 Revision 1 (same as TVA SS-E18.14.01 Rev. 3)

- EN 55022 “Information technology equipment. Radio disturbance characteristics. Limits and methods of measurement” uses Comité International Spécial des Perturbations Radioélectriques (CISPR) 22 as the test required for Information Technology Equipment (ITE).
- The NRC in RG1.180 Revision 1 references CISPR 11 as an acceptable test.
- CISPR 22 and CISPR 11 use similar requirements for conducted and radiated emissions

**Conducted Emissions Testing Comparison**

**5.1 Limits of mains terminal disturbance voltage**

**Table 1 – Limits for conducted disturbance at the mains ports of class A ITE**

Frequency range MHz	Limits dB(µV)	
	Quasi-peak	Average
0,15 to 0,50	79	66
0,50 to 30	73	60
NOTE The lower limit shall apply at the transition frequency.		

**Figure 1 CISPR 22 Conducted Emissions**

TVA White Paper  
 Comparison of British Standards Institute (BSI) EN 55022 and Electric Power Research Institute  
 (EPRI) TR102323 Suggested Electromagnetic Compatibility Test Methods  
 December 5, 2011

**Table 2a – Mains terminal disturbance voltage limits  
 for class A equipment measured on a test site**

Frequency band  MHz	Class A equipment limits dB( $\mu$ V)					
	Group 1		Group 2		Group 2 <sup>a</sup>	
	Quasi-peak	Average	Quasi-peak	Average	Quasi-peak	Average
0,15 – 0,50	79	66	100	90	130	120
0,50 – 5	73	60	86	76	125	115
5 – 30	73	60	90	80	115	105
			Decreasing linearly with logarithm of frequency to			
			70	60		

NOTE Care should be taken to comply with leakage current requirements.

a Mains supply currents in excess of 100 A per phase when using the CISPR voltage probe or a suitable V-network (LISN or AMN).

**Figure 2 CISPR 11 Conducted Emissions**

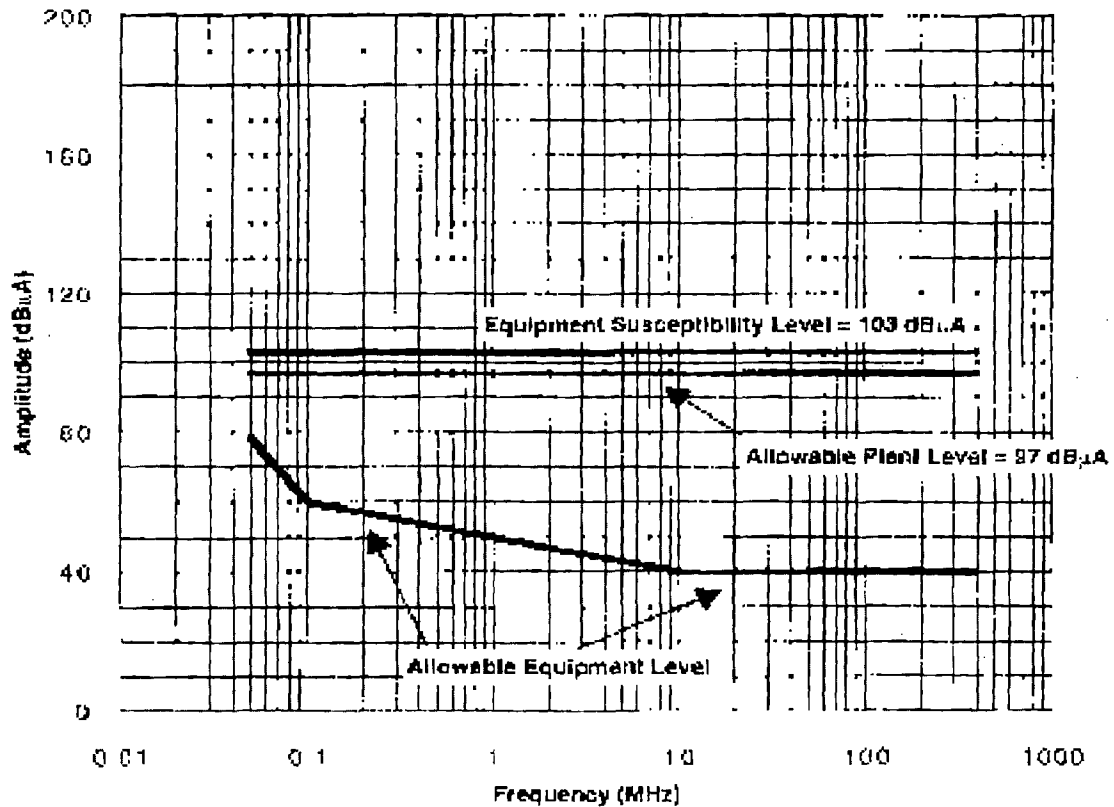


Figure 7-2 Recommended Allowable Plant and Equipment Conducted Emissions  
 Levels between 50 kHz to 400 MHz

**Figure 3 EPRI TR102323 Conducted Emissions**

TVA White Paper  
Comparison of British Standards Institute (BSI) EN 55022 and Electric Power Research Institute  
(EPRI) TR102323 Suggested Electromagnetic Compatibility Test Methods  
December 5, 2011

The EPRI limits are reported in dB $\mu$ A while the CISPR standards reference the value in dB $\mu$ V referenced to a 50 ohm impedance. To convert either subtract 34dB from the CISPR requirements or add 34dB to the EPRI requirements. The following table provides a comparison of the CISPR and corrected EPRI limits.

Frequency Band MHz	CISPR Quasi-peak dB $\mu$ V	CISPR Average dB $\mu$ V	EPRI dB $\mu$ V
0.15 - 0.50	79	66	92 - 87
0.5 - 5	73	60	87 - 76
5-30	73	60	74

**Conclusion:** The table above shows that the CISPR limits for conducted emissions (lower is more restrictive) in EN 55022 are more restrictive than the limits allowed by EPRI TR102323 which are used by TVA and endorsed by RG 1.180 Revision 1.

**Conducted Emissions Testing Comparison**

**Table 5 – Limits for radiated disturbance of class A ITE  
 at a measuring distance of 10 m**

Frequency range MHz	Quasi-peak limits dB(μV/m)
30 to 230	40
230 to 1 000	47
NOTE 1 The lower limit shall apply at the transition frequency.	
NOTE 2 Additional provisions may be required for cases where interference occurs.	

**Figure 4 CISPR 22 Radiated Emissions**

**Table 3 – Electromagnetic radiation disturbance limits for group 1 equipment**

Frequency band  MHz	Measured on a test site		Measured <i>in situ</i>
	Group 1, class A 10 m measurement distance  dB(μV/m)	Group 1, class B 10 m measurement distance  dB(μV/m)	Group 1, class A Limits with measuring distance 30 m from exterior wall outside the building in which the equipment is situated  dB(μV/m)
0.15 – 30	Under consideration	Under consideration	Under consideration
30 – 230	40	30	30
230 – 1 000	47	37	37

NOTE For group 1, classes A and B equipment, intended to be permanently installed in X-ray shielded locations, an increase in the electromagnetic radiation disturbance limits of 12 dB for tests conducted on a test site is allowed.

Such equipment which does not meet the Table 3 limits is labelled as "Class A + 12" or "Class B + 12". The installation instructions should contain the following warning:

*"Warning: This equipment is allowed to be installed only in X-ray protected rooms, which provide an attenuation of at least 12 dB for radio disturbances from 30 MHz to 1 GHz."*

**Figure 5 CISPR11 Radiated Emissions**

TVA White Paper  
 Comparison of British Standards Institute (BSI) EN 55022 and Electric Power Research Institute  
 (EPRI) TR102323 Suggested Electromagnetic Compatibility Test Methods  
 December 5, 2011

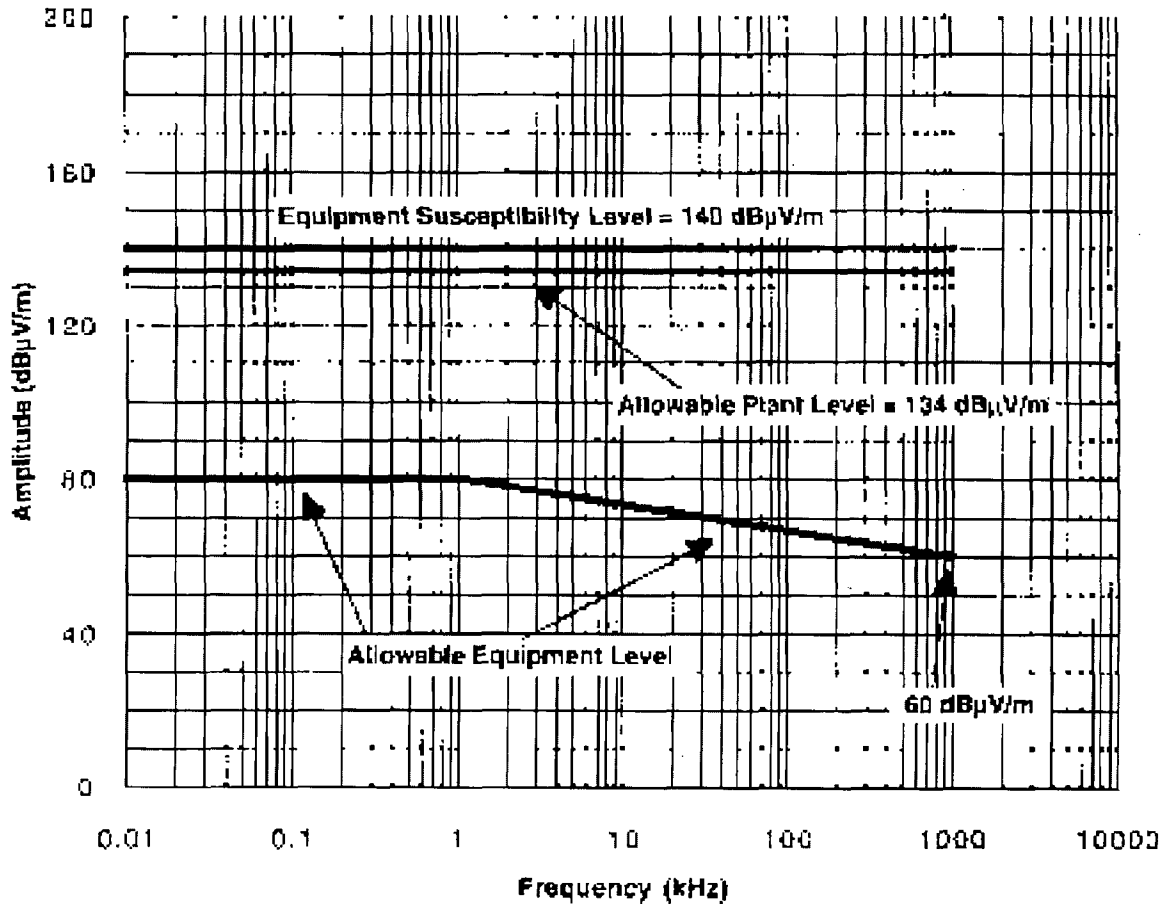


Figure 7-4 Recommended Allowable Plant and Equipment Radiated Emissions Levels between 10 kHz to 1,000 MHz

**Figure 6 EPRI TR102323 Rev. 1 Radiated Emissions**

The CISPR standards list the level at 10m while the EPRI (and MIL-STDs) use 1m. The field strength in the far field varies linearly with distance. So, either subtract 10dB from the EPRI standard values or add 10dB to the CISPR Standard values. The following table provides a comparison of the CISPR and corrected EPRI limits.

Frequency Band MHz	CISPR dBµV/m @10m	EPRI dBµV/m @10m
30-230	40	60 - 54
230 - 1000	47	54 - 50

**Conclusion:** The table above shows that the CISPR limits for radiated emissions (lower is more restrictive) in EN 55022 are more restrictive than the limits allowed by EPRI TR102323 which are used by TVA and endorsed by RG 1.180 Revision 1.

**Attachment 2**

**NOT USED**

**Attachment 7**

**WEC document CAW-11-3118, Application For Withholding Proprietary Information From Public Disclosure EQ-QR-68-WBT-P, "Qualification Summary Report for Post-Accident Monitoring System (PAMS)," Revision 0, (proprietary)," dated February 28, 2011 (Letter Item 4, SSER 23 Appendix HH Item Number 108)**





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U.S. Nuclear Regulatory Commission  
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Proj letter: WBT-D-2959

CAW-11-3118

February 28, 2011

APPLICATION FOR WITHHOLDING PROPRIETARY  
INFORMATION FROM PUBLIC DISCLOSURE

Subject: EQ-QR-68-WBT-P, Rev. 0, "Qualification Summary Report for Post-Accident Monitoring System (PAMS)," (Proprietary)

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-11-3118 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying affidavit by Tennessee Valley Authority.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, CAW-11-3118, and should be addressed to J. A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company LLC, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.

Very truly yours,

J. A. Gresham, Manager  
Regulatory Compliance

Enclosures

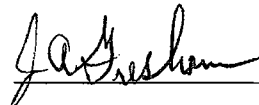
AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

SS

COUNTY OF BUTLER:

Before me, the undersigned authority, personally appeared J. A. Gresham, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:



J. A. Gresham, Manager

Regulatory Compliance

Sworn to and subscribed before me  
this 28th day of February 2011



Notary Public

COMMONWEALTH OF PENNSYLVANIA

Notarial Seal  
Cynthia Olesky, Notary Public  
Manor Boro, Westmoreland County  
My Commission Expires July 16, 2014  
Member, Pennsylvania Association of Notaries

- (1) I am Manager, Regulatory Compliance, in Nuclear Services, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.
- (2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.
- (3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.
- (4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.
  - (i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.
  - (ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

    - (a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

- (b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.
- (c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.
- (d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.
- (e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.
- (f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

- (a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.
- (b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.
- (c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

- (d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.
  - (e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.
  - (f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.
- (iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390; it is to be received in confidence by the Commission.
- (iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.
- (v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in EQ-QR-68-WBT-P, Rev. 0, "Qualification Summary Report for Post-Accident Monitoring System (PAMS)" (Proprietary), dated February 2011, for submittal to the Commission, being transmitted by Tennessee Valley Authority letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with the Watts Bar 2 Post Accident Monitoring System and may be used only for that purpose.

This information is part of that which will enable Westinghouse to:

- (a) Provide environmentally qualified Post Accident Monitoring Systems to its customers.
- (b) Maintain competitive position in the workplace.

Further this information has substantial commercial value as follows:

- (a) Westinghouse plans to sell the use of similar information to its customers for the purpose of maintaining Westinghouse-designed systems.
- (b) Westinghouse can sell support and defense of licensing.
- (c) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar analysis and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

## **PROPRIETARY INFORMATION NOTICE**

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

## **COPYRIGHT NOTICE**

The reports transmitted herewith each bear a Westinghouse copyright notice. The NRC is permitted to make the number of copies of the information contained in these reports which are necessary for its internal use in connection with generic and plant-specific reviews and approvals as well as the issuance, denial, amendment, transfer, renewal, modification, suspension, revocation, or violation of a license, permit, order, or regulation subject to the requirements of 10 CFR 2.390 regarding restrictions on public disclosure to the extent such information has been identified as proprietary by Westinghouse, copyright protection notwithstanding. With respect to the non-proprietary versions of these reports, the NRC is permitted to make the number of copies beyond those necessary for its internal use which are necessary in order to have one copy available for public viewing in the appropriate docket files in the public document room in Washington, DC and in local public document rooms as may be required by NRC regulations if the number of copies submitted is insufficient for this purpose. Copies made by the NRC must include the copyright notice in all instances and the proprietary notice if the original was identified as proprietary.

Tennessee Valley Authority

Letter for Transmittal to the NRC

The following paragraphs should be included in your letter to the NRC:

Enclosed are:

1. \_\_\_ copies of EQ-QR-68-WBT-P, Rev. 0, "Qualification Summary Report for Post-Accident Monitoring System (PAMS)" (Proprietary)
2. \_\_\_ copies of EQ-QR-68-WBT-NP, Rev. 0, "Qualification Summary Report for Post-Accident Monitoring System (PAMS)" (Non-Proprietary)

Also enclosed is the Westinghouse Application for Withholding Proprietary Information from Public Disclosure CAW-11-3118, accompanying Affidavit, Proprietary Information Notice, and Copyright Notice.

As Item 1 contains information proprietary to Westinghouse Electric Company LLC, it is supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of Section 2.390 of the Commission's regulations.

Accordingly, it is respectfully requested that the information which is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations.

Correspondence with respect to the copyright or proprietary aspects of the items listed above or the supporting Westinghouse affidavit should reference CAW-11-3118 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company LLC, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.



**Attachment 9**

**Proposed FSAR Amendment changes to Table 7.1-1 (Letter Item 9)**

**Table 7.1-1 Watts Bar Nuclear Plant NRC Regulatory Guide Conformance  
(Page 3 of 11)**

Regulatory Guide 1.152, Revision 0, November 1995 "Criteria for Programmable Digital Computer System Software in Safety-Related Systems of Nuclear Power Plants" (See Notes 6, 8, and 14).

Regulatory Guide 1.152, Revision 3, July 2011 "Criteria for Digital Computers in Safety Systems of Nuclear Power Plants: (See Note 13).

Regulatory Guide 1.153, Revision 0, December 1985 "Criteria For Power, Instrumentation and Control Portions of Safety Systems" (See Notes 8 and 9).

Regulatory Guide 1.153, Revision 1, June 1996, "Criteria For Safety Systems" (See Note 13).

Regulatory Guide 1.168, Revision 0, February 2004, "Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants" (See Note 13).

Regulatory Guide 1.209, Revision 0, March 2007, "Guidelines for Environmental Qualification of Safety-Related Computer-Based Instrumentation and Control Systems in Nuclear Power Plants" (See Note 13).

ANSI/IEEE-ANS-7-4.3.2-1982 "Application Criteria for Programmable Digital Computer Systems in Safety Systems of Nuclear Power Generating Stations" (See Notes 8, 10, and 14).

IEEE Std. 7-4.3.2-2003 "Application Criteria for Programmable Digital Computer Systems in Safety Systems of Nuclear Power Generating Stations" (See Note 13).

IEEE Std. 279-1971, "Protection Systems for Nuclear Power Generating Stations" (F) (See Sections 7.2, 7.3, 7.6).

IEEE Standard 308-1971, "Class 1E Power Systems for Nuclear Power Generating Stations" (See Section 8.1.5).

IEEE Std. 323-1971, "IEEE Trial-Use Standard: General Guide for Qualifying Class 1E Equipment for Nuclear Power Generating Stations" (See Note 4).

IEEE Std. 323-1974, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," (See Notes 4, 8, and 14).

**Table 7.1-1 Watts Bar Nuclear Plant NRC Regulatory Guide Conformance  
(Page 5 of 11)**

IEEE Std. 384-1992, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits," (See Notes 13 and 19).

IEEE Std. 603-1980, IEEE Standard Criteria For Safety Systems for Nuclear Power Generating Stations," (See Note 8).

IEEE Std. 603-1991, "IEEE Standard Criteria For Safety Systems for Nuclear Power Generating Stations," (See Note 13).

1986

IEEE Std. 1012-~~1998~~, "IEEE Standard for Software Verification and Validation" (See Note 13).

1988

IEEE Std. 1028-~~1997~~, "IEEE Standard for Software Reviews" (See Note 13).

#### NOTES

##### Note 1 Conformance to IEEE 338-1971

The periodic testing of the reactor protection systems conforms to the requirements of IEEE Standard 338-1971 with the following comments:

1. The surveillance requirements of the Technical Specifications for the protection system ensure that the system functional operability is maintained comparable to the original design standards. Periodic tests at frequent intervals demonstrate this capability for the system.

Protection systems response times from the sensor through the actuated device, as identified in the Watts Bar Technical Requirements Manual, will be verified. Technical Specifications require periodic testing on at least 18-month intervals. Each test shall include at least one logic train such that both logic trains are tested at least once per 36 months and one channel per function such that all channels are tested at least once every (N times 18) months, where N is the total number of redundant channels in a specific protection function.

The measurement of response time at the specified frequencies provides assurance that the protective and Engineered Safety Features action function associated with each channel is completed within the time limit assumed in the accident analyses.

**Attachment 10**

**Non-proprietary GA-ESI letter 010-01038-001, "Response to AC Filter Question," dated December 20, 2011 (Letter Item 2, SSER 23 Appendix HH Item Number 81)**



December 20, 2011

Letter 010-01038-001

Attention: Steve Clark

Subject: Response to AC Filter Question

Attachment: 04502050-001 Receipt Inspection

**Question:**

After reviewing the receipt inspection documents staff observed that no functional test results for the AC Filter are enclosed in this package. TVA is requested to provide the functional test documentation to enable the staff to complete its evaluation of this package. If the functional test document is not available, then TVA should justify why the requested document is not available and submit a complete inspection documentation package for another component to demonstrate compliance to commercial dedication processes and procedures.

**Response:**

The AC Filter is subjected to functional testing by the vendor. GA-ESI documentation indicates the testing was verified during a previous GA-ESI vendor audit. Recent follow up conversations with the vendor indicate the functional test is performed using an automated testing machine, and the results are Pass/Fail. A test report is not produced during the test, rather, the Certificate of Conformance is provided to certify successful completion of the testing.

Attached is a documentation package for a different component, a power supply, which is tested by GA-ESI during receipt inspection.

Mike McBrearty

A handwritten signature in black ink, appearing to read "Mike McBrearty". The signature is stylized and cursive.

Quality Assurance