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

June 10, 2011

10 CFR 50.4

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

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

Reference: 1. Licensee Open Items to be Resolved for SER Approval List

The purpose of this letter is to provide TVA's responses to NRC's information requests on the "Licensee Open Items to be Resolved for SER Approval List." 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.

This letter does not contain any new regulatory commitments. If you have any questions, please contact William Crouch at (423) 365-2004.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 10th day of June, 2011.

Respectfully,

David Stinson
Watts Bar Unit 2 Vice President

D030
NRR

Enclosures:

1. Responses to Licensee Open Items To Be Resolved For SER Approval
2. List of Attachments
3. List of References

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 June 10, 2011
Responses to Licensee Open Items to be Resolved for SER Approval

The following acronyms/abbreviations are used in this letter:

AC160	[1]Advant® Controller 160
[2]AP1000	Westinghouse Generation III+ advanced light water reactor design
[3]BEACON™	Best Estimate Analyzer for Core Operations Nuclear
CAPS	Westinghouse Corrective Action Process System
CET	Core Exit Thermocouple
CFR	Code of Federal Regulation
EDCR	Engineering Document Change Request
EQ	Environmental Qualification
DCI-CVIB	Division of Component Integrity-Vessels and Internals Integrity Branch
FPDS	Flat Panel Display System
FSAR	Final Safety Analysis Report
ICS	Integrated Computer System (aka Plant Computer)
[4]IEEE™	Institute of Electrical and Electronics Engineers
IIS	Incore Instrument System
IITA	Incore Instrument Thimble Assembly
LPMS	Loose Parts Monitoring System
MCR	Main Control Room
MI	Mineral Insulated
MIDS	Movable In-core Detector System
MTP	Maintenance and Test Panel
NRC	Nuclear Regulatory Commission
OI	Open Item (from NRC I&C Open Item Matrix)
OM	Operators Module
PAMS	Post Accident Monitoring System
PDMS	Power Distribution Monitor System
QA	Quality Assurance
RAI	Request for Additional Information
RCS	Reactor Coolant System
RG	Regulatory Guide
SCMP	Software Configuration Management Plan
SDD	Software Design Document
SPD	Self Powered Detector
SPM	Software Program Manual
SPS	Signal Processing System
SRP	Standard Review Plan (NUREG-800)
SRS	Software Requirements Specification
SysRS	System Requirements Specification
TSM	Technical Specification Monitor
TVA	Tennessee Valley Authority
V&V	Verification and Validation
WEC	Westinghouse Electric Company LLC
WBN	Watts Bar Nuclear Plant
[5]WINCISE™	Westinghouse In-Core Information Surveillance & Engineering

[1] Advant is registered trademark of ABB Automation Technology Products Management AG
[2] AP1000 is a registered trademark of the Westinghouse Electric Company LLC
[3] BEACON is a registered trademark of the Westinghouse Electric Company LLC
[4] IEEE is a registered trademark of the Institute of Electrical and Electronics Engineers Inc.

NOTE: The NRC can make arrangements to view documents in the WEC Rockville office by contacting Ms. Leslie Collins at 301-881-7040 (e-mail: collinlj@westinghouse.com).

1. **NRC Request (Item Number 362)**

OI #331 requested TVA to provide information regarding how the Loose Parts Monitoring System (LPMS) in-containment components (e.g., Accelerometer (including the integral insulated hardline cable), Softline cable, and Remote Charge Preamplifiers) were qualified for vibration as addressed in regulatory position C.1.g of RG 1.133, Rev. 1. TVA responded by stating that "TVA has reviewed the information provided by Westinghouse describing how the Loose Part Monitoring System (LPMS) sensor is qualified for normal operating conditions provided in Westinghouse letter WBT-D-2782, dated December 17, 2010 (Reference 11) as addressed in regulatory position C.1.g of Reg. Guide 1.133 and found it acceptable. Vibration qualification is not applicable to the softline cable. Due to the installation location (junction boxes mounted to the shield or fan room walls) and previous seismic qualification, vibration qualification of the charge converter/preamplifier is not required. This completes the response to this item."

However, the staff still desires further clarification on this response. (1) Specifically, please provide a documented basis that demonstrates the LPMS in-containment equipment is qualified for normal operating conditions (e.g., test results compared to the equipment qualification specification), including vibration qualification. (2) Also, provide justification for why vibration qualification if the Remote Charge Preamplifier is not required

TVA Partial Response to NRC Request

TVA has previously provided responses on all in-containment hardware with the exception of vibration qualification of the accelerometer and integral hardline cable. Attachment 1 contains WEC non-proprietary document EQ-QR-79, Revision 0, "Summary Test Report Vibration Testing of the Westinghouse Digital Metal Impact Monitoring System (DMIMS-DX) In-Containment Sensor and Integral Hardline Cable 5357C52G01," dated May 2011. This completes the TVA response to this item.

2. **NRC Request (Item Number 372)**

On 5/6/2010 (See Open Item No. 81) the NRC Staff requested an evaluation of the Common Q PAMS against the current staff position.

By letter dated 2/25/11 (ML110620219), TVA docketed a response.

The requirements in the SysRS and SRS are not traceable back to the design basis (e.g., IEEE Std 603-1991 Section 4) for the system. The SRS does not include any documented evidence that it was ever independently reviewed in accordance with the 10CFR50 Appendix B Criterion III, "Design Control." (Note: It appears that the only Common Q or WBN2 PAMS document that was independently reviewed in accordance with 10 CFR 50 Appendix B requirements is the SysRS.)

---

[5] WINCISE is a registered trademark of the Westinghouse Electric Company LLC

Based upon the review of the SysRS and SRS, the staff finds that there is reasonable assurance that the systems fully conform to the applicable guidelines, except for the following open items:

1. *TVA to produce an acceptable description of how the SysRS and SRS implement the design basis requirements of IEEE 603-1991 Clause 4.*

2. *TVA to produce a final SRS that is independently reviewed in accordance with 10 CFR 50 Appendix B, "Criterion III Design Control," requirements.*

TVA Response to NRC Request:

1. Response provided in TVA letter to NRC dated May 6, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 -Instrumentation and Controls (I&C) Staff Information Requests." (Reference 9)

2. The following request was made by the NRC staff during the WBN Unit 2 Common Q PAMS audit conducted at the WEC facility in Warrendale, PA the week of February 28, 2011:

   "For the WBN2 PAMS project, Westinghouse will provide documentation in their Rockville MD offices demonstrating that each document requiring independent review was in fact independently reviewed and CAPs No. 11-061-M047 will contain a commitment to provide documented evidence of appropriate independent reviews. "

   The following response to this item was provided by WEC:

   The referenced WEC CAPS issue has been closed. To summarize the CAPS disposition:

   All revisions of the Watts Bar NSSS Completion Program I&C Projects Post Accident Monitoring System "System Design Specification" (WNA-DS-O1 667-WBT-PINP, Revision 0 to Revision 4), "Software Requirements Specification" (WNA-SD-00239-WBT-PINP Revision 0 to Revision 4), "Software Design Description for the AC 160 Software" (WNA-SD-00250-WBT, Revision 0 to Revision 3), and "Software Design Description for the FPDS Software" (WNA-SD-00248-WBT, Revision 0 to Revision 3) documents have been independently reviewed (verified) per WEC procedure WEC 6.1 "Document Control." Please note that according to WEC procedure NSNP 3.3.3, "Design Verification by Independent Review or Alternate Calculations," the independent review is considered as an acceptable method of verification.

The above documents, for all revisions, include a verifier (an independent reviewer) who is a competent individual other than the document author to verify that the document is technically correct and satisfactorily meets the intended requirements.

The front page of each document lists the author, the independent reviewer (the first reviewer listed; second reviewer listed is the Project Manager verifying document's compliance to the program rules). The second page lists any contributors to the document. It is important to note that the document's independent reviewer (verifier) is NOT included within the list of contributors indicating their independence from the original work.

In summary, according to WEC 6.1 the Responsible Manager (also listed on the front page) must: 1) approve the document for issuance, 2) ensure that the verification method and design methodology are demonstrated appropriately, and 3) ensure that the qualifications of the originator and verifier are adequate. The manager(s) listed on the document attests to the fact that he or she has completed these responsibilities. Moreover, the manager has ensured that the verifier: 1) is competent to perform the independent review, 2) did not perform the original work even though they may be from the same organization or group, and 3) verified that the document is technically correct and satisfactorily meets the intended requirements.

3. <u>NRC Request (Item Number 373)</u>

The SDDs do not include any documented evidence that they were independently reviewed in accordance with the 10 CFR 50 Appendix B Criterion III, "Design Control."

Based upon the review of the SDDs, the staff the following open item:

1. *TVA to produce final SDDs that are independently reviewed in accordance with 10 CFR 50 Appendix B Criterion III, "Design Control," requirements.*

<u>TVA Response to NRC Request:</u>

1. See the response to Letter Item No. 2, Question No. 2. (NRC Matrix Item Number 372)

4. <u>NRC Request (Item Number 376)</u>

Division of Component Integrity-Vessels and Internals Integrity Branch (DCI-CVIB) Input:

Reference: EDCR # 52321, Revision A, EDCR Unit Difference Form, Page 2 – Maintenance Difference

The proposed In-Core Instrument Thimble Assemblies (IITAs) which will replace Movable In-Core Detectable Systems (MIDs) have the following features:

(1) IITAs are not fully extracted and they are held in a movable frame assembly.

(2) IITAs exert lower vibration amplitude and therefore, aging degradation due to wear does not occur.

(3) Loss of reactor coolant system pressure boundary due to breach of IITA outer sheath does not occur.

Question:

The staff believes that the licensee should provide an inspection program to confirm that the aforementioned attributes associated with IITAs are valid and this inspection program can be a part of a routine maintenance program.

TVA Response to NRC Request:

TVA does not agree with this recommendation. The IITA assemblies cannot be inspected for wall thinning using internal eddy current methods that are used to inspect thimble tubes. In addition, after the IITAs are irradiated, inspection using external ultrasonic measurements that are used to detect pipe wall thinning would result in excessive personnel exposure. While visual inspection is possible, it cannot detect wall thinning and is limited to the section of the IITA that is not inserted into the reactor core.

As documented in WEC to TVA letter WBT-D-3072 "WINCISE Vibration Induced Wear Calculation Conclusion," dated April 6, 2011 (Reference 8) calculation CN-PO-09-15, "Westinghouse Incore Information Surveillance and Engineering (WINCISE) Incore Instrument Thimble Assembly (IITA) Vibration Analysis for Watts Bar Unit 2," M. J. Reho, September 22, 2010, demonstrates that the assemblies are not subject to vibration induced wear. Based on the above and the fact that the outer wall of the IITA is not a RCS pressure boundary, TVA does not agree to include an IITA inspection program in the plant maintenance program. The referenced proprietary letter and calculation are available for review at the WEC Rockville office.

5. NRC Request (Item Number 378)

Make the following WEC proprietary documents available for NRC review at the Westinghouse Rockville office:

- *WINCISE Functional Specification for Watts Bar Unit 2, 420A90, Rev. 2*
- *BEACON Data Processing Application Program Software Requirements Specification, WNA-DS-02196-WBT, Rev. 1* .
- *Standard Fixed In-Core Detector Data Processing (PRLQFDO.2) Function Block Specification, WNA-DS-01400-GEN, Rev. 0*
- *Standard Vanadium Detector Filter (FBM.SPDO.2) Function Block Specification, WNA-DS-O 1402-GEN, Rev. 0*
- *IIS SPS Datalink Client Software Interface Specification, WNA-DS-02208-WBT, Rev. 1*
- *BEACON Datalink Interface Specification, WNA-DS-02194-WBT, Rev. 1*
- *ICS Datalink Interface Specification, WNA-DS-02193-WBT, Rev. 1*

- *Watts Bar 2 Incore Instrument System (IIS) Signal Processing System (SPS) Isolation Requirements, WNA-CN-00IS7-WBT, Rev. 0*

TVA Response to NRC Request:

Per WEC letter WBT-D-3201 (Reference 1), the documents are available for NRC review at the WEC Rockville office.

6. **NRC Request (Item Number 379)**

Provide proprietary and non-proprietary versions of the WINCISE slides from the May 12 public meeting.

TVA Response to NRC Request:

The proprietary versions of the slides were provided in TVA letter to NRC dated May 20, 2011 (Reference 2). Attachment 2 contains WEC document WBT-D-3191-NP Attachment, non-proprietary version of the WINCISE slides from the May 12, 2011 public meeting.

7. **NRC Request (Item Number 380)**

Provide a non-proprietary functional description of the WINCISE Application Server including discussion on redundancy for both the servers and the configuration of the Beacon A/B computers.

TVA Response to NRC Request:

Attachment 3 contains the WEC non-proprietary functional description of the WINCISE Application Server.

8. **NRC Request (Item Number 381)**

Provide a non-proprietary description of the qualification of the mineral insulated (MI) cable assemblies with references to any environmental qualification (EQ) report (if applicable)

TVA Response to NRC Request:

Attachment 4 contains the WEC non-proprietary description of the qualification of the mineral insulated (MI) cable assemblies.

9. **NRC Request (Item Number 382)**

Provide a non-proprietary description of the qualification of the Signal Processing System (SPS) cabinet with references to EQ report(s).

TVA Response to NRC Request:

Attachment 5 contains the WEC non-proprietary description of the qualification of the Signal Processing System (SPS) cabinet.

10. NRC Request (Item Number 383)

Provide a non-proprietary description of the qualification of the IITA with references to EQ report(s).

TVA Response to NRC Request:

Attachment 6 contains the WEC non-proprietary description of the qualification of the IITA.

11. NRC Request (Item Number 384)

Provide a non-proprietary description of the differences between Unit 1 and Unit 2 core monitoring with references to Westinghouse documentation.

TVA Response to NRC Request

The only similarities between the WBN Unit 1 and Unit 2 IIS are:

1. Unit 1 and Unit 2 will utilize the same version of the BEACON-TSM software.
2. The BEACON-TSM software will be installed on a computer utilizing a LINUX operating system.
3. Attachment 11 provides some non-proprietary details of the differences between the Unit 1 and Unit 2 IIS.

12. NRC Request (Item Number 385)

Provide a non-proprietary description of the calculation note shown to the NRC at the meeting.

TVA Response to NRC Request

Attachment 7 contains WEC non-proprietary description of the calculation note shown to the NRC at the May 12, 2011 meeting.

13. NRC Request (Item Number 386)

Provide a description of the communications between the SPS and the ICS. This should include what data is transmitted to the ICS and what data comes from the ICS that is used by WINCISE. Also, how are the requirements for safety-to-non-safety isolation achieved.

TVA Response to NRC Request

There is no direct communication between the SPS cabinets and the ICS. The SPS cabinets communicate with the WINCISE Application Servers. The ICS sends data to the WINCISE Application Servers. The ICS receives data from the BEACON Servers via the WINCISE Application Servers. In addition to the BEACON data, the WINCISE Application Servers send system status information (SPS cabinet temperatures, etc.) to the ICS. The WINCISE Application Servers receive data from the WINCISE SPS cabinets and the ICS, package the data into a form useable by the BEACON TSM software and send the data to the BEACON Servers.

The data points sent by the ICS to the WINCISE Application Servers and the data points the BEACON Servers send to the ICS are listed in Attachment 8. For simplicity, the system status data points (which include the status of each individual detector, card power supply, etc.) are not included.

Since the WINCISE Application Servers, the BEACON Servers and the ICS are all non-safety-related, there is no safety-to-non-safety interface so no isolation is required. However, there is a firewall between the ICS network and the WINCISE/BEACON network to prevent a problem on one network from impacting the other.

14. NRC Request (Item Number 387)

Provide a copy of the analysis which states how Westinghouse has met the Reg Guide 1.75/IEEE-384 requirements for isolation between safety and non-safety for the CETs and the SPS panels.

TVA Response to NRC Request

As discussed in the WEC WINCISE presentation at the public meeting on May 12, 2011, the WBN Unit 2 IITA assemblies are the same in this regard to those used in the AP-1000. The information on how the AP-1000 IITAs meet IEEE 384 requirements is documented in WCAP-17226-P, Revision 2, "Assessment of Potential Interactions Between the Core Exit Thermocouple Signals and the Self-Powered Detector Signals in the AP1000™ In-Core Instrumentation System," dated July 2010 submitted to the NRC on WEC to NRC letter DCP_NRC_003021, "Submittal of AP1000™ Instrumentation and Control Documents to Support of the AP1000 Design Certification Amendment Application (Docket No. 52-006)," dated August 25, 2010 (ML102390520). The non-proprietary description of how the IITA meets IEEE 384 requirements is contained in Attachment 7.

15. NRC Common Q PAMS Audit Action Item Response:

Provide responses to the generic issues cited in the Watts Bar Nuclear Plant, Unit 2-Audit Report of the Common Q Post-Accident Monitoring System (PAMS) (TAC NO. ME273l).

TVA Response

Notes:

1. The following non-proprietary responses are from WEC to TVA letter WBT-D-3154, dated May 4, 2011 (Reference 3).

2. The following responses are based on the fact that revision 1 of the Software Program Manual (SPM) is currently going through NRC review.

3. The WEC Corrective Action Process (CAP) and other supporting documents for each response are available for review at the WEC Rockville Office.

- **Commercial Grade Dedication:**

  No Generic Action Items

- **Requirements Traceability:**

  No Generic Action Items

- **Configuration Management:**

  Generic Action: Revise the SPM to reflect the current media labeling process.

  Generic Response: This issue has been captured in the WEC CAPS, under Issue Report # 11-071-M009. Closure is dependent on the NRC completing review of the revision 1 SPM.

- **Verification and Validation:**

  A. **Generic Action**: Programmatically, the SPM will be revised to clarify that the V&V team verifier does not perform the role of independent reviewer for the design team.

     Generic Response: This issue has been captured in the WEC CAPS, under Issue Report # 11-071-M005. Closure is dependent on the NRC completing review of the revision 1 SPM.

  B. **Generic Action**: See CAPS No. 11-061-M047: This issue will also be addressed programmatically, possibly providing additional templates, and specifying templates for specific categories of documents. (There currently exists one template that is used for both safety-related and non-safety-related documents.)

     Generic Response: This issue has been captured in the WEC CAPS, under Issue Reports # 11-061-M047 and 11-062-M004. Closure of this issue is monitored through the CAPS as defined in WEC procedure WEC 16.2, "Westinghouse Corrective Actions Process."

C. **Generic Action**: This issue (QA audit insufficient) will also be addressed programmatically.

Generic Response: This issue has been captured in the WEC CAPS, under Issue Reports # 11-071-M008 and 11-045-M008. Closure of this issue is monitored through the CAPS as defined in WEC 16.2.

D. **Generic Action**: WEC to ensure that consistent terminology is used in the SPM and QA implementing procedures.

Generic Response: This issue has been captured in the WEC CAPS, under Issue Report # 11-062-M004. Closure is dependent on the NRC completing review of the revision 1 SPM.

E. **Generic Action**: WEC to ensure internal consistency of the next revision of the SPM.

Generic Response: This issue has been captured in the WEC CAPS, under Issue Report # 11-011-M027. Closure is dependent on the NRC completing review of the revision 1 SPM.

F. **Generic Action**: The next revision of the SPM will be internally consistent and will specify that the design team is responsible for configuration management. The V&V team will issue software release records for software that has been issued from the Design Team to the V&V team and has successfully completed the associated V&V activities.

Generic Response: The revision 1 SPM, submitted to the NRC, addresses design team responsibility for configuration management. In addition, this issue has been captured in the WEC CAPS, under Issue Report # 11-071-M003. Closure is dependent on the NRC completing review of the revision 1 SPM.

G. **Generic Action**: WEC to clarify in the next revision of the SPM. [V&V's review of the adequacy and completeness of the SCMP]

Generic Response: This issue has been captured in the WEC CAPS, under Issue Report # 11-071-M001. Closure is dependent on the NRC completing review of the revision 1 SPM.

H. **Generic Action**: The requirement phase of the SCMP in the SPM will be revised to include a discussion on generic vs. project-specific requirements. The SPM will also be updated to include where these software items are defined.

Generic Response: This issue has been captured in the WEC CAPS, under Issue Report # 11-071-M002. Closure is dependent on the NRC completing review of the revision 1 SPM.

I. **Generic Action**: The responsibilities for configuration management will consistently be defined as the Design Team activity and not a V&V activity in the next revision of the SPM.

Generic Response: The revised SPM submitted to the NRC addresses design team responsibility for configuration management. In addition, this issue has been captured in the WEC CAPS, under Issue Report # 11-071-M003. Closure is dependent on the NRC completing review of the revision 1 SPM.

J. **Generic Action**: The SPM will be clarified. [V&V's review of Coding Standards]

Generic Response: This issue has been captured in the WEC CAPS, under Issue Report # 11-094-M032. Closure is dependent on the NRC completing review of the revision 1 SPM.

16. <u>NRC Common Q PAMS Audit Action Item Response:</u>

Provide responses to the WBN2 specific issues cited in the Watts Bar Nuclear Plant, Unit 2 -Audit Report of the Common Q Post-Accident Monitoring System (PAMS) (TAC NO. ME273I).

<u>TVA Response:</u>

WEC has resolved the Common Q Audit Report WBN2 specific actions. The responses to the individual items are documented in Proprietary WEC to TVA letter WBT-D-3212. (Reference 6) The results of the self assessment required by the WBN2 specific action, is documented in WEC Proprietary Internal Letter NA-IV&V-11-0005. Both letters are available for NRC review at the WEC Rockville office.

17. <u>NRC Commitment Closure:</u>

In TVA to NRC letter dated December 10, 2010 (Reference 4), TVA committed to provide a non-proprietary version of Thermo Fisher Scientific Qualification Report No. 864, "Class 1E Qualification of the Source Range, Intermediate Range and Wide Range Channels."

<u>TVA Response:</u>

Attachment 9 contains Thermo Fisher Scientific Qualification Report No. 864RD, "Class 1E Qualification of the Source Range, Intermediate Range and Wide Range Channels - Redacted Version," dated February, 2011.

18. <u>NRC Verbal Request:</u>

The NRC inspector requested a non-proprietary summary of the Common Q PAMS datastorm test to reference in the SER.

TVA Response to NRC Request:

The following non-proprietary response was provided in WEC to TVA letter WBT-D-3149 (Reference 5).

Data Storm Test

Watts Bar Unit 2 Post Accident Monitoring System went through a Data Storm Test to verify that the safety related functions of the system driven by the Advant Controller 160 (AC 160) and the safety related indications monitored on the Operator Module (OM) located in the Main Control Room (MCR) are not affected when the Ethernet network interface of the Maintenance and Test Panel (MTP) is under data storm conditions. This test was requested by TVA.

The purpose of the data storm test was to test the ability of the MTP to handle the possible volume of traffic generated by a broadcast storm without impacting the safety functions. A broadcast storm occurs when a large number of broadcast packets are received. Forwarding these packets can cause the network to slow down or to time out.

Another objective of the data storm test was to test the ability of the MTP to handle malformed packets possibly generated by a data storm without impacting the safety functions.

The following pass/fail criteria were used to evaluate the success of the data storm test results:

1. During the data storm test, the OM shall continue trending the selected input signal smoothly on the data trend display. The smooth trending was verified by creating a data trend of the point being monitored and comparing it to the data trend observed during the data storm.

2. During the data storm test, the OM shall respond to screen touches (navigation) normally. This was determined by navigating several different screens during the execution of the test.

3. During the data storm, the AC 160 user-selectable analog output channel shall generate the analog signal without interruption. The output of the analog channel was captured using a calibrated recording device. A recording of the analog output point being monitored was created before the data storm and this recording was compared to a recording observed during the data storm.

During the data storm, it was acceptable to have the MTP stop responding because it does not perform a safety function. When this occurred, the following pass/fail criteria were used:

1. The System Trouble Annunciator (digital output from the AC 160) to alarm (open contact).

2. The System Trouble Alarm Block on the OM display to indicate alarm (turn to red).

3. The MTP icon on the OM System Health page to indicate alarm or a failure (turn to red or turn to magenta) depending on the type of failure of the MTP.

Test Execution and Test Results

After collecting baseline data, the broadcast storm was applied to the system. While the broadcast storm was in progress the following was observed:

- The OM was operational throughout the broadcast storm. The trend signal was smooth and all screens were navigational from the directory via touches on the touch screen.
- The MTP stopped responding for several minutes, and then returned to operational status. While the MTP was inoperable, the system trouble alarm occurred on the OM and annunciator output, and the MTP status was red on the OM. Once the data storm was halted, the MTP began to respond again.
- The analog output from the AC 160 remained operational during the broadcast storm.

The results of the testing determined that the system met the acceptance criteria outlined above.

19. <u>NRC Commitment Closure</u>

In TVA to NRC letter dated October 29, 2010 (Reference 7), TVA committed to provide final EDCR 55385 excerpts including Scope, Intent, Unit Difference and Technical Evaluation

<u>TVA Response to NRC Request:</u>

Attachment 10 contains EDCR 55385 excerpts including the Scope, Intent, Unit Difference and Technical Evaluation.

20. <u>NRC Commitment Closure</u>

In TVA to NRC letter dated October 29, 2010 (Reference 7), TVA committed to provide final EDCR 52351 excerpts including Scope, Intent, Unit Difference and Technical Evaluation

<u>TVA Response to NRC Request:</u>

Attachment 12 contains EDCR 52351 excerpts including the Scope, Intent, Unit Difference and Technical Evaluation.

21. <u>NRC Commitment Closure</u>

In TVA to NRC letter dated April 15, 2011 (Reference 10), TVA committed to provide the application for withholding for the WINCISE Technical Manual.

TVA Response to NRC Request:

Attachment 13 contains WEC document CAW-11-3141, dated April 15, 2011, "Application for Withholding Information from Public Disclosure for NO-WBT-002, Rev. 0, 'Westinghouse Incore Information Surveillance & Engineering (WINCISE™) System' (Proprietary)."

List of Attachments

1. WEC non-proprietary document EQ-QR-79, Revision 0, "Summary Test Report Vibration Testing of the Westinghouse Digital Metal Impact Monitoring System (DMIMS-DX) In-Containment Sensor and Integral Hardline Cable 5357C52G01," dated May 2011 [Letter Item #1 (NRC Request #362)]
2. WEC document WBT-D-3191- NP Attachment, non-proprietary version of the WINCISE slides from the May 12, 2011 public meeting [Letter Item #6 (NRC Request #379)]
3. Non-proprietary functional description of the WINCISE Application Server [Letter Item #7 (NRC Request #380)]
4. Non-proprietary description of the qualification of the mineral insulated (MI) cable assemblies [Letter Item #8 (NRC Request #381)]
5. Non-proprietary description of the qualification of the Signal Processing System (SPS) cabinet [Letter Item #9 (NRC Request #382)]
6. Non-proprietary description of the qualification of the IITA [Letter Item #10 (NRC Request #383)]
7. Non-proprietary description of the calculation note shown to the NRC at the May 12, 2011 meeting [Letter Item #12 (NRC Request #385)] [Letter Item #14 (NRC Request #387)]
8. List of BEACON to/from ICS datapoints [Letter Item #13 (NRC Request #386)]
9. Thermo Fisher Scientific Qualification Report No. 864RD, "Class 1E Qualification of the Source Range, Intermediate Range and Wide Range Channels - Redacted Version," dated February 2011 [Letter Item #17]
10. EDCR 55385 excerpts including Scope, Intent, Unit Difference and Technical Evaluation [Letter Item #19]
11. Non proprietary description of the differences between the Unit 1 and Unit 2 IIS [Letter Item #11 (NRC Request #384)]
12. EDCR 52351 excerpts including Scope, Intent, Unit Difference and Technical Evaluation [Letter Item #20]
13. WEC document CAW-11-3141, dated April 15, 2011, "Application for Withholding Information from Public Disclosure for NO-WBT-002, Rev. 0, 'Westinghouse Incore Information Surveillance & Engineering (WINCISE™) System' (Proprietary)" [Letter Item #21]

Westinghouse Non-Proprietary Document EQ-QR-79, Revision 0,

"Summary Test Report Vibration Testing Of The Westinghouse Digital Metal Impact Monitoring System (DMIMS-DX) In-Containment Sensor And Integral Hardline Cable 5357C52G01," Dated May 2011

Westinghouse

Summary Test Report
Vibration Testing of the Westinghouse Digital Metal Impact Monitoring System (DMIMS-DX) In-Containment Sensor and Integral Hardline Cable 5357C52G01

EQ-QR-79, Revision 0

May 2011

Prepared by: *Electronically Approved** Date: See EDMS
R. H. Jabs, Principal Engineer
NA / Equipment Qualification I

Reviewed by: *Electronically Approved** Date: See EDMS
C. J. Black, Senior Engineer
NA / Incore and Monitoring Systems

Verified by: *Electronically Approved** Date: See EDMS
S. G. Cheyne, Senior Engineer
NA / Equipment Qualification I

Approved by: *Electronically Approved** Date: See EDMS
G. G. Ament, Manager
NA / Equipment Qualification I

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

Nuclear Automation
1000 Westinghouse Drive
New Stanton, PA 15672-9606

REVISION HISTORY

Revision	Author	Description	Date
0	R. H. Jabs	Original Release	See EDMS

TABLE OF CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

DMIMS-DX	Digital Metal Impact Monitoring System
Hz	Hertz
g	Acceleration of gravity
rms	Root mean square
U.S. NRC	United States Nuclear Regulatory Commission

Trademark Note:

DMIMS-DX is a trademark of Westinghouse Electric Company LLC, its subsidiaries and/or its affiliate owners.

1.0 Objective

The objective of this test summary is to describe the vibration testing that was performed on the Westinghouse Digital Metal Impact Monitoring System (*DMIMS-DX™*) in-containment sensors with integral hardline cables. The testing was performed to demonstrate that normal in-service vibration will not affect the ability of the sensor or the hardline cable to detect loose parts as required by United States Nuclear Regulatory Commission (U.S. NRC) Regulatory Guide 1.133, Revision 1 (Reference 1).

2.0 Test Specimens

Two DMIMS-DX sensors with integral hardline cables, Westinghouse part number 5357C52G01, were subjected to vibration testing. These test specimens had serial numbers of 5046 and 5050. The outputs of the sensors were routed through Westinghouse DMIMS-DX preamplifiers and signal conditioners to verify their performance during the testing.

The sensors and integral hardline cable assemblies were functionally tested per Westinghouse procedure 1TS2856, Revision 2 (Reference 2) prior to the start of testing.

3.0 Test Requirements

3.1 Test Conditions

The Westinghouse DMIMS-DX sensors and integral hardline cable assemblies were subjected to a sinusoidal input motion at an acceleration of 0.75g rms with varying frequencies sweeping continuously from 5 Hz to 1000 Hz and back to 5 Hz. The sweep rate was about one octave/minute. Ten sweep cycles of vibration were applied in each of the three orthogonal directions, continuously sweeping up and down through this frequency range.

3.2 Performance Requirements

1. The test specimens were required to be completely operable during and after the vibration testing and shall be able to detect a simulated loose parts signal.
2. Following completion of the vibration testing, the test specimens were required to meet the functional requirements of 1TS2856, Revision 2 (Reference 2).
3. The sensors were required to maintain structural integrity during all vibration sweeps.

4.0 Test Procedure

4.1 Mounting

The sensors were installed to a rigid test fixture and tightened to their specification. The 4-foot length of the integral hardline cable was unsupported, except for at a fixed connection point off the vibration machine at the connector, to simulate the most conservative mounting configuration. One test specimen was mounted in the horizontal orientation, while the other test specimen was mounted in the vertical orientation.

4.2 Electrical Connections and Monitoring

Each test specimen was connected to a Westinghouse softline cable, built to Westinghouse Drawing 5359C29 (Reference 3), and then to a DMIMS-DX preamplifier. The preamplifier was connected to a DMIMS-DX signal conditioner. The output of the signal conditioner was continuously monitored during all sweeps. An oscilloscope was also used to visually observe each accelerometer output during the sweeps.

4.3 Test Instrumentation

The acceleration of the vibration machine was monitored by a single axis accelerometer mounted on the vibration table in the direction of the vibration motion. The accelerometer provided the control signal to the laboratory test and data acquisition computer.

4.4 Functional Test

Prior to performing vibration testing, a functional test was performed to show that the DMIMS-DX sensors were able to detect a simulated impact by tapping on the test fixture. The simulated impacts were recorded on the chart recorder.

4.5 Test Procedure

The DMIMS-DX sensors and integral hardline cable were mounted to a rigid test fixture representing a vertical and horizontal installation. The cables were supported off the vibration machine at the connector end to simulate a worst case field installation. Following functional testing, a sinusoidal vibration in the vertical direction was started, sweeping from 5 Hz to 1000 Hz and back to 5 Hz at a rate of about one octave per minute at 0.75g rms. This was repeated for a total of 10 sweep cycles in this orientation. Functional testing was performed after the 10 sweep cycles were completed.

The vibration machine orientation was then changed to provide a horizontal vibration input. Testing continued in the first horizontal direction, sweeping from 5 Hz to 1000 Hz back to 5 Hz at a rate of about one octave/minute sweep at 0.75g rms. Ten sweep cycles were performed in this orientation. Following the ten sweep cycles, a functional test was performed.

The test fixture was then rotated 90 degrees in the horizontal direction for testing in the third orthogonal direction. Testing continued sweeping from 5 Hz to 1000 Hz back to 5 Hz at a rate of about one octave/minute sweep at 0.75g rms. Ten sweep cycles were performed in this orientation. Following the ten sweep cycles, a functional test was performed.

Upon completion of the vibration testing, the DMIMS-DX sensors and integral hardline cable were removed from the test fixture and physically inspected. The DMIMS-DX sensors and integral hardline cable were then functionally tested per Westinghouse procedure 1TS2856, Revision 2 (Reference 2).

No modifications were made to the test setup during the vibration testing.

5.0 Test Results

The DMIMS-DX sensors and integral hardline cable remained completely functional during all sweep cycles in the three orthogonal directions. A functional test performed to Westinghouse procedure 1TS2856, Revision 2 (Reference 2) following the vibration testing, showed acceptable results.

6.0 Summary and Conclusions

Westinghouse DMIMS-DX sensors with integral hardline cable, Westinghouse part number 5357C52G01, were subjected to sinusoidal vibration at 0.75g rms, sweeping from 5 Hz to 1000 Hz and back to 5 Hz. Ten sweeps were performed in each orthogonal direction. Electrical monitoring of the test specimen outputs showed that they maintained their required signal during all sweeps. Electrical functional testing 1TS2856, Revision 2 (Reference 2) was performed following the vibration test. The Westinghouse DMIMS-DX sensors with integral hardline cables met all performance requirements.

It is concluded that the Westinghouse DMIMS-DX sensors with integral hardline cables, Westinghouse part number 5357C52G01, will maintain the ability to detect loose parts and meet the requirements of U.S. NRC Regulatory Guide 1.133, Revision 1 (Reference 1) during normal in-service plant vibration.

7.0 References

1. U.S. NRC Regulatory Guide 1.133, Revision 1, "Loose-Part Detection Program for the Primary System of Light-Water-Cooled Reactors," May 1981.
2. Westinghouse Document, 1TS2856, Revision 2, "Accelerometer Assembly 5357C52G01 Functional Test Procedure," July 25, 2005 (Westinghouse Proprietary).
3. Westinghouse Drawing, 5359C29, Revision 9, "DMIMS Softline Cable Outline and Assembly."

Attachment 2
TVA Letter Dated June 10, 2011
Responses to Licensee Open Items to be Resolved for SER Approval

Westinghouse Document WBT-D-3191- NP Attachment, Non-Proprietary Version

Of The WINCISE Slides From The May 12, 2011 Public Meeting

WINCISE System – Design Scope

- The Nuclear Services contractual scope of the WINCISE System design includes the following items:
  - IITA Design
  - SPS Cabinet design
  - CET and SPD signal cables
  - SPS Cabinet communication network design
  - BEACON-TSM interface design

WINCISE System – Design Scope

- The Nuclear Services scope of the WINCISE System design does **not** include the following items:
  - CET and SPD cable layout and installation
  - SPS cabinet location and installation
  - SPS cabinet external power supply routing and installation
  - Fiber Optic cable procurement, layout, and installation
  - IITA incore radial location layout
  - Fuel Assembly instrument thimble design
  - Site Storage, handling, bending, folding, spindling, or mutilation.

WINCISE System - What Does it Do?

- The WINCISE System functionality is essentially identical to the FID Systems used in all CE-style operating reactors.
  - The Seabrook Plant also uses a similar system.
- The WINCISE System is used to produce continuous (≤1 per minute) core power distribution measurements using the BEACON™-TSM System software package.
  - The core power distribution measurement information is used to determine whether the core is operating within the peak F_Q and $F_{\Delta H}$ limits

WINCISE System - What Does it Do?

- Each IITA contains 5 Vanadium Self-Powered Detector (SPD) elements and 1 Core Exit Thermocouple (CET).
  - The SPD elements output analog current values (μA) directly proportion to the local neutron flux.
  - The CET output voltage signals (mV) that are related to the temperature surrounding the CET.

WINCISE System - What Does it Do?

- The CET signals are routed to PAMS as 1E signals.
- The Signal Processing System (SPS) receives the analog SPD currents as input, digitizes them, and outputs the digitized current values for input to the BEACON-TSM interface system.

a,c

- The measured core power distribution is used to determine whether the reactor is operating at an allowable power distribution.

WINCISE System - What Does it Do?

- The CET operability requirements contained in the Post Accident Monitoring Instrumentation Tech Specs require that the System provide valid CET measurements from 2 CET in each core quadrant.
  - The 58 CET signals are segregated into 2 1E Trains.
  - Each CET Train contains signals from 29 CET.
  - The radial core distribution of CET in each Train ensures that each Train sees essentially identical core temperature distributions.

WINCISE System - What Does it Do?

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1							1			30					
2			2			31		32							
3								3		33		4		34	
4		5	35					36							
5					6				7		37		8		
6	38		9			10		11						12	
7				39			40			13			41		
8	14		15		42		16			43		44	17	45	
9		46							47		18				19
10					20		48					49			
11	21				50			22			23				51
12						24			52			53			
13			25		54			26						27	
14			55				56			28		57			
15					29			58							

WINCISE System - What Does it Do?

- In order to create a valid core power distribution measurement, the System must supply the BEACON-TSM with valid SPD signals per the requirements in WCAP 12472, BEACON Core Monitoring and Operating Support System, Addendum 1A:

Table 3.1

a,c

[ ]

- With 75% of the SPD operable for the first power distribution measurement in each operating cycle
- 50% of the SPD operable for all subsequent power distribution measurements

WINCISE System - What Doesn't it Do?

- The WINCISE System does not directly perform Reactor Protection, Engineered Safety Feature, or Control System functions.
  - In the event of total failure of the System input to the BEACON-TSM, the plant Tech Specs allow 31 EFPD to restore System operability.
  - Post-accident use of CET requires 3 operable CET per core quadrant.

WINCISE System - System Components

- 58 Incore Instrument Thimble Assemblies (IITA)
  - 5 Self-Powered Detector (SPD) elements per IITA
  - 1 Grounded-Junction Type-K Core-Exit Thermocouple (CET)
- 58 Seal Table Maintenance Swagelok Fittings
- Signal Cables and Connectors
  - SPD Signals
  - CET Signals
- SPD Signal Processing System (SPS) Electronics
- BEACON-TSM Interface System Hardware and Software

WINCISE System - System Components

a,c

WINCISE System - In-Containment Hardware

- Hardware
  - The in-containment hardware includes:
    - The IITA
    - The Swagelok Pressure Boundary Fittings on the Seal Table.
    - Cables routing SPD and CET signals from the Seal Table electrical connector on each IITA assembly to the two SPD current signal Analog-to-Digital (A/D) conversion and multiplexing hardware cabinets.
    - Cables routing CET signals to the appropriate containment penetrations.
    - Fiber optic cables routing multiplexed detector signals through containment penetrations to the BEACON-TSM interface hardware.

WINCISE System - In-Containment Hardware

- Signal Processing Hardware
  - Features of the SPD Signal Processing System (SPS) electronics cabinets include:
    - Two standard cabinet housings each containing 50% of the SPD signals.
    - SPD current signal analog-to-digital processing hardware that outputs the processed SPD signals via redundant fiber optic cables.
    - Fiber Optic cables that route the digitized SPD signals from the SPS cabinets to the appropriate non-safety containment penetrations.
    - Redundant internal cabinet power supplies.
    - The cabinets are located in a low radiation dose area.

WINCISE System - In-Containment Hardware

- Signal Processing Hardware
  - CET signals require use of 1-E electrical connectors and post-accident qualified cables.
  - Potential interactions between the SPD and CET signals are limited to meet IEEE 384 requirements.

WINCISE System – SPS Data Processing System

- Hardware
  - Redundant network servers host SPS and BEACON-TSM communication software.
  - Communicates via data link to containment hardware and BEACON-TSM interface.
- BEACON-TSM Software
  - BEACON-TSM performs the power distribution measurement calculation function.
  - BEACON is the **Only** physics code licensed by the US-NRC for Vanadium SPD use.

Questions?

OPARSSEL IITA – Design Description

- The style of IITA used in the WINCISE System is the patented Optimized Proportional Axial Region Signal Separation, Extended Life (OPARSSEL™) design.
  - Design demonstrated successfully at St. Lucie.
    - Data acquired used to license Vanadium methods in BEACON (WCAP 12472 Addendum 2).
  - Vanadium SPD elements with a design lifetime of 20 reactor years.
    - Expected lifetime of 20+ reactor years.
  - CET for Post Accident Monitoring integral to design.
    - CET is axially positioned to provide a response consistent with the Bottom Mounted CET used in the current operating fleet.
- The WINCISE OPARSSEL IITA design is documented in Design Specification 418A28, Revision 2.

OPARSSEL IITA – Design Description

- The WINCISE OPARSSEL IITA design is illustrated on drawing 10034E85, Rev. 0.

OPARSSEL IITA – Design Description

a,c

OPARSSEL IITA – Deliverables

- Hardware
  - 58 OPARSSEL IITA per plant
- Documentation
  - Mechanical Design Report (ASME Code Calculations)
  - Technical Manual
- Schedule
  - IITA delivery to site on schedule for April of 2011.

OPARSSEL IITA – RISKS

- The 0.335 inch OD of the WINCISE OPARSSEL IITA is somewhat larger than the 0.3 inch OD used in Watts Bar Unit 1, which may result in insertion and withdrawal difficulties.
  - Full-scale insertion and withdrawal testing of an WINCISE OPARSSEL IITA was successfully conducted at a test insertion path at our Waltz Mill plant.
- Vibration induced wear characteristics are not completely demonstrated.
  - Vibration calculations (CN-NO-09-15) demonstrate a significantly lower vibration amplitude and resistance to vibration onset than the current MID thimble design.

OPARSSEL IITA – Open Items

- None

WBT WINCISE System Final Design Review

Questions?

Seal Table - Description

- The IITA detector interfaces at the seal table to form a Reactor Coolant Pressure Boundary point, similar to the current moveable detector system.

- Seals the annulus between the Guide Tube and the IITA.

[ ] a,c

Seal Table – IITA Interface at Seal Table

a,c

Seal Table - Details

- An improved, “maintenance-fitting” will be installed, to reduce the possibility of leakage.

- The following Westinghouse plants have installed seal table maintenance fitting assemblies fully or partially and have not experienced issues:
  - Sequoyah Units 1 & 2
  - Watts Bar Unit 1
  - Comanche Peak Units 1 & 2
  - Beaver Valley Unit 1
  - Kori Units 1-4
  - Indian Point Units 2 & 3
  - Wolf Creek Unit 1

Seal Table - Details

- Low pressure seals provided for refueling

- Additional fittings will also be supplied to support start-up testing (cold hydro and hot functional)

Seal Table - Qualification

- Seismic qualification of seal table fittings and top of IITA – calc note generated based on prior qualifications.

- Only soft parts are low pressure seals – proven design, not safety related.

Seal Table - Installation

- Installation to be performed by Westinghouse.
- Based on past practices - no new methods required.
- Seal table currently has no fittings installed, and is "clean" (as-found walk-down Spring '07)
- Participation in integrated walk-down to confirm seal table condition.

Seal Table – Open Issues

- None

Questions?

Signal Cables - Description

- The WINCISE Mineral Insulated (MI) Core Exit Thermocouple Cable System
  - Class 1E Cable System
  - All 58 Instruments to be Cabled
  - Three Interfaces for Cable System: Instrument, SPS Cabinet , CET

[ ]a,c

    - See Figure Next Slide
  - WINCISE Application is an extension of MI Cable technology already installed in over 60 PWRs and BWRs worldwide for Class 1E applications – Including TVA
    - Installed Class 1E applications include: Fixed In-cores, Core Exit Thermocouples, Heated Junction Thermocouples, Radiation Monitors

Signal Cables - Design

a,c

Signal Cables - Details

- Hardware
  - All seal welded stainless steel construction

[ ] a,c

  - Minimal susceptibility to radiation damage
  - Very high tolerance for abnormal temperatures & pressures

Signal Cables - Details

- Train Separation
  - Train Separation Requirements
  - Cable Trays, Supports & Routing by TVA
  - Historically, Train Separation Has Always Been Easily Achieved.
  - No Problems Anticipated

- Design Team
  - Same Product Group Since Post TMI Modifications
  - Product Group has previously supplied Class 1E Cable Upgrades to TVA for Watts Bar 1, Sequoyah 1, Sequoyah 2

Signal Cables - Deliverables

- Hardware – See Block Diagram Figure
  - (58) Seal Table Area to 2 Transition MI Cable Assemblies
  - (10) Core Exit Thermocouple 6 to 1 Transition MI Cable Assemblies
  - (10) Core Exit Thermocouple Containment MI Cable Assemblies
  - (10) Core Exit Thermocouple Feedthrough Module Assemblies

    - Above Hardware = Safety Related / Class 1E
    - Ex-Containment Field Cabling & Splice Hardware is TVA Scope
    - (Ref 5A of TD)

- Documentation
  - Top Assembly Drawings for Supplied Hardware
  - Technical Manual
  - EQ Report
    - (Ref 5B of TD)

Signal Cables - EQ

- The MI Cable Assemblies are provided as Class 1E / Safety Related.
- MI Cable Assemblies: IEEE Standards 323-1974, 344-1975 and NUREG-0588 Rev 01.
- CET Feedthroughs: IEEE Standard 317-1976
- Extensive Experience: Product Group has provided Environmentally Qualified Class 1E Cable Assemblies to over 70 PWRs & BWRs Worldwide Including TVA.

Signal Cables - Installation

- Installation = TVA Scope

- Westinghouse Scope is Limited to On-Site Technical Advisor during TVA cable assembly installation activities.

Signal Cables - Open Items

- None

Questions?

Signal Processing System

- Description
- Details
- Design
- EQ
- Installation
- Open Issues
- Risks

Signal Processing System - Description

- The WINCISE Signal Processing System (SPS)
  - accepts input currents from the WINCISE SPD detector assemblies,
  - processes /multiplexes these inputs to digital signals, and
  - provides these signals to the application servers for use by the BEACON core monitoring system.
- Analog current signals from 58 incore detector assemblies are evenly divided between two SPS cabinets.
  - Each cabinet houses Signal Processing Electronics (SPE) consisting of Backplane Cards, Amplifier Cards, and Data Link Cards.

Signal Processing System - Details

- Field cables from the WINCISE IITA SPD signals terminate at cabinet top plate bulk head connectors.

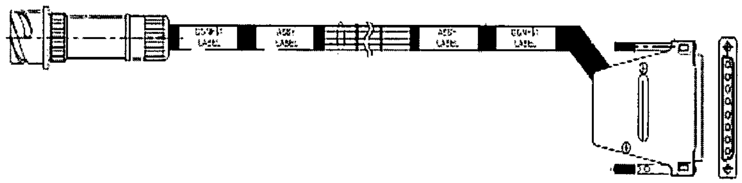
- Backplane Cards in the SPE racks interface the input signals from the bulk head connectors to the Amplifier Cards, as well as interface signals from the Amplifier Cards to the Datalink Cards.

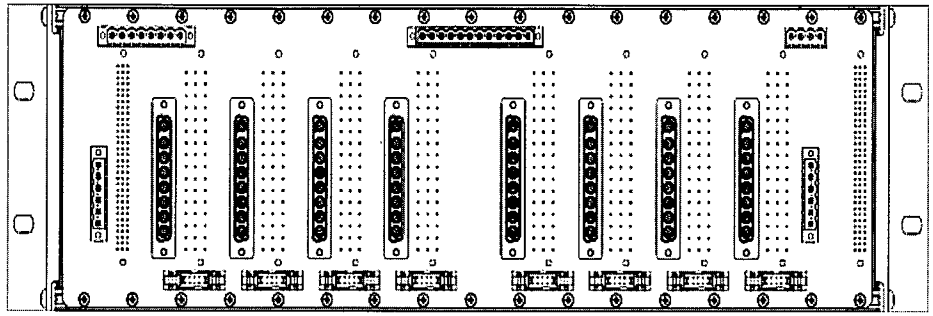
- Processed data is transmitted outside each cabinet by Fiber Optic communication from the Datalink Cards to the Host Software located on the Application Server.

Signal Processing System - SPS block diagram

a,c

Signal Processing System - Backplane





- Low level SPD currents are transmitted from the Bulk Head Connectors to the Backplane Cards through coaxial cables terminated with D-Sub connectors.
  - D-Sub Connectors are on the backplane cards

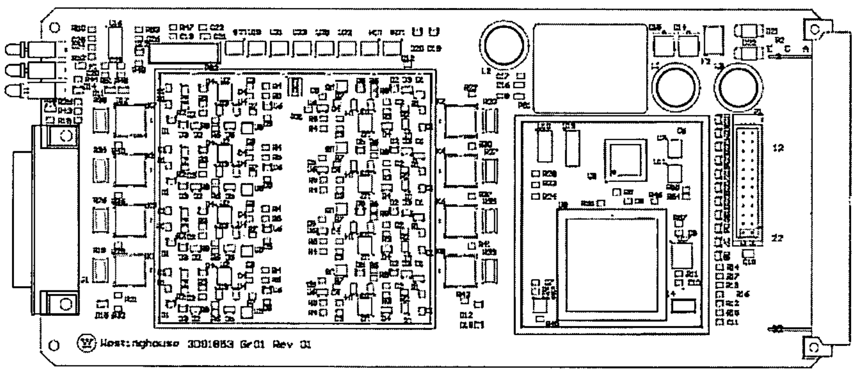
[ ]a,c

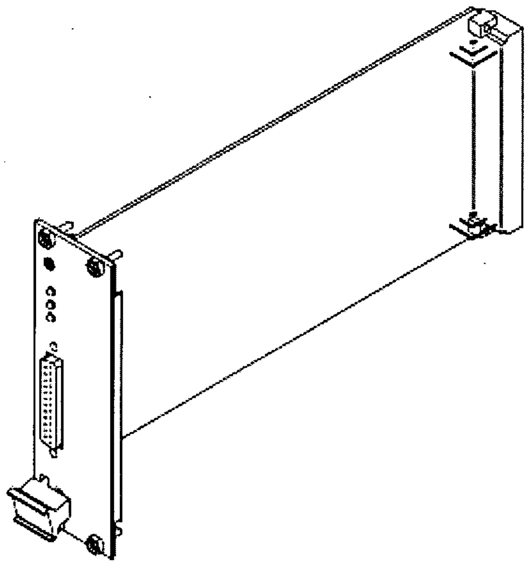
Signal Processing System - Amplifier Card

- Amplifier Card

a,c

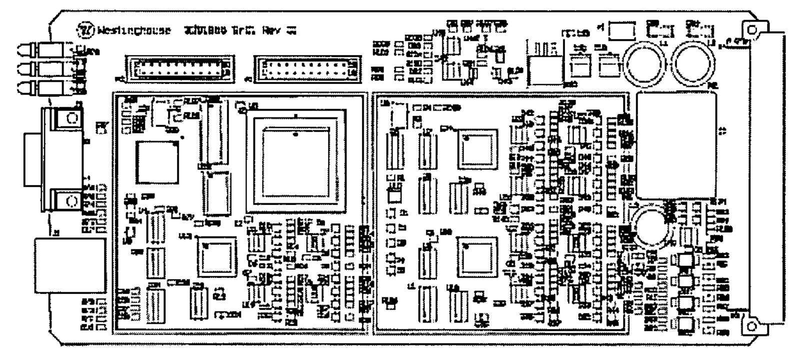
  - Converts the input current signals to voltages, and then amplifies and digitizes the signal.

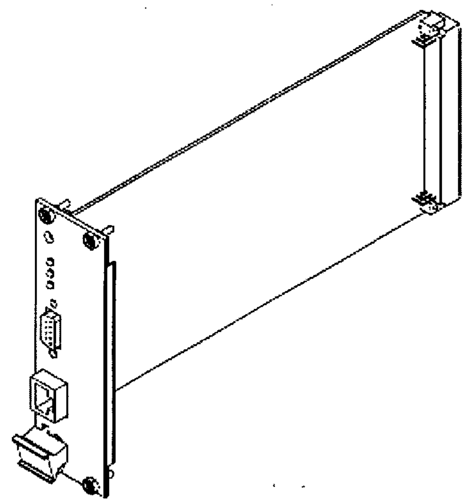




Signal Processing System - Datalink Card

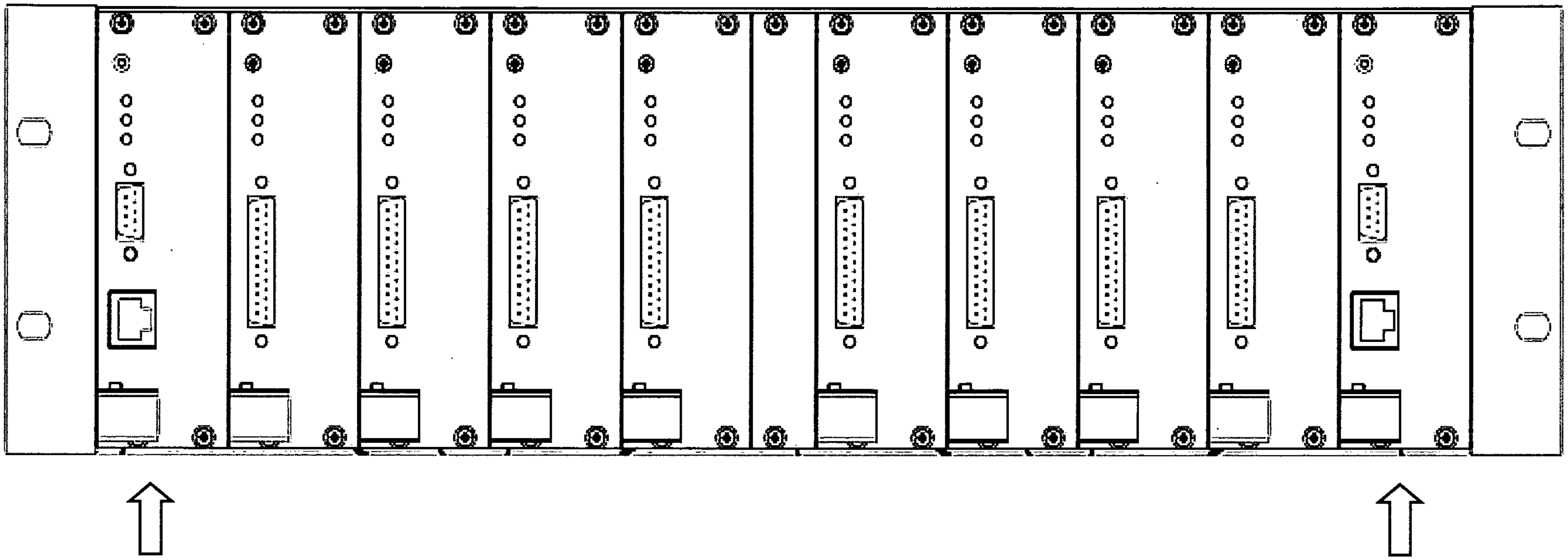
- Datalink Card
  - Digitized signals are transmitted to the Datalink Cards.
  - Datalink Cards gather input from up to eight Amplifier Cards as well as Cabinet Status and sends them out of the cabinet via redundant Fiber Optic communication to the Host software located on the Application Server.





Signal Processing System - Single Rack

WINCISE will have 4 SPE racks per cabinet



Datalink Modules

Signal Processing System - Design

- No cables are attached to the front* of the Amplifier cards.
  - Allows easy access and easy removal of a card from the backplane, if necessary.
  - The Amplifier and Datalink Cards can be removed or installed while the SPE rack is powered and the reactor is at power.
  - All other signals enter and exit these modules through the Backplane Card at the rear of the rack.
  - SPE status is transmitted to the Host Software.
  - Status information includes card removal from a rack, power supply status, cabinet-door-open and an analog high temperature signal

* Access for diagnostics/maintenance are available through front connector to query card status, perform calibration, or perform signal injection to the SPE at power. Diagnostics cannot be acquired without a hand-held test box and a personal computer with custom software (Not provided).

Signal Processing System - Cabinet

- WBT WINCISE Cabinet Assembly Drawing (10044E66)
  - Based upon the Westinghouse Standard 7721 Seismic Cabinet design (2E10019)
- Ground straps are installed at:
  - Front and rear doors to cabinet frame
  - Left and right side panels to cabinet frame
  - Top cover to cabinet frame
- Fully Loaded Cabinet Weight ~720 lbs
  - Empty cabinet is 440 lbs
  - On Seismic table 695 lbs
  - Estimate for external cabling 25 lbs

Signal Processing System - Cabinet Power Sources

a,c

Signal Processing System - Cabinet

a,c

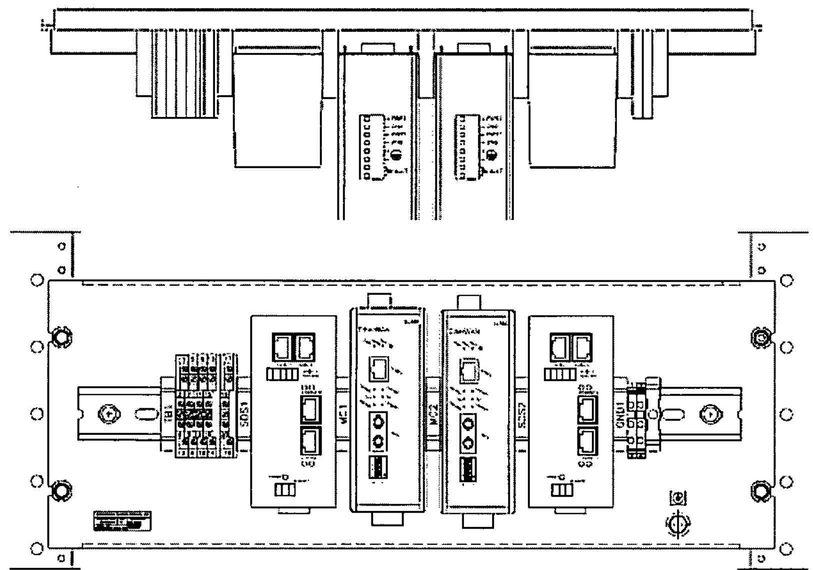
Signal Processing System - Cabinet

- Each SPS cabinet will come fully equipped with power supplies, four racks of SPE, and other cabinet hardware.
  - All internal cabinet wiring will be completed before delivery per WNA-WD-00824-WBT and 10044E67.
  - SPS cabinets contain fans to provide cooling.

[ ] a,c

Signal Processing System - Cabinet

- Media conversion will be used between the Datalink Interface Modules and the Host Software to transmit the SPS signals via Fiber Optic communication - Middle



Signal Processing System - EQ

- Notice of successfully completing Equipment Qualification was issued on April 20, 2010.
- The SPS cabinets, including the cabinet input connectors and the fiber optic outputs are classified as non-safety, seismic category II.
- Cabinets are qualified to IEEE 344-1987 as seismic category II cabinets.
- Cabinets are EMC tested with the following test methods:
  - IEC 61000 series for Susceptibility
  - MIL-STD-461E and EN 55011 for Emissions

Signal Processing System - Installation

- The SPS cabinets are located inside of containment in the seal table room.

- The A/E is responsible for:
  - installing the cabinets and designing the routing and supports for the cabinet input, output, and power supply cables and cooling facilities, and
  - providing the Fiber Optic output cables, containment penetrations and ex-containment cables to connect the SPS signals to the host software application server.

Signal Processing System - Open Issues

- Formal documentation is now being generated to formally report the results of Equipment Qualification.

Questions?

SPS Network Interface

- The SPS Network Interface (also referred to as Host Software) consists of the following elements:
  - SPS Datalink Interface
  - BEACON Data Processing (BDP) Application Program
  - QFD Function Block
  - BEACON Datalink Interface
  - Plant Computer (ICS) FTP Interface

SPS Network Interface - Host Software

- The following are general design considerations for the Host Software:
  - Software Design is based on Temelin WDPF INFM software
  - "Modernization" of the QFDCALB custom algorithm
  - Provides communication between SPS/BEACON/Plant Computer
  - Supports calculations for Vanadium detector types

SPS Network Interface - SPS Datalink Interface

a,c

SPS Network Interface - System SPS Datalink data flow path

a,c

SPS Network Interface - BDP Application

a,c

SPS Network Interface - QFD Function Block

a,c

SPS Network Interface - BEACON Datalink Interface

a,c

SPS Network Interface - BEACON Datalink data flow

a,c

SPS Network Interface - ICS Datalink Interface

- The following are design features of the Plant Computer (ICS) Datalink Interface:
  - Parses configuration file containing ICS highway points
  - Controls FTP transfer of ICS text data file to Application Server
  - Places ICS point values into Ovation database for use by BEACON datalink task

SPS Network Interface - Host Software Interfaces

a,c

SPS Network Interface - Host Software requirements documentation

- Signal Processing Hardware
  - 420A90 “WINCISE Functional Specification for Watts Bar Unit 2”
  - WNA-DS-02196-WBT “BEACON Data Processing Application Program Software Requirements Specification”
  - WNA-DS-01400-GEN “Standard Fixed In-Core Detector Data Processing (QFD) Function Block Specification”
  - WNA-DS-01402-GEN “Standard Vanadium Detector Filter (FBM.SPD0.2) Function Block Specification”
  - WNA-DS-02208-WBT “IIS SPS Datalink Client Software Interface Specification”
  - WNA-DS-02194-WBT “BEACON™ Datalink Interface Specification”
  - WNA-DS-02193-WBT “ICS Datalink Interface Specification”

SPS Network Interface - Host Software Open Issues

- None

WINCISE IIS – IISNet Architecture

File: WB2_IISNet_Architecture_webermm

a,c

SPS Network Interface - SystemNet Architecture

- Utilizes separate network, SystemNet
- Redundancy
- AppSrvrs, BEACON, SPS cabinets, switches
- BEACON monitoring/predictive servers Linux based.
- Firewall between ICS and AppSrvrs

SPS Network Interface - Host Software Risks

- None

Questions?

Non-Proprietary Functional Description Of The WINCISE Application Server

Functional Description of the [1]WINCISE™ Application Server

The material below is summarized in the Incore Instrument System (IIS) System Architecture Sketch provided in the PowerPoint presentation provided in TVA to NRC letter "dated May 20, 2011.

Signal Processing System (SPS) Cabinets

The 58 Watts Bar Unit 2 Incore Instrument Thimble Assemblies (IITA) cables are divided into two independent groups (Groups 1 and 2) of 29 IITAs. The signals are divided between the two cabinets, which are located in containment, such that all detector signals associated with Group 1 are terminated at one Westinghouse In-Core Information Surveillance and Engineering (WINCISE) Signal Processing System (SPS) cabinet and all the Group 2 signals are terminated at the second SPS cabinet. A valid power distribution surveillance requires that at least 50% of all self-powered neutron detector (SPND) elements be available (additional requirements on the spatial distribution of the functional detectors, and for the initial surveillance in a given fuel cycle, are contained in the plant Technical Requirements Manual), so grouping the IITAs in this manner provides some redundancy in the event of failure of an individual cabinet and may eliminate the need for an at-power containment entry.

Each cabinet contains the signal processing electronics (SPE) needed to process the analog signals from the SPNDs and transmit the digitized data to the external host software running on the [2]Ovation® Application Servers. The SPE contains embedded firmware to convert the low-current analog signals from the detectors to multiplexed digitized data before transmission to the Application Servers.

The 29 mineral insulated SPND cables from the IITAs in each group terminate at connectors on the top of the associated SPS cabinet. A breakdown of major components in the SPS cabinets can be found in the following subsections.

Signal Processing Electronics (SPE) Chassis

Each SPS cabinet contains four SPE chassis. The primary function of each SPE chassis is to convert SPND input analog currents to digital values for use by the core power distribution monitoring system. A secondary function of the SPE chassis is to provide cabinet status information. Each SPE chassis consists of two datalink interface module assemblies and up to eight amplifier module assemblies which are plugged into a backplane. The individual cables from each IITA (each cable containing 5 SPND conductors) terminate to SPS cabinet top plate connectors, which are wired internally from the top of the SPS cabinet to connectors on the opposite side of the backplane from each amplifier module. The top three SPE chassis contain eight amplifier modules and the bottom chassis contain five amplifier modules.

Each amplifier module assembly digitizes and transmits the five SPND currents from the connected IITA approximately once per second to both datalink interface modules on the same SPE chassis backplane.

---

[1] WINCISE is a registered trademark of the Westinghouse Electric Company LLC
[2] Ovation is a registered trademark of Westinghouse Process Control Inc.

The datalink interface modules on the lower three SPE chassis communicate up to the datalink interface modules on the upper SPE chassis. The datalink interface modules on the upper chassis are designated the master datalink (MDL) and redundant master data link (RMDL). These master datalink interface modules communicate redundant data out over RS-422 serial lines to media converters for conversion to optical fiber-based Ethernet. For further information refer to Reference 2.

Media Converter Assembly

The function of the media converter assembly is to convert the serial RS-422 outputs of the master datalink interface cards to copper Ethernet and communicate with the external Application Server over duplex single-mode optical fiber Ethernet. The active components on the media converter assembly are two serial device drivers, which convert the serial input from the master chassis datalink interface modules to Ethernet, and two media converters, which convert Ethernet on copper to Ethernet over optical fiber.

Power Supply Panel Assembly

The function of the power supply panel assembly is to convert the single-phase 120 VAC, 60 Hz, line input to the cabinet to DC power. Two pairs of power supplies provide redundant, auctioneered DC power output such that if one power supply fails, the second supply will be able to support the full power load of that pair.

Line Filter Panel Assembly

The function of the line filter panel assembly is to protect the cabinet from faults on the power line, and to protect the power line from faults within the cabinet. The power first is connected through a circuit breaker to protect against overcurrent, then through a surge suppressor to protect against short duration overvoltage. The final component is a line filter, which is designed to limit the harmonics on the power line caused by the cabinet power supplies.

High Temperature Cutout Assembly

The function of the high temperature cutout is to shut off power to cabinet components when the temperature rises above 130°F (54°C) in order to protect the cabinet electronics in the case of a loss of cooling. Once the temperature has dropped sufficiently (nominally below 110°F, or 43°C) the high temperature cutout can only be reset by cycling cabinet power to de-energize the relay. This can be done locally or remotely as described further in Reference 2.

DC Distribution Assembly

The functions of the DC distribution assembly are to distribute DC power between the various electrical components within the cabinet and to provide an easy method to control the power to individual components or groups of components.

Cabinet Status Interface Panel

The cabinet status interface assembly provides a single termination location for cabinet status wiring and monitors the cabinet temperature using an analog temperature input. All status signals that are input to the cabinet status interface and the temperature sensor output are sent to the datalink modules on the SPE chassis, where all analog signals are converted to digital values, and all status information is communicated to the external application server.

Application Servers

The Microsoft Windows-based Ovation Application Servers coordinate communication between the SPS cabinets, the plant Integrated Computer System (ICS) and the Best Estimate Analyzer for Core Operations Nuclear ([3]BEACON) Power Distribution Monitoring System servers. In addition, they serve as a computation platform for the BEACON Data Processing application and act as a network gateway between the Ovation network and the Incore Instrument System Network (IISNet). This gateway is necessary since the BEACON servers, SPS data links, and ICS are not Ovation-based and therefore cannot be directly connected to the Ovation network.

The Application Servers are configured in a fully redundant configuration. The Application Server that is in active mode transfers active data between itself, the active BEACON workstation, the plant ICS, and one of the two datalink modules in each SPS cabinet. An Application Server is able to determine if any network communication path is not working and will issue an alarm and switch to a redundant network communication path as necessary. If the active Application Server has a hardware failure, the backup server will automatically assume the active role. Manual intervention can also be used to switch between the active and backup Application Server in the case of software failure or for system maintenance.

The key applications which run on the Application Server platform are:

- ICS Datalink – provides a software interface to the ICS servers through the IISNet where point values and qualities are transferred using text files through a secure file transfer protocol (SFTP) interface.

- BEACON Datalink – provides a software interface to the BEACON servers through the IISNet where point values and qualities are transferred using text files through an SFTP interface.

- SPS Datalink – provides a software interface to the in-containment SPS cabinets in containment through the IISNet utilizing the standard Modbus communication protocol.

- BEACON Data Processing (BDP) – calculates time-averaged compensated and uncompensated SPND signals using raw digital data provided through the SPS Datalink from the in-containment SPS cabinets. The time compensation function consists of a software lead/lag filter configured to improve the time response of the Vanadium SPND elements to be similar to that of Rhodium elements. Time averaging is performed to remove signal noise. Signal corrections to account for current leakage within the field cables are also applied.

[3] BEACON is a registered trademark of the Westinghouse Electric Company LLC

- Application Server Manager – supervisory software which loads as a Microsoft Windows service at boot time and provides scheduling of other applications to ensure calculations are performed at required frequencies, logging services for other applications, and a watchdog function. The watchdog functionality monitors registered processes to ensure they are operating properly, and can take corrective action to kill and restart a misbehaving application, or fail over to the backup Application Server.

System / Engineer / Domain Server

This server is provided for Ovation network system administration and Microsoft Windows domain security management. The Ovation domain controller is a server that contains the common security database for the Ovation network and controls the access to network security resources. Any drop in the system that is not a domain controller, but responds to the domain controller commands is configured to be a domain member.

BEACON Servers

These servers provide a platform for running the BEACON-Technical Specification Monitor (TSM) Power Distribution Monitor (PDMS) software. BEACON uses the 3-D Advanced Nodal Code (ANC) for neutronic calculations, together with continuous input from WINCISE and plant process instrumentation (through the ICS firewall) to support plant operations with core monitoring and core prediction functions. In addition, BEACON-TSM uses the data provided by the WINCISE system to perform Technical Specification core power distribution surveillances. The core monitoring functions allow the user to view displays of radial power distribution anomalies, xenon mode condition, control bank position, axial power margin, and axial offset deviation.

These Linux-based servers are not configured in a fully-redundant manner and require minimal user intervention to swap over to the redundant backup server in the event that the primary BEACON server fails or must be removed from service for maintenance. In the event the primary BEACON server fails, manual actions are required set the backup server as the primary BEACON server. This action can be easily accomplished within 1 hour by following procedures provided with the BEACON System. Because formal power distribution surveillances are required once every 31 days, there will plenty of time for this action to be performed

References

1. Westinghouse Technical Manual LTR-NO-10-94, "Incore Instrument Thimble Assembly Technical / Instruction Manual."

2. Westinghouse Operations & Maintenance Manual WNA-GO-00075-WBT, "WINCISE Signal Processing System Cabinet Operation & Maintenance Manual."

3. Westinghouse Instruction Manual IM-0013, "BMI (Bottom-Mounted Instrumentation) Jacking Tool Manual."

4. Westinghouse Procedure WNA-TP-02985-WBT, "Westinghouse Incore Information Surveillance & Engineering (WINCISE) Site Acceptance Test Procedure."

5. Emerson Process Automation Document REF_1007, “Maintaining your Ovation System.”

6. Westinghouse Technical Manual DP-ME-09-1, “Technical Manual for the WINCISE Cable and Connector Upgrade at Watts Bar Unit 2.”

Non-Proprietary Description Of The Qualification Of The Mineral Insulated (MI) Cable Assemblies

Mineral Insulated (MI) Cable Environmental Qualification Description

This document is an overview of the analysis of the environmental and seismic/structural qualification in accordance with [1,2]IEEE 323-1974™ and [3]IEEE 344-1975™ of the Westinghouse Incore Information Surveillance and Engineering System ([4]WINCISE) Mineral Insulated (MI) Cabling for Watts Bar Unit 2 based upon the qualification testing presented in References 1, 2, 3, 4, 6 and 7 and as supplemented by Reference 5. The method of hardware qualification is similarity analysis. The basis for the Watts Bar Unit 2 site specific environmental and seismic/structural qualification parameters is outlined in Reference 8. The qualification program for the MI Cables was completed in conjunction with Tennessee Valley Authority (TVA) Work Authorization 65717.

Three components underwent qualification testing for the MI Cabling and consisted of the WINCISE 1 to 2 Transition Cable Assemblies, 6 to 1 Transition Cable Assemblies, and Core Exit Thermocouple (CET) Containment Feedthrough Cable Assemblies. The supplied cable assemblies were provided with factory terminated electrical connectors, meaning that field termination of the electrical connectors to the cable is not applicable. The exception is the CET Containment Feedthrough Cable Assemblies that contain pigtails for field termination by TVA.

The WINCISE 1 to 2 Transition Cable Assemblies and 6 to 1 Transition Cable Assemblies underwent the same series of qualification testing. This program had three categories; normal operation, abnormal operation, and accident conditions. These will be discussed further below. The specific Watts Bar Unit 2 environmental parameters/inputs selected were taken from Reference 8. The following descriptions review the qualification testing for these components.

Normal Operation

- *Thermal Aging Conditions*

  The Watts Bar Unit 2 normal operating service temperature is specified as 60°F to 120°F in Reference 8. The qualification test hardware of Reference 1 specifies a continuous service temperature of 165°F for the 40-year service life. To meet these conditions, the MI cable and connectors were aged at 350°F for 312.1 hours. The thermal aging program of Reference 1 exceeds the Watts Bar Unit 2 normal operation service maximum temperature of 120°F specified in Reference 8.

- *Relative Pressure*

  The Watts Bar Unit 2 normal operating relative pressure is 14.3 to 14.7 psia as specified in Reference 8. The qualification hardware test program of Reference 1 specifies normal environment operating pressure as atmospheric. The test program envelopes the relative pressure requirements of Reference 8.

---

[1] IEEE is a registered trademark in the U.S. Patent & Trademark Office, owned by the Institute of Electrical and Electronics Engineers, Incorporated.
[2] IEEE 323 is a registered trademark of the Institute of Electrical and Electronics Engineers, Incorporated.
[3] IEEE 344 is a registered trademark of the Institute of Electrical and Electronics Engineers, Incorporated.
[4] WINCISE is a registered trademark of the Westinghouse Electric Company LLC

- *Relative Humidity*

  The Watts Bar Unit 2 normal operating relative humidity is 30-80% as specified in Reference 8. The construction materials on the exterior surfaces that form the hermetic boundary are not subject to degradation as a result of relative humidity exposure. In addition, the qualification hardware test program of Reference 1 specifies a 0-90% relative humidity for the normal service operating conditions. The test program envelopes the Watts Bar requirements of Reference 8.

- *Radiation Aging*

  The Watts Bar Unit 2 normal operating radiation aging for 40 years is 20 megarads as specified in Reference 8. The qualification test hardware of Reference 1 was exposed to a Cobalt 60 gamma source for a period of 159.7 hours at an average dose rate of 0.35 megarads per hour. The calculated dose based on the dosimetry was 55.14 megarads. This dose included a 10% margin to account for the synergistic effects of simultaneous irradiation and thermal aging. The radiation aging program of Reference 1 envelopes the radiation aging requirements of Reference 8.

- *Mechanical Aging*

  There are no mechanical aging requirements for Watts Bar Unit 2 specified in Reference 8. The qualification test of Reference 1 includes 10 mate/demate cycles on the multipin connectors based on the Grafoil seal being replaced every tenth cycle. There were 5 mate/demate cycles on the twin-pin connectors, with the copper crush gasket being replaced after each cycle, to mechanically age the hardware. This test was performed prior to the seismic testing.

  A subsequent test was done in 1994 to further verify the mechanical integrity of the multipin connector (Reference 7). This test included 250 mate/demate cycles on a multipin connector followed by a loss of coolant accident (LOCA) test. The results showed that the multipin connector, including the Grafoil seal, maintained its integrity during and after this mechanical/LOCA test.

Abnormal Operation

- *Thermal Aging Conditions*

  The Watts Bar Unit 2 abnormal operating service temperature is specified as 50°F to 130°F in Reference 8. The qualification test hardware of Reference 1 specifies a continuous service temperature of 165°F for the 40 year service life. To meet these conditions, the MI cable and connectors were aged at 350°F for 312.1 hours. The normal operation thermal aging program of Reference 1 exceeds the Watts Bar Unit 2 abnormal operation service maximum temperature of 130°F specified in Reference 8.

- *Relative Pressure*

  The Watts Bar Unit 2 abnormal operating relative pressure is 14.3 to 14.7 psia as specified in Reference 8. The qualification hardware test program of Reference 1 specifies atmospheric pressure as the normal environment operating pressure.

- *Relative Humidity*

  The Watts Bar Unit 2 abnormal operating relative humidity is 10-100% as specified in Reference 8. The qualification hardware test program of Reference 1 specifies a 0-90% relative humidity for the normal service operating conditions. The excess relative humidity from 90-100% is considered acceptable since the construction materials on the exterior surfaces forming the hermetic boundary are not subject to degradation as a result of relative humidity exposure. The test program satisfies the Watts Bar relative humidity requirements of Reference 8.

- *Dynamic/Seismic Testing*

  The Watts Bar Unit 2 required response spectra (RRS) is provided in Reference 8. The qualification hardware test response spectra are provided in Figure 11 of Reference 1. The cabling was tested for Operating Basis Earthquakes (OBE) and Safe Shutdown Earthquakes (SSE).

  The testing performed in Reference 1 was performed on semi-rigid mineral insulated cabling. A separate seismic and vibration test for the flexible mineral insulated cable, including the stripwound hose, was performed as documented in Reference 3. This supplemental testing of Reference 3 used the same RRS as Reference 1. In all cases, the test data exceeds Watts Bar Unit 2 requirements.

Accident Conditions

- *Radiation Aging*

  The Watts Bar Unit 2 accident dose specified in Reference 8 is 24.91 megarads gamma and 300.9 megarads beta. The qualification test hardware of Reference 1 was subjected to an accident dose of 165 megarads gamma. Combining the gamma component and gamma equivalent beta dose, and adding a 10% margin for accident doses yields a total required accident dose of 28.05 megarads gamma. The total required accident dose of 28.05 megarads gamma is enveloped by the 165 megarads gamma of available accident dose from Reference 1. The accident radiation dose of Reference 1 envelopes the requirements for accident conditions for Watts Bar Unit 2 as specified in Reference 8.

- *Pressure Profile*

  Watts Bar Unit 2 required peak pressure is specified in Reference 8. The pressure profile of the hardware tested in Reference 1 envelopes the Watts Bar Unit 2 LOCA pressure profile requirement with the exception of the final 5 days. The Watts Bar Unit 2 pressure is a nominal 1 to 1¼ psi above the test profile for this 5 day period. This is acceptable based on the excess test pressure during the remainder of the test period. The LOCA pressure profile of the hardware tested in Reference 1 envelopes the Watts Bar Unit 2 LOCA/Main Steam Line Break (MSLB) pressure profile requirements of Reference 8.

- *Temperature Profile*

  Watts Bar Unit 2 required temperature profile is specified in Reference 8. The qualification test temperature profile of Reference 1 envelopes Watts Bar Unit 2 requirements of Reference 8 with the exception of two periods: a) the initial 10 seconds; and b) the period from 30 to 100 days. These deviations are acceptable based on:

  a) Initial 10 seconds – The initial transient of Reference 1 is more conservative as compared to the relative steady state conditions of Reference 8 for this short period.

  b) Thirty days to 100 Days - The time period of 30 days to 100 days is qualified by Arrhenius methodology as supported by Reference 5. This is a Watts Bar-specific calculation demonstrating that a small sampling of the excess aging incurred by the qualification hardware of Reference 1 envelopes the Watts Bar 100 day post-accident operability requirement.

  The LOCA/MSLB temperature profile of the hardware tested in Reference 1 envelopes the Watts Bar Unit 2 LOCA/MSLB temperature profile requirements of Reference 8.

- *Humidity*

  The Watts Bar Unit 2 relative humidity requirement is 100% as specified in Reference 8. The environmental test hardware of Reference 1 was subjected to a complete LOCA/MSLB boric acid spray of a 100% humidity accident.

- *Chemical Spray*

  The Watts Bar Unit 2 chemical spray requirement of a pH of 7.5-10 is specified in Reference 8. The qualification test chemical spray of Reference 1 is comprised of 3000 ppm ± 10% boron as H_3BO_3, with a pH of 11 for the initial conditions and a pH of 8 for long term conditions. The pH was obtained and controlled using NaOH. Once initiated, the chemical spray continued for 24 hours. For the remainder of the 30-day test, spray was applied 1.5 hours per day. The spray rate was 0.5 gpm/ft^2. This chemical spray envelopes the requirements of Reference 8.

- *Submergence*

  The new CET MI Cable Assembly hardware will be routed as provided in Reference 9 so that all electrical connectors are installed above flood level. With this routing, the only portion of the run subject to submergence would be the MI Cable section of the Containment Cable Assembly. This section of the cable run is exclusive of electrical connectors. The stainless steel sheath material of the MI Cable is impervious to the submergence requirements of Reference 8. The supplied hardware and associated installation satisfies the submergence requirement of Reference 8.

Feedthrough Module with an integral pigtail portion of the WINCISE CET Containment Feedthrough Cable Assemblies is also qualification tested under the MI Cabling. Reference 6 is the Watts Bar plant-specific Environmental and Seismic Qualification Report that was previously approved by TVA and is the Environmental Qualification (EQ) basis for the Conax Buffalo Containment Penetration Assemblies currently installed at Watts Bar Units 1 and 2. As such, with the exception of the testing on the interface between the MI Cable and the WINCISE CET Containment Feedthrough Cable Assembly, no additional analysis is required to demonstrate the adequacy of the qualification of the Watts Bar Containment Penetration Assemblies and associated Feedthrough Modules.

Qualification testing was completed on the interface between the MI Cable and the WINCISE CET Containment Feedthrough Cable Assembly. During the development of the interface of these components, it was concluded that seismic testing was the only additional type of testing required to demonstrate the qualification of this interface. The following descriptions review the EQ testing for the MI Cable to CET Containment Feedthrough Cable Assembly interface.

- *Vibration Aging*

  There are no vibration aging requirements identified for Watts Bar Unit 2 for this application. Vibration aging was performed as part of the qualification test of Reference 4 to simulate the 40-year normal vibration environment.

- *Dynamic/Seismic Aging*

  The Watts Bar Unit 2 required response spectra (RRS) is provided in Reference 8. The qualification hardware test response spectra are provided in Reference 4. The cabling was tested for Operating Basis Earthquakes (OBE) and Safe Shutdown Earthquakes (SSE). The seismic testing performed in Reference 4 exceeds the Watts Bar Unit 2 seismic requirements from Reference 8.

- *Submergence*

  The interface between the MI Cable and Feedthrough Module is located above the Watts Bar Unit 2 surge flood level and is exempt from the submergence requirements of Reference 8.

The qualification testing completed for the WINCISE 1 to 2 Transition Cable Assemblies, 6 to 1 Transition Cable Assemblies and CET Containment Feedthrough Cable Assemblies, outlined above, meets or exceeds the Watts Bar Unit 2 requirements specified in Reference 8. The Watts Bar Unit 2 CET MI Cable System is qualified for Class 1E application in accordance with the methodology and guidance of IEEE 323-1974 and IEEE 344-1975.

References:

1) Westinghouse (ABB CE) Report Number CE-NPSD-275-P, "Summary Report: Class 1E Qualification Test of the Electronic Resources Division (ERD) Electrical Connectors and Mineral Insulated Cable", Dated November 1984. (TVA Reference Number T25060314156).

2) Westinghouse (ABB CE) Report Number CE-NPSD-275-P, Supplement 2-P, "Qualification Summary Report for the Single Glass Bead Seal Multipin Connector Family Supplied by ERD for Combustion Engineering", Dated September 1988. (TVA Reference Number T25060314157)

3) Westinghouse (ABB CE) Report Number CE-NPSD-654-P, "Qualification Summary Report for the Imaging and Sensing Technology Canada Inc. Flexible MI Cable with Litton Connectors", Dated March 1991. (TVA Reference Number T25060314158)

4) Westinghouse (ABB CE) Report Number CE-NPSD-329-P, "Qualification Summary Report for the Conax Feedthrough Modules with Whittaker Connectors", Dated March 6, 1986.

5) Westinghouse Document Number CN-ME-09-5, Revision 00, "Aging Calculations for the Watts Bar Unit 2 Core Exit Thermocouple Cable & Connector Upgrade".

6) Conax Buffalo Document Number IPS-752, Revision D, "Design Qualification Report for Electric Penetration and Feedthrough Assemblies for Watts Bar Nuclear Plant Units 1 & 2 Tennessee Valley Authority". (TVA Reference Number B78000810004)

7) NTS Test Report Number 60353-94N, "Test Report for Mechanical Cycling & LOCA Testing of One (1) ERD Multipin Connector for Commonwealth Edison Company", Issue Date 1/26/94. (TVA Reference Number T25060314162)

8) Watts Bar Letter Number WBT-TVA-0125 - Revised, "Response to WINCISE – Cable Critical Technical Input", Dated November 25, 2008, CWA Number WESTWBT- 2008-005.

9) TVA Reference Number Engineering Document Change Request (EDCR) 52321 WINCISE.

Non-Proprietary Description Of The Qualification Of The

Signal Processing System (SPS) Cabinet

Signal Processing System (SPS) Cabinet Environmental Qualification Description

The purpose of the qualification program is to demonstrate that the Westinghouse Incore Instrumentation and Surveillance System ([1]WINCISE™) Signal Processing System (SPS) meets the seismic and environmental qualification requirements specified in the Contract Work Authorization WEST-WBT-2008-005 and the WINCISE Signal Processing System Design Requirements WNA-DS-01811-WBT.

The qualification testing program contains two areas of testing, seismic and electromagnetic compatibility (EMC). For EMC compliance, the SPS must be in accordance with U.S NRC Regulatory Guide 1.180 Revision 1 and [2,3]IEEE 323-1983. Thus, the equipment must not generate spurious electromagnetic emissions or suffer some common mode failure due to its operating environment that could directly or indirectly impact the operation of safety-related equipment. For seismic compliance, the SPS must be in accordance with U.S NRC Regulatory Guide 1.100, [4]IEEE 344-1975 and IEEE 344-1987. Thus, the equipment must be capable of withstanding the effects of five Operational Basis Earthquakes (OBEs) and one Safe Shutdown Earthquake (SSE) without the loss of physical integrity or creation of missile hazards.

The SPS cabinet was subjected to an EMC test program to meet the requirements and performance specifications outlined above. In addition, an open item from the document "Watts Bar 2 Incore Instrument System (IIS) Signal Processing System (SPS) Isolation Requirements," WNA-CN-00157-WBT, was to demonstrate that surge events up to 4 kV on the WINCISE SPS AC power feed into the cabinet could not propagate through the cabinet. The concern was that this could create a fault in excess of the 600 V breakdown specification presented for the mineral-insulated (MI) cable connector dielectric separating the non-1E neutron flux signal lines connected to the SPS from the Class 1E Core Exit Thermocouples (CETs) connected to the PAMS.

The acceptance criteria for the surge tests are that the 24 VDC cabinet electronics do not suffer damage during surge events – as long as this is maintained, any surge propagation into the cabinet would clearly have remained far less than the 600 V breakdown limit. Since this is a non-safety-related system, some brief loss of system function is acceptable. The Performance Criterion B definition from IEC 61000-6-2 is used as the guideline specification for the surge testing program.

The cabinet was energized from 115 VAC/60 Hz supply and was operating in its intended operating condition for its installation at Watts Bar Unit 2. Simulated neutron flux detector current signals were provided to the cabinet via MI cable to emulate the as-installed operating conditions. Fiber optic links were used to transmit the cabinet output data to a personal computer (PC) used to monitor the system operation.

The EMC test program was performed as follows, in accordance with the test procedure, "Electromagnetic Compatibility Test Plan and Procedure for Westinghouse Incore Information Surveillance & Engineering System (WINCISE) Signal Processing System Equipment Qualification Cabinet," EQ-TP-98-WBT:

---

[1] WINCISE is a registered trademark of the Westinghouse Electric Company LLC
[2] IEEE is a registered trademark in the U.S. Patent & Trademark Office, owned by the Institute of Electrical and Electronics Engineers, Incorporated.
[3] IEEE 323 is a registered trademark of the Institute of Electrical and Electronics Engineers, Incorporated.
[4] IEEE 344 is a registered trademark of the Institute of Electrical and Electronics Engineers, Incorporated.

- Receipt inspection of test specimen and functional monitoring equipment
- Functional test of test specimen
- EMC Testing – Emissions (Regulatory Guide 1.180 Revision 1 compliance)
    - Must comply within limits specified in Regulatory Guide 1.180 Revision 1
- EMC Testing - Surge Withstand (WNA-CN-00157-WBT open item)
    - Withstand up to 4 kV disturbance with Performance Criterion B or better
- Post-Test Inspection and Functional Test

The cabinet successfully complied with the emissions requirements of Regulatory Guide 1.180 Revision 1 and the supplemental surge withstand testing was left as an open item in WNA-CN-00157-WBT, in accordance with EQ-TP-98-WBT.

The SPS cabinet was also subjected to a seismic test program to meet the requirements and performance specifications outlined above. The cabinet was energized during the seismic test and the output data monitored for informational purposes, even though it was not mandatory for the cabinet to demonstrate maintenance of function throughout the seismic tests.

As indicated by documents WEST-WBT-2008-005 and WNA-DS-01811-WBT, WINCISE SPS is non-safety-related equipment. Since there are no direct safety-related functions within the SPS, the WINCISE SPS needs only to be qualified for structural integrity in accordance with Regulatory Guide 1.100, IEEE 344-1975 and IEEE 3441987. This will ensure that the cabinet or none of its components become missile hazards that could adversely impact the operation of safety-related equipment. WNA-DS-01811-WBT also specifies that the cabinet exteriors should not deflect more than 1.5" relative to the cabinet's mounting points during a seismic event.

The seismic test program was performed as follows, in accordance with the test procedure, "Seismic Qualification Procedure for Westinghouse Incore Information Surveillance & Engineering System (WINCISE) Signal Processing System Equipment Qualification Cabinet," EQ-TP-99-WBT:

- Receipt inspection of test specimen and functional monitoring equipment
- Functional test of test specimen
- Resonance Search
- Seismic Testing – OBE (five runs)
- Seismic Testing – SSE (one run)
- Post-Test Inspection (Cabinet Interior and Exterior) and Functional Test
- Resonance Search

The cabinet maintained structural integrity without any component detachment throughout the test program, and thus complied with the Watts Bar Unit 2 seismic qualification specification WB-DC-40-31.2, with testing performed in accordance with U.S. NRC Regulatory Guide 1.100, IEEE 344-1975 and IEEE 344-1987. The maximum deflection was found to be 0.26 inches, which was much less than the 1.5 inch maximum deflection required by WNA-DS-01811-WBT.

The qualification program was performed to demonstrate that the WINCISE SPS cabinet is qualified for the Watts Bar Unit 2 application, based on the requirements of WEST-WBT-2008-005 and WNA-DS-01811-WBT, and as further evaluated by WNA-CN-00157-WBT. The seismic, EMC testing, and supplementary evaluations demonstrate that the WINCISE SPS cabinet is qualified for use at Watts Bar Unit 2.

References:

1. WEST-WBT-2008-005, "WINCISE Fixed Incore Instrumentation Contract Work Authorization (CWA) Request," Revision 1, December 2010.
2. WNA-DS-01811-WBT, "WINCISE Signal Processing System Design Requirements," Revision 0, June 2010
3. WB-DC-40-31.2, "Watts Bar Nuclear Plant Seismic Qualification of Category I Fluid System Components and Electrical or Mechanical Equipment," Revision 8, November 2000. (Attached to this document in EDMS)
4. U.S. N.R.C. Regulatory Guide 1.100, "Seismic Qualification of Electrical and Mechanical Equipment for Nuclear Power Plants," Revision 2, June 1988.
5. IEEE Std 344-1975, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, Inc., 1975.
6. IEEE Std 344-1987, "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, Inc., 1987.
7. Nuclear Regulatory Commission Regulatory Guide 1.180, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems," Revision 1, October 2003.
8. IEEE Std 323-1983, "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generator Stations," Institute of Electrical and Electronics Engineers, Inc., 1983.
9. WNA-CN-00157-WBT, "Watts Bar 2 Incore Instrument System (IIS) Signal Processing System (SPS) Isolation Requirements," Revision 0, February 2010.
10. IEC 61000-6-2, "Electromagnetic compatibility (EMC). Generic Standards. Immunity for Industrial Environments," 2005.
11. EQ-TP-98-WBT, "Electromagnetic Compatibility Test Plan and Procedure for Westinghouse Incore Information Surveillance & Engineering System (WINCISE) Signal Processing System Equipment Qualification Cabinet," Revision 0, March 2010.

12. EQ-TP-99-WBT, "Seismic Qualification Procedure for Westinghouse Incore Information Surveillance & Engineering System (WINCISE) Signal Processing System Equipment Qualification Cabinet," Revision 0, April 2010.

Non-Proprietary Description Of The Qualification Of The IITA

Description of the qualification of the IITA with references to EQ report(s)

The ex-vessel portion of the Incore Instrument Thimble Assembly (IITA) used at Watts Bar Unit 2 is essentially identical to the environmentally qualified corresponding IITA design used in most of the currently operating Combustion Engineering (CE)-style reactors. The post-accident and seismic conditions that could be experienced in the Movable In-core Detector Seal Table area by the IITA at Watts Bar Unit 2 are bounded by the conditions that would be experienced by the IITA currently qualified for use at the CE-style plants that install their IITA through the top of the reactor vessel. The IITA used in the current operating CE-style plants have been demonstrated and documented to be qualified for the more severe post accident and seismic conditions that would exist on top of the reactor vessel head. The existing environmental qualification information is being used to perform and document an analysis that shows the Watts Bar Unit 2 IITA will meet the environmental qualification requirements needed for use at Watts Bar Unit 2. This evaluation will cite the qualification bases documentation used justifying the Watts Bar Unit 2 IITA. A draft analysis will be provided to TVA as part of the normal project review cycle by June 30. Westinghouse will issue this document as soon as TVA has completed its review and comment cycle.

Non-Proprietary Description Of The Calculation Note Shown To The NRC

At The May 12, 2011 Meeting

WNA-CN-00157-WBT, Watts Bar 2 Incore Instrument System (IIS) Signal Processing System (SPS) Isolation Requirements

Purpose

This evaluation addresses the immunity of the Watts Bar 2 Class 1E Core Exit Thermocouple (CET) system from faults originating in, or by means of, the non-1E Incore Instrumentation System (IIS) Signal Processing System Cabinets (SPS).

This evaluation also addresses incore detector signal conductor charge-up issues caused by disconnection of the incore detector signal cable from its normal termination at the SPS cabinet.

This evaluation is necessary to ensure compliance with the isolation requirements of IEEE 384 for independence of Class 1E equipment and circuits. Though compliance with [1,2]IEEE 384-1981 is required, the latest revisions of this standard, IEEE 384-1992 and IEEE 384-2008, include additional clarification on the requirements established in the 1981 revision, without relaxing any applicable requirements. For this reason, this document quotes the 2008 revision to IEEE 384, with the understanding that the requirements of the 1981 and 1992 revision are also met.

This calculation note was prepared according to Westinghouse Procedure NSNP 3.2.6.

This evaluation addresses the following two issues:

1) Ensure that no fault originating either within the Incore signal processing system (SPS) cabinet or electrical surges on the input power lines or output ETHERNET communications link can result in fault voltages at the Seal Table connector of greater than 600 Vdc between the connector pins.

2) Ensure that inadvertent disconnection or failures of any IITA emitter wire or wires either at the SPS cabinet, or anywhere in the cabling between the IITA seal table connector and the SPS cabinet will not cause voltage charge-up on the emitter wire exceeding 600 Vdc during worst case (full power) plant operation, thus preventing the fault voltage from affecting the associated CET.

Assumptions and Interface Requirements

This evaluation is based on the interfaces to the SPS meeting the following requirements:

1. The maximum normal voltage on the AC input power to the SPS is limited to 264 Vac as defined in References 4 and 8.

2. The IITA and interfacing mineral insulated cabling up to the SPS cabinet interface shall have a dielectric voltage rating of at least 600 Vdc.

3. The IITA and interfacing mineral insulated cabling shall be tested to confirm the ability to withstand a 600 Vdc application on the emitter wire without a reduction in insulation

[1] IEEE is a registered trademark in the U.S. Patent & Trademark Office, owned by the Institute of Electrical and Electronics Engineers, Incorporated.
[2] IEEE 384 is a registered trademark of the Institute of Electrical and Electronics Engineers, Incorporated.

resistance such that the fault voltage could propagate to the IITA sheath, the interfacing MI cable sheath or adjacent connector pins. Results of testing shall be documented to successfully demonstrate that the requirements are met.

4. The AC power cable to the SPS cabinet shall be routed in metal conduit such that the normal maximum voltage that can be impressed upon the AC power input is restricted to the 264 volts assumed in this evaluation.

5. Watts Bar must confirm that the 120 Vac input power to the SPS cabinets are from isolated 1E sources, and are channelized such that the same source used in PAMS train A is used in SPS cabinet 1, and the same AC source used in PAMS train B is used in SPS cabinet 2.

SPS Fault Evaluation

For the normal situation in which the 1E power input is maintained below 264 Vac, there are three possible sources of faulting within or by means of the non-1E Incore SPS. Each of these was evaluated for fault potential against the acceptance criteria of a 600 Vdc limit on potential faulting.

The three faults evaluated are:

1. Electrical surges (up to 4 kV) on the ETHERNET communications link
2. Electrical surges (up to 4 kV) on the 120/220 Vac input power feed
3. Quint 24 Vdc Power Supply failure during normal or harsh environmental conditions

Additionally, it was assumed that the input AC power feed could bypass (or short through) the 24 Vdc power supply unattenuated directly to the SPND input signal leads.

Conclusions

No credible source of faulting within the SPS, the IITA, or the interconnecting cabling can negatively impact either PAMS train. Thus, both trains will remain operable.

For large input over-voltage conditions on the 120 Vac input instrument bus used in both the SPS cabinet and associated PAMS train, the SPS will not cause any failure within the PAMS train that would not otherwise occur as a direct result of the over-voltage condition within the PAMS power supply.

References

1. WINCISE System Wiring Diagram, E-WBN2-155-006.
2. Standard Safety Line Filter Panel Assembly, Drawing 10042D05, sheets 1 through 4.
3. Standard Safety Power Supply Panels Assembly, Drawing 10043D28, sheets 1 through 23.
4. Quint-PS/1AC/24DC/10 Primary Switched Power Supply with SFB Technology, 1AC, output current 10A Data Sheet. (Attached to WNA-CN-00157-WBT).

5. IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits, IEEE Std 384-1992, IEEE 384-1981, and IEEE 384-2008.

6. Quint Power Supply Fault Voltage Assessment, letter from Ken Allwine, Lead Product Marketing Specialist for Phoenix Contact Corporation to Marty Ryan (WEC). (Attached to WNA-CN-00157-WBT).

7. Watts Bar Unit 2 WINCISE Signal Processing System Design Requirements, WNA-DS-01811-WBT.

8. Quint-PS/1AC/24DC/20 Primary Switched Power Supply with SFB Technology, 1AC, Output current 20A Data Sheet. (Attached to WNA-CN-00157-WBT).

9. Drawing 6657E27, OPARSSEL Incore Instrumentation Thimble Assembly.

10. Engineering Specification for Incore Instrumentation Thimble Assembly, Specification number 418A28.

11. Design Specification 00000-FEA-6102 Design and Fabrication Specification or Mineral Insulated Cable Assemblies Without Integral Reference Junctions.

12. WINCISE 1 to 2 Transition Cable Assemblies, E-WBN2-155-002.

13. Letter from Larry Bodendorf, Engineering Supervisor, Mirion Technologies, to Michael Heibel: Subject: Vanadium Detector Insulation resistances, January 7, 2010.

14. International Standard IEC 61000-4-5, Edition 1.1. 2001-04, Electromagnetic Compatibility (EMC)-Part 4-5, Testing and measurement techniques-Surge immunity test.

15. Standard Specification for Thermocouples, Sheathed, Type K and Type N, for Nuclear or for Other High Reliability Applications, ASTM Standard E 235-06.

16. Letter from R. W. Morris to D. Menard, LTR-ME-10-3, Watts Bar 2 Incore Instrumentation System Dielectric Characteristics of Completed MI Cable Assemblies, January 11, 2010.

17. WINCISE 6 to 1 Transition Cable Assemblies, drawing E-WBN2-155-003.

18. PT 2-PE/S-120AC-ST, Phoenix Contact Protective Plug PT with surge voltage equipment protection for power supply units, visual fault warning. Nominal voltage: 120 Vac.

19. Repair, Replacement, and Automation Services (RRAS) Common Q Power Supply Technical Manual, 00000-ICE-3453.

20. Watts Bar Unit 2 WINCISE Power Supply Panel Assembly, 10004D05, sheets 1 through 3.

List Of BEACON To/From ICS Datapoints

BEACON Data Sent to the ICS

POINT_NAME	DESCRIPTION	LO_ENGINEERING_LMT	HI_ENGINEERING_LMT	ENGINEERING_UNITS
BEACAOCF	AO Correction Factor	-10	10	N/A
BEACBC	BEACON calculated boron	-999	9999	PPM
BEACBU	Burnup	0	99999	MWd/tU
BEACBW	Boron Worth	-99	0	pcmppm
BEACCPM	Reactor Power Margin	-100	100	%
BEACDTXV	Delta Xenon	-999	999	%
BEACDTXW	Average Xenon	0	999	pcm
BEACFDHL	Fdh Limit	0	9	N/A
BEACFDHU	Fdh Uncertainty	0	5	%
BEACFDHV	Fdh	0	9	N/A
BEACFQLT	Fq Limit	0	99	N/A
BEACFQUN	Fq Uncertainty	0	5	%
BEACFQV	Fq	0	99	N/A
BEACIAO	Incore Axial Offset	-100	100	%
BEACSW	Samarium Worth	0	999	pcm
BEACXMXC	Xenon Mode 1	-1E-10	1E10	N/A
BEACXMYC	Xenon Mode 2	-1E-10	1E10	N/A
BEACXW	Xenon Worth	0	999	pcm

Analog Signals	Analog signals			
Signal name	Description	Engineering units	EU operating range low	EU operating range high
IIS-SPSODOM00	IIS Datalink Odometer 1	N/A	0	65535
IIS-SPSODOM01	IIS Datalink Odometer 2	N/A	0	65535
IIS-SPSODOM02	IIS Datalink Odometer 3	N/A	0	65535
IIS-SPSODOM03	IIS Datalink Odometer 4	N/A	0	65535
IIS-SPSODOM04	IIS Datalink Odometer 5	N/A	0	65535
IIS-SPSODOM05	IIS Datalink Odometer 6	N/A	0	65535
IIS-SPSODOM06	IIS Datalink Odometer 7	N/A	0	65535
IIS-SPSODOM07	IIS Datalink Odometer 8	N/A	0	65535
IIS-SPSODOM08	IIS Datalink Odometer 9	N/A	0	65535
IIS-SPSODOM09	IIS Datalink Odometer 10	N/A	0	65535
IIS-SPSODOM10	IIS Datalink Odometer 11	N/A	0	65535
IIS-SPSODOM11	IIS Datalink Odometer 12	N/A	0	65535
IIS-SPSODOM12	IIS Datalink Odometer 13	N/A	0	65535
IIS-SPSODOM13	IIS Datalink Odometer 14	N/A	0	65535
IIS-SPSODOM14	IIS Datalink Odometer 15	N/A	0	65535
IIS-SPSODOM15	IIS Datalink Odometer 16	N/A	0	65535
IIS-SPSODOM16	IIS Datalink Odometer 17	N/A	0	65535
IIS-SPSODOM17	IIS Datalink Odometer 18	N/A	0	65535
IIS-SPSODOM18	IIS Datalink Odometer 19	N/A	0	65535
IIS-SPSODOM19	IIS Datalink Odometer 20	N/A	0	65535
IIS-SPSODOM20	IIS Datalink Odometer 21	N/A	0	65535
IIS-SPSODOM21	IIS Datalink Odometer 22	N/A	0	65535
IIS-SPSODOM22	IIS Datalink Odometer 23	N/A	0	65535
IIS-SPSODOM23	IIS Datalink Odometer 24	N/A	0	65535
IIS-SPSODOM24	IIS Datalink Odometer 25	N/A	0	65535
IIS-SPSODOM25	IIS Datalink Odometer 26	N/A	0	65535
IIS-SPSODOM26	IIS Datalink Odometer 27	N/A	0	65535
IIS-SPSODOM27	IIS Datalink Odometer 28	N/A	0	65535
IIS-SPSODOM28	IIS Datalink Odometer 29	N/A	0	65535
IIS-SPSODOM29	IIS Datalink Odometer 30	N/A	0	65535
IIS-SPSODOM30	IIS Datalink Odometer 31	N/A	0	65535
IIS-SPSODOM31	IIS Datalink Odometer 32	N/A	0	65535
IIS-SPSODOM32	IIS Datalink Odometer 33	N/A	0	65535
IIS-SPSODOM33	IIS Datalink Odometer 34	N/A	0	65535
IIS-SPSODOM34	IIS Datalink Odometer 35	N/A	0	65535
IIS-SPSODOM35	IIS Datalink Odometer 36	N/A	0	65535
IIS-SPSODOM36	IIS Datalink Odometer 37	N/A	0	65535
IIS-SPSODOM37	IIS Datalink Odometer 38	N/A	0	65535
IIS-SPSODOM38	IIS Datalink Odometer 39	N/A	0	65535
IIS-SPSODOM39	IIS Datalink Odometer 40	N/A	0	65535
IIS-SPSODOM40	IIS Datalink Odometer 41	N/A	0	65535
IIS-SPSODOM41	IIS Datalink Odometer 42	N/A	0	65535
IIS-SPSODOM42	IIS Datalink Odometer 43	N/A	0	65535
IIS-SPSODOM43	IIS Datalink Odometer 44	N/A	0	65535
IIS-SPSODOM44	IIS Datalink Odometer 45	N/A	0	65535
IIS-SPSODOM45	IIS Datalink Odometer 46	N/A	0	65535
IIS-SPSODOM46	IIS Datalink Odometer 47	N/A	0	65535
IIS-SPSODOM47	IIS Datalink Odometer 48	N/A	0	65535
IIS-SPSODOM48	IIS Datalink Odometer 49	N/A	0	65535
IIS-SPSODOM49	IIS Datalink Odometer 50	N/A	0	65535
IIS-SPSODOM50	IIS Datalink Odometer 51	N/A	0	65535
IIS-SPSODOM51	IIS Datalink Odometer 52	N/A	0	65535
IIS-SPSODOM52	IIS Datalink Odometer 53	N/A	0	65535
IIS-SPSODOM53	IIS Datalink Odometer 54	N/A	0	65535
IIS-SPSODOM54	IIS Datalink Odometer 55	N/A	0	65535
IIS-SPSODOM55	IIS Datalink Odometer 56	N/A	0	65535
IIS-SPSODOM56	IIS Datalink Odometer 57	N/A	0	65535
IIS-SPSODOM57	IIS Datalink Odometer 58	N/A	0	65535
IIS-SPSPPTT00	Cabinet A Temperature	°F	40	150
IIS-SPSPPTT01	Cabinet B Temperature	°F	40	150
IIS-BEACON000	Active AppSrvr (1=A,2=B)	N/A	1	2
IIS-BEACON001	Active BEACON Srvr (1=A,2=B)	N/A	1	2
DDS-D144FA	FA Record Drop 144	N/A	0	65535
DDS-D144FB	FB Record Drop 144	N/A	0	255
DDS-D144FC	FC Record Drop 144	N/A	0	255
DDS-D144FK	FK Record Drop 144	N/A	0	255
DDS-D144FO	FO Record Drop 144	N/A	0	65535
DDS-D144FS	FS Record Drop 144	N/A	0	65535
DDS-D144HC	HC Record Drop 144	N/A	0	65535
DDS-D144TA	TA Record Drop 144	N/A	0	65535

DDS-D148FA	FA Record Drop 148	N/A	0	65535
DDS-D148FB	FB Record Drop 148	N/A	0	255
DDS-D148FC	FC Record Drop 148	N/A	0	255
DDS-D148FK	FK Record Drop 148	N/A	0	255
DDS-D148FO	FO Record Drop 148	N/A	0	65535
DDS-D148FS	FS Record Drop 148	N/A	0	65535
DDS-D148HC	HC Record Drop 148	N/A	0	65535
DDS-D148TA	TA Record Drop 148	N/A	0	65535
DDS-D200FA	FA Record Drop 200	N/A	0	65535
DDS-D200FB	FB Record Drop 200	N/A	0	255
DDS-D200FC	FC Record Drop 200	N/A	0	255
DDS-D200FK	FK Record Drop 200	N/A	0	255
DDS-D200FO	FO Record Drop 200	N/A	0	65535
DDS-D200FS	FS Record Drop 200	N/A	0	65535
DDS-D200HC	HC Record Drop 200	N/A	0	65535
DDS-D200TA	TA Record Drop 200	N/A	0	65535

Digital signals Digital signals

Signal name	Description	Status checking type
IIS-SPSDLOKA1	DL OK Cab A Rack 1	0 - alarm if current value is 0
IIS-SPSDLOKA2	DL OK Cab A Rack 2	0 - alarm if current value is 0
IIS-SPSDLOKA3	DL OK Cab A Rack 3	0 - alarm if current value is 0
IIS-SPSDLOKA4	DL OK Cab A Rack 4	0 - alarm if current value is 0
IIS-SPSDLOKB1	DL OK Cab B Rack 1	0 - alarm if current value is 0
IIS-SPSDLOKB2	DL OK Cab B Rack 2	0 - alarm if current value is 0
IIS-SPSDLOKB3	DL OK Cab B Rack 3	0 - alarm if current value is 0
IIS-SPSDLOKB4	DL OK Cab B Rack 4	0 - alarm if current value is 0
IIS-SPSDS1A	IIS SPS Door Switch 1 Cab A	0 - alarm if current value is 0
IIS-SPSDS1B	IIS SPS Door Switch 1 Cab B	0 - alarm if current value is 0
IIS-SPSDS2A	IIS SPS Door Switch 2 Cab A	0 - alarm if current value is 0
IIS-SPSDS2B	IIS SPS Door Switch 2 Cab B	0 - alarm if current value is 0
IIS-SPSLRA1	Left/Right Cabinet A Rack 1	N - not used
IIS-SPSLRA2	Left/Right Cabinet A Rack 2	N - not used
IIS-SPSLRA3	Left/Right Cabinet A Rack 3	N - not used
IIS-SPSLRA4	Left/Right Cabinet A Rack 4	N - not used
IIS-SPSLRB1	Left/Right Cabinet B Rack 1	N - not used
IIS-SPSLRB2	Left/Right Cabinet B Rack 2	N - not used
IIS-SPSLRB3	Left/Right Cabinet B Rack 3	N - not used
IIS-SPSLRB4	Left/Right Cabinet B Rack 4	N - not used
IIS-SPSMCA	IIS SPS Media Converter Cab A	0 - alarm if current value is 0
IIS-SPSMCB	IIS SPS Media Converter Cab B	0 - alarm if current value is 0
IIS-SPSMSA1	Master/Slave Cabinet A Rack 1	N - not used
IIS-SPSMSA2	Master/Slave Cabinet A Rack 2	N - not used
IIS-SPSMSA3	Master/Slave Cabinet A Rack 3	N - not used
IIS-SPSMSA4	Master/Slave Cabinet A Rack 4	N - not used
IIS-SPSMSB1	Master/Slave Cabinet B Rack 1	N - not used
IIS-SPSMSB2	Master/Slave Cabinet B Rack 2	N - not used
IIS-SPSMSB3	Master/Slave Cabinet B Rack 3	N - not used
IIS-SPSMSB4	Master/Slave Cabinet B Rack 4	N - not used
IIS-SPSODLOKA1	Other DL OK Cab A Rack 1	0 - alarm if current value is 0
IIS-SPSODLOKA2	Other DL OK Cab A Rack 2	0 - alarm if current value is 0
IIS-SPSODLOKA3	Other DL OK Cab A Rack 3	0 - alarm if current value is 0
IIS-SPSODLOKA4	Other DL OK Cab A Rack 4	0 - alarm if current value is 0
IIS-SPSODLOKB1	Other DL OK Cab B Rack 1	0 - alarm if current value is 0
IIS-SPSODLOKB2	Other DL OK Cab B Rack 2	0 - alarm if current value is 0
IIS-SPSODLOKB3	Other DL OK Cab B Rack 3	0 - alarm if current value is 0
IIS-SPSODLOKB4	Other DL OK Cab B Rack 4	0 - alarm if current value is 0
IIS-SPSPSA	IIS SPS Power Supply Cab A	0 - alarm if current value is 0
IIS-SPSPSB	IIS SPS Power Supply Cab B	0 - alarm if current value is 0
DDS-BDP296-X1	Limit Check HLV Cabinet A	N - not used
DDS-BDP297-X1	Limit Check HLV Cabinet B	N - not used
DDS-BDPDULSA	ASM BDP DU APP A STATUS	1 - alarm if current value is 1
DDS-BDPDULSB	ASM BDP DU APP B STATUS	1 - alarm if current value is 1
DDS-BDPLSA	ASM BDP APP A STATUS	1 - alarm if current value is 1
DDS-BDPLSB	ASM BDP APP B STATUS	1 - alarm if current value is 1
DDS-BEALSA	ASM BEACON DL A STATUS	1 - alarm if current value is 1
DDS-BEALSB	ASM BEACON DL B STATUS	1 - alarm if current value is 1
DDS-BEASTAT	BEACON DL Task Status	1 - alarm if current value is 1
DDS-ICSLSA	ASM ICS FTP DL A STATUS	1 - alarm if current value is 1
DDS-ICSLSB	ASM ICS FTP DL B STATUS	1 - alarm if current value is 1
DDS-ICSSTAT	ICS SFTP Task Status	1 - alarm if current value is 1

DDS-IISLSA1	ASM IIS SPS DL A 1 STATUS	1 - alarm if current value is 1
DDS-IISLSA2	ASM IIS SPS DL A 2 STATUS	1 - alarm if current value is 1
DDS-IISLSB1	ASM IIS SPS DL B 1 STATUS	1 - alarm if current value is 1
DDS-IISLSB2	ASM IIS SPS DL B STATUS	1 - alarm if current value is 1
DDS-IISSTAT1	IIS SPS A Task Status	1 - alarm if current value is 1
DDS-IISSTAT2	IIS SPS B Task Status	1 - alarm if current value is 1
BEACALM	BEACON Trouble Alarm	1 - alarm if current value is 1
BEACMALM	BEACON Margin Alarm	1 - alarm if current value is 1
BEACMALT	BEACON Margin Alert	1 - alarm if current value is 1

Packed Signals

Signal name	Description	Alarm group mask	Alarm group bit sense
IIS-SPSPPTU00-STAT	Status Packed Point Board 00	0xFF80	0xFF00
IIS-SPSPPTU01-STAT	Status Packed Point Board 01	0xFF80	0xFF00
IIS-SPSPPTU02-STAT	Status Packed Point Board 02	0xFF80	0xFF00
IIS-SPSPPTU03-STAT	Status Packed Point Board 03	0xFF80	0xFF00
IIS-SPSPPTU04-STAT	Status Packed Point Board 04	0xFF80	0xFF00
IIS-SPSPPTU05-STAT	Status Packed Point Board 05	0xFF80	0xFF00
IIS-SPSPPTU06-STAT	Status Packed Point Board 06	0xFF80	0xFF00
IIS-SPSPPTU07-STAT	Status Packed Point Board 07	0xFF80	0xFF00
IIS-SPSPPTU08-STAT	Status Packed Point Board 08	0xFF80	0xFF00
IIS-SPSPPTU09-STAT	Status Packed Point Board 09	0xFF80	0xFF00
IIS-SPSPPTU10-STAT	Status Packed Point Board 10	0xFF80	0xFF00
IIS-SPSPPTU11-STAT	Status Packed Point Board 11	0xFF80	0xFF00
IIS-SPSPPTU12-STAT	Status Packed Point Board 12	0xFF80	0xFF00
IIS-SPSPPTU13-STAT	Status Packed Point Board 13	0xFF80	0xFF00
IIS-SPSPPTU14-STAT	Status Packed Point Board 14	0xFF80	0xFF00
IIS-SPSPPTU15-STAT	Status Packed Point Board 15	0xFF80	0xFF00
IIS-SPSPPTU16-STAT	Status Packed Point Board 16	0xFF80	0xFF00
IIS-SPSPPTU17-STAT	Status Packed Point Board 17	0xFF80	0xFF00
IIS-SPSPPTU18-STAT	Status Packed Point Board 18	0xFF80	0xFF00
IIS-SPSPPTU19-STAT	Status Packed Point Board 19	0xFF80	0xFF00
IIS-SPSPPTU20-STAT	Status Packed Point Board 20	0xFF80	0xFF00
IIS-SPSPPTU21-STAT	Status Packed Point Board 21	0xFF80	0xFF00
IIS-SPSPPTU22-STAT	Status Packed Point Board 22	0xFF80	0xFF00
IIS-SPSPPTU23-STAT	Status Packed Point Board 23	0xFF80	0xFF00
IIS-SPSPPTU24-STAT	Status Packed Point Board 24	0xFF80	0xFF00
IIS-SPSPPTU25-STAT	Status Packed Point Board 25	0xFF80	0xFF00
IIS-SPSPPTU26-STAT	Status Packed Point Board 26	0xFF80	0xFF00
IIS-SPSPPTU27-STAT	Status Packed Point Board 27	0xFF80	0xFF00
IIS-SPSPPTU28-STAT	Status Packed Point Board 28	0xFF80	0xFF00
IIS-SPSPPTU29-STAT	Status Packed Point Board 29	0xFF80	0xFF00
IIS-SPSPPTU30-STAT	Status Packed Point Board 30	0xFF80	0xFF00
IIS-SPSPPTU31-STAT	Status Packed Point Board 31	0xFF80	0xFF00
IIS-SPSPPTU32-STAT	Status Packed Point Board 32	0xFF80	0xFF00
IIS-SPSPPTU33-STAT	Status Packed Point Board 33	0xFF80	0xFF00
IIS-SPSPPTU34-STAT	Status Packed Point Board 34	0xFF80	0xFF00
IIS-SPSPPTU35-STAT	Status Packed Point Board 35	0xFF80	0xFF00
IIS-SPSPPTU36-STAT	Status Packed Point Board 36	0xFF80	0xFF00
IIS-SPSPPTU37-STAT	Status Packed Point Board 37	0xFF80	0xFF00
IIS-SPSPPTU38-STAT	Status Packed Point Board 38	0xFF80	0xFF00
IIS-SPSPPTU39-STAT	Status Packed Point Board 39	0xFF80	0xFF00
IIS-SPSPPTU40-STAT	Status Packed Point Board 40	0xFF80	0xFF00
IIS-SPSPPTU41-STAT	Status Packed Point Board 41	0xFF80	0xFF00
IIS-SPSPPTU42-STAT	Status Packed Point Board 42	0xFF80	0xFF00
IIS-SPSPPTU43-STAT	Status Packed Point Board 43	0xFF80	0xFF00
IIS-SPSPPTU44-STAT	Status Packed Point Board 44	0xFF80	0xFF00
IIS-SPSPPTU45-STAT	Status Packed Point Board 45	0xFF80	0xFF00
IIS-SPSPPTU46-STAT	Status Packed Point Board 46	0xFF80	0xFF00
IIS-SPSPPTU47-STAT	Status Packed Point Board 47	0xFF80	0xFF00
IIS-SPSPPTU48-STAT	Status Packed Point Board 48	0xFF80	0xFF00
IIS-SPSPPTU49-STAT	Status Packed Point Board 49	0xFF80	0xFF00
IIS-SPSPPTU50-STAT	Status Packed Point Board 50	0xFF80	0xFF00
IIS-SPSPPTU51-STAT	Status Packed Point Board 51	0xFF80	0xFF00
IIS-SPSPPTU52-STAT	Status Packed Point Board 52	0xFF80	0xFF00
IIS-SPSPPTU53-STAT	Status Packed Point Board 53	0xFF80	0xFF00
IIS-SPSPPTU54-STAT	Status Packed Point Board 54	0xFF80	0xFF00
IIS-SPSPPTU55-STAT	Status Packed Point Board 55	0xFF80	0xFF00
IIS-SPSPPTU56-STAT	Status Packed Point Board 56	0xFF80	0xFF00
IIS-SPSPPTU57-STAT	Status Packed Point Board 57	0xFF80	0xFF00

WINCISE-BEACON System Status Information Definitions

Status information available on the Ovation highway for transmittal to ICS. Most of this information was included previously within WEC project letter WBT-D-1924

•IIS-SPSLRxy where x=A,B for each cabinet and y=1-4 for each rack
This point indicates the location of the specific datalink module to be on the L(eft) or R(right) side of the SPS cabinet.

•IIS-SPSMSxy x=A,B for each cabinet and y=1-4 for each rack
This point indicates whether the specific datalink module is configured as a S(lave) or a M(aster) module.

•IIS-SPSDLOKxy x=A,B for each cabinet and y=1-4 for each rack
The point gives the overall module status of the specific module.

•IIS-SPSODLOKxy x=A,B for each cabinet and y=1-4 for each rack
This point gives the overall module status of the redundant module. If the A side of rack 1 is being communicated with, this point will give the status of the B side card in rack 1.

•IIS-SPSPPTT0x where x=0 for cabinet A and x=1 for cabinet B
This point gives cabinet temperature in degrees-F.

•DDS-BDP296-X1 =1 if cabinet A temperature above 100 degrees-F
•DDS-BDP297-X1 =1 if cabinet B temperature above 100 degrees-F
These are two digital points that are true if the corresponding temperature is above 100 degrees-F.

•IIS-SPSDS(1,2)(A,B) Door Switch 1/2 for each cabinet, =0 if open
•IIS-MC(A,B) Media Converter Alarm, =0 on alarm
•IIS-SPSPS(A,B) Power Supply Status =0 on error
These are SPS cabinet environmental status points.

•IIS-SPSPPTUxx-STAT where xx is 0-57 for each amplifier module/core location.
This point is a 16 bit pack point with the following bit definitions:

- Bit 15 – Channel 1 Overrange condition
- Bit 14 – Channel 2 Overrange condition
- Bit 13 – Channel 3 Overrange condition
- Bit 12 – Channel 4 Overrange condition
- Bit 11 – Channel 5 Overrange condition
- Bit 10 – Channel 6 Overrange condition
- Bit 9 – Channel 7 Overrange condition
- Bit 8 – Channel 8 Overrange condition
- Bit 7 – Amplifier card Global GOOD bit

•DDS-IISODOMxx where xx is 0-57 for each amplifier module/core location.
This point is the amplifier heartbeat and counts by 1 every second for any given healthy amplifier board.

•DDS-BDPDULS(A,B)
•DDS-BDPLS(A,B)
•DDS-BEALS(A,B)
•DDS-IISLS(A,B)(1,2)
•DDS-ICSLS(A,B)
These are points driven by the Application Server software monitor task. There are 6 software executables that are controlled and monitored by the Application Server Monitor (ASM) which is a software watchdog/monitor. The ASM routine generates alarm status points (LS) for each of the 6 tasks. There are two instances of the SPS Cabinet datalink, one for each cabinet. The 5 executable types are:
a) BEACON/AppSrvr datalink (BEA)
b) SPS Cabinet/SppSrvr datalink (IIS)
c) ICS System/AppSrvr datalink (ICS)
d) BEACON Data Processing (BDP) Application.
e) BEACON DU record (BDPDU) processing

•DDS-BEASTAT
•DDS-ICSSTAT
•DDS-IISSTAT(1,2)
These are status/alarm points for each of the 4 datalink software executables. These status points (STAT) are generated within the executable and are used to indicate error conditions within the software being monitored.

•DDS-Dxxxyy where xxx is the drop number (144,148,200) and yy is the field designation from above.
The Ovation software running on the Application Servers performs a wide variety of monitoring and generates drop alarms to report this information. This information is contained within various fields of the Ovation drop (DU) records. The values of these fields are discussed in the Ovation documentation. These fields are indicated with two letter designations:

FA – Functional Processor Status Word
FB – Drop Mode
FC – Drop Fault Code
FK – Fault Identification Code
FS – Fault Parameter 1
FO – Fault Parameter 2
HC – Highway Status Word
TA – Drop Attention Code

•BEACALM	=1, BEACON trouble alarm
•BEACMALM	=1, BEACON Margin Alarm
•BEACMALT	=1, BEACON Margin Alert
•IIS-BEACON000	active AppSrvr 1=A, 2=B
•IIS-BEACON001	active BEACON Server 1=A, 2=B

These are BEACON related status/alarm points.

Thermo Fisher Scientific Qualification Report No. 864RD, "Class 1E Qualification Of The Source Range, Intermediate Range And Wide Range Channels - Redacted Version," Dated February, 2011

QUALIFICATION REPORT NO. 864RD

CLASS 1E QUALIFICATION OF SOURCE RANGE, INTERMEDIATE RANGE AND WIDE RANGE CHANNELS -- REDACTED VERSION

FOR WATTS BAR NUCLEAR STATION UNIT II

February, 2011

THERMO FISHER SCIENTIFIC
10010 Mesa Rim Rd
San Diego, Calif. 92121

BECHTEL POWER CORPORATION	Job Number: 25402
SUPPLIER DOCUMENT REVIEW STATUS	

STATUS CODE:

- 1 ☐ Work may proceed.
- 1C ☐ Work may proceed. Editorial comments need only be incorporated if revised for other purposes.
- 2 ☐ Revise and resubmit. Work may proceed subject to incorporation of changes indicated.
- 3 ☐ Rejected. Revise and resubmit.
- 4 ☒ Review not required. Work may proceed.

PO 224364

Permission to proceed does not constitute acceptance or approval of design details, calculations, analysis, test methods, or materials developed or selected by the Supplier and does not relieve the Supplier from full compliance with contractual obligations.

Reviewed by	Arch	Civil	CS	Elect	Mech	MET	PD	Constr	Startup	STE
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Status By: Jayne McNutt Jayne McNutt DATE 05/02/11

LEGIBILITY EVALUATED AND ACCEPTED FOR ISSUE.

Jayne McNutt Jayne McNutt 5/2/11
SIGNATURE DATE

CLASS 1E QUALIFICATION OF SOURCE RANGE, INTERMEDIATE RANGE AND WIDE RANGE CHANNELS

FOR WATTS BAR NUCLEAR STATION
UNIT II

DOCUMENT WRITTEN BY ______________ **DATE** 2/4/11

APPROVAL:

ENGINEERING MANAGER ______________ **DATE:** 2/4/11

PROGRAM MANAGER ______________ **DATE:** 2/9/11

QUALITY ASSURANCE MANAGER ______________ **DATE:** 3/9/11

Revision Legend:

Initial Issue	**November, 2009**
Rev 1	**February, 2011**

Copy No. _____

Assigned To: ______________________

QTR 864RD

Table of Contents

APPENDICES

1. EXECUTIVE SUMMARY

This report qualifies the following THERMO FISHER SCIENTIFIC neutron flux monitoring equipment for Class 1E operation as part of the Source, Intermediate and Wide Range Channels of the Nuclear Instrumentation System supplied to Watts Bar Nuclear Station Unit II:

900596-101	Wide Range Detector
202394-101	Junction Box Assembly
201712-xxx	In-Containment Cable Assembly
201722-xxx	Amplifier Cable Assembly
900597-101	Wide Range Amplifier
900598-101	Optical Isolator
900599-101	Source Range Rack Mount Signal Processor
900600-101	Intermediate Range Rack Mount Signal Processor
900601-101	Wide Range Rack Mount Signal Processor
900602-101	Shutdown Margin Monitor

('xxx' is cable length code)

This equipment was designed based upon Watts Bar Nuclear Station Unit II Design Specification No. 6417, Rev. 1 (Ref. 1) and System Description N3-92-4003, Rev. 8 (Ref. 15). A complete Source and Intermediate Range Channel consists of a Detector, Interconnect Cables, Junction Box, Amplifier and Signal Processor Assemblies. A complete Source, Intermediate and Wide Range Channel consists of a Detector, Interconnect Cables, Junction Box, Amplifier, Optical Isolator and Signal Processor Assemblies.

The qualification method is Qualification by Analysis. All assemblies are qualified by extrapolation from previously tested equipment. The methodology used to qualify the equipment is based on IEEE-323 (Ref. 2) and IEEE-344 (Ref. 3).

To summarize, the Source and Intermediate Range Channels are qualified for of operation in Watts Bar Nuclear Station Unit II.

2. EQUIPMENT SPECIFICATION

The THERMO FISHER SCIENTIFIC Source, Intermediate and Wide Range Channels were designed to meet Watts Bar Nuclear Station Unit II Design Specification No. 6417, Rev. 1 (Ref. 1) and System Description N3-92-4003, Rev. 8 (Ref. 15). The following sections summarize the specification in accordance with IEEE-323.

2.1 Equipment Identification

2.1.1 Wide Range Detector, Cables and Junction Box

The Wide Range Detector 900596-101, In-Containment Cables 201712-xxx, Amplifier Cables 201722-xxx and Junction Box 202394-101 are manufactured THERMO FISHER SCIENTIFIC for operation as part of a neutron flux monitoring channel in Westinghouse PWR's. The assembly level drawings and parts lists are included in Appendix B for information. Subassembly drawings are found in the THERMO FISHER SCIENTIFIC Instruction Manual supplied with each system.

The THERMO FISHER SCIENTIFIC Wide Range Detector provides reliable conversion of a neutron flux to an electrical signal for processing by the Wide Range Amplifier and Signal Processors. The Cable and Junction Box connect the Detector to the WR Amplifier. The normal operating range of the Detector is from percent power.

The Wide Range Detector Customer Level Drawing is 900596-101 and the Assembly Level Drawing is 200889-128. The changes between the 900596-101 and 200889-128 are for the support tube and mounting foot as well as the suspension assembly used during installation. The Wide Range Detector 900596-101 is manufactured by THERMO FISHER SCIENTIFIC for operation as part of a neutron flux monitoring channel in Watts Bar Nuclear Station Unit II. The Customer Level and Assembly Level drawings and parts lists are included in Appendix B for information. Subassembly drawings are found in the THERMO FISHER SCIENTIFIC Instruction Manual supplied with each system.

2.1.2 Wide Range Amplifier

The Wide Range Amplifier Customer Level Drawing is 900597-101 and the Assembly Level Drawing is 202406-101. There were no changes between the 900597-101 and 202406-101, therefore, the Wide Range Amplifier will be referred to as 202406-101 in the rest of this report. The Wide Range Amplifier 202406-101 is manufactured by THERMO FISHER SCIENTIFIC for operation as part of a neutron flux monitoring channel in Watts Bar Nuclear Station Unit II. The assembly level drawing and parts list are included in Appendix B for information. Subassembly drawings are found in the THERMO FISHER SCIENTIFIC Instruction Manual supplied with each system.

The THERMO FISHER SCIENTIFIC Wide Range Amplifier provides reliable conversion of neutron flux signals from the detector to the Source Range and Intermediate Range Signal Processors. The WR Amplifier conditions input signals from the detector and provides the proper inputs to the Signal Processors over the range from percent power. It also provides test circuits and monitors for fault conditions.

Table 2.1 Wide Range Channel Amplifier Electrical and Mechanical Specifications

Parameter	Specification
Conversion Accuracy[1]	
Input Power	120 VAC 60 Hz
Dimensions (in.) - height X width - depth	 24 X 20 11.25

[1] % is expressed as % of Full Scale

2.1.3 Optical Isolator

The Optical Isolator Customer Level Drawing is 900598-101 and the Assembly Level Drawing is 201893-102. There were no changes between the 900598-101 and 201893-102, therefore, the Optical Isolator will be referred to as 201893-102 in the rest of this report. The Optical Isolator 201893-102 is manufactured by THERMO FISHER SCIENTIFIC for operation as part of a neutron flux monitoring channel in Watts Bar Nuclear Station Unit II. The assembly level drawing and parts list are included in Appendix B for information. Subassembly drawings are found in the THERMO FISHER SCIENTIFIC Instruction Manual supplied with each system.

The THERMO FISHER SCIENTIFIC Optical Isolator Assembly provides protection from short circuits, large voltage/current transients, and over current conditions. It also provides isolation and splitting of the Amplifier signal to two Signal Processors.

Table 2.2 Optical Isolator Electrical and Mechanical Specifications

Parameter	Specification
Conversion Accuracy[1]	
Input Power	120 VAC 60 Hz
Dimensions (in.) - height X width - depth	 20 X 16 8

[1] % is expressed as % of Full Scale

2.1.4 Source Range RMSP

The Source Range Rack Mount Signal Processor Customer Level Drawing is 900599-101 and the Assembly Level Drawing is 202384-103. There were no changes between the 900599-101 and 202384-103, therefore, the Source Range Rack Mount Signal Processor will be referred to as 202384-103 in the rest of this report. The Source Range RMSP 202384-103 is manufactured by

THERMO FISHER SCIENTIFIC for operation as part of a neutron flux monitoring channel in Watts Bar Nuclear Station Unit II. The assembly level drawing and parts list are included in Appendix B for information. Subassembly drawings are found in the THERMO FISHER SCIENTIFIC Instruction Manual supplied with each system.

The THERMO FISHER SCIENTIFIC Source Range Signal Processor provides reliable neutron flux indication to the Reactor Protection System and other plant locations which monitor reactor power in the source range. In addition,

Table 2.3 Source Range RMSP Electrical and Mechanical Specifications

Parameter	Specification
Level Accuracy[1]	
Bistable Accuracy[1]	
Input Power	105 - 132 VAC 54 - 66 Hz
Dimensions (in.) - front panel - depth	 10.25 X 19 18.13

[1] % is expressed as % of Full Scale

2.1.5 Intermediate Range RMSP

The Intermediate Range Rack Mount Signal Processor Customer Level Drawing is 900600-101 and the Assembly Level Drawing is 202383-103. There were no changes between the 900600-101 and 202383-103, therefore, the Intermediate Range Rack Mount Signal Processor will be referred to as 202383-103 in the rest of this report. The Intermediate Range RMSP 202383-103 is manufactured by THERMO FISHER SCIENTIFIC for operation as part of a neutron flux monitoring channel in Watts Bar Nuclear Station Unit II. The assembly level drawing and parts list are included in Appendix B for information. Subassembly drawings are found in the THERMO FISHER SCIENTIFIC Instruction Manual supplied with each system.

The THERMO FISHER SCIENTIFIC Intermediate Range Signal Processor provides reliable neutron flux indication to the Reactor Protection System and other plant locations which monitor reactor power in the intermediate range. In addition, the Intermediate Range Monitor isolates Class 1E equipment from non-Class 1E equipment.

The Intermediate Range Signal Processor conditions input signals from the amplifier and provides a logarithmic intermediate range indication from percent power as well as a rate indication from . LCD meters on the front panel display the outputs of these signals.

Table 2.4 Intermediate Range RMSP Electrical and Mechanical Specifications

Parameter	Specification
Level Accuracy[1]	
Bistable Accuracy[1]	
Input Power	105 - 132 VAC 54 - 66 Hz
Dimensions (in.) - front panel - depth	 10.25 X 19 18.13

[1] % is expressed as % of Full Scale

2.1.6 Wide Range RMSP

The Wide Range Rack Mount Signal Processor Customer Level Drawing is 900601-101 and the Assembly Level Drawing is 201951-103. There were no changes between the 900601-101 and 201951-103, therefore, the Wide Range Rack Mount Signal Processor will be referred to as 201951-103 in the rest of this report. The Wide Range RMSP 201951-103 is manufactured by THERMO FISHER SCIENTIFIC for operation as part of a neutron flux monitoring channel in Watts Bar Nuclear Station Unit II. The assembly level drawing and parts list are included in Appendix B for information. Subassembly drawings are found in the THERMO FISHER SCIENTIFIC Instruction Manual supplied with each system.

The THERMO FISHER SCIENTIFIC Wide Range Signal Processor provides reliable neutron flux indication in the Wide range and is used primarily as a post-accident monitor.

The Wide Range Signal Processor conditions input signals from the amplifier and provides a

Table 2.5 Wide Range RMSP Electrical and Mechanical Specifications

Parameter	Specification
Level Accuracy[1]	
Bistable Accuracy[1]	
Input Power	105 - 132 VAC 54 - 66 Hz
Dimensions (in.) - front panel - depth	 7.00 X 19 18.13

[1] % is expressed as % of Full Scale

2.1.6 Shutdown Margin Monitor

The Shutdown Margin Monitor Customer Level Drawing is 900602-101 and the Assembly Level Drawing is 202646-101. There were no changes between the 900602-101 and 202646-101, therefore, the Shutdown Margin Monitor will be referred to as 202646-101 in the rest of this report. The Shutdown Margin Monitor 202646-101 is manufactured by THERMO FISHER SCIENTIFIC for operation as part of a neutron flux monitoring channel in Watts Bar Unit 2. . The assembly level drawing and parts list are included in Appendix B for information. Subassembly drawings are found in the THERMO FISHER SCIENTIFIC Instruction Manual supplied with each system.

The THERMO FISHER SCIENTIFIC Shutdown Margin Monitor is an instrument that measures the contrite from a neutron counting instrument and identifies any statistically significant increase that would indicate a loss of reactor shutdown margin. The Shutdown Monitor input signal can be obtained from the scaler output of any neutron-flux monitoring system.

Table 2.6 Shutdown Margin Monitor Electrical and Mechanical Specifications

Parameter	Specification
Level Accuracy[1]	
Bistable Accuracy[1]	
Input Power	105 - 132 VAC 54 - 66 Hz
Dimensions (in.) - front panel - depth	 6.97 X 19 11.6

[1] % is expressed as % of Full Scale

2.2 Interfaces

2.2.1 Detector, Cables, and Junction Box

The Detector is mounted in the detector well and rests on a support foot or may be suspended by a cable. The Cables and Junction Box connect the Detector to the WR Amplifier trough the containment penetration. The Detector converts the neutron flux to an electrical signal. The components have no plant interfaces.

2.2.2 Wide Range Amplifier

The Wide Range Amplifier is typically mounted to a wall or bulkhead in the penetration or cable spreading room outside of the containment building. It conditions input signals from the Detector for output to the Signal Processors. It has no plant interfaces.

2.2.3 Optical Isolator Assembly

The Optical Isolator Assembly is typically mounted to a wall or bulkhead in the penetration or cable spreading room outside of the containment building. It isolates the Amplifier Assembly from the Signal Processors. It has no plant interfaces.

2.2.4 Source Range Signal Processor

The Source Range Monitor is typically mounted to an instrumentation rack in the control room of the power plant. It conditions input signals from the Wide Range Amplifier for display of reactor power on the front panel, and for various outputs supplied to the Reactor Protection System (RPS), the Reactor Control System, remote meters, plant computer, rate amplifier, remote recorder, and the Audio Count Rate drawer.

2.2.5 Intermediate Range Signal Processor

The Intermediate Range Monitor is typically mounted to an instrumentation rack in the control room of the power plant. It conditions input signals from the Wide Range Amplifier for display of reactor power on the front panel, and for various outputs supplied to the Reactor Protection System (RPS), the Reactor Control System, remote meters, plant computer, rate amplifier, remote recorder, and the reactivity computer.

2.2.6 Wide Range Signal Processor

The Wide Range Monitor is typically mounted to an instrumentation rack in the control room of the power plant. It conditions input signals from the Wide Range Amplifier for display of reactor power on the front panel, and for various outputs supplied to the Reactor Protection System (RPS), the Reactor Control System, remote meters, plant computer, rate amplifier, remote recorder, and the reactivity computer.

2.2.7 Shutdown Margin Monitor Assembly

The Shutdown Margin Monitor is typically mounted to an instrumentation rack in the control room of the power plant. It continuously measures and displays the count rate from a neutron flux monitor.

2.3 Qualified Life Objective

The Wide Range Detector, Cables, Junction Box, Wide Range Amplifier, Optical Isolator, Source Range RMSP, Intermediate Range RMSP and the Shutdown Margin Monitor are qualified for a design life of

2.4 Safety Functions

The Wide Range Amplifier provides source range power indication and wide range reactor power indication to the operators and the Reactor Protection System. The safety function of the 202406-101 Wide Range Amplifier is to provide accurate indication of reactor power level from the source level to full power operation during and following a SSE seismic event, a MSLB or LOCA condition.

The Optical Isolator provides circuit failure protection for the amplifier assembly from the signal processors.

The Nuclear Instrument Channel provides source, intermediate and wide range reactor power indication to the operators and the Reactor Protection System. In addition, it isolates Class 1E equipment from non-Class 1E equipment. All functions that may be considered Class 1E functions are considered safety functions. The Assemblies have the following outputs and interfaces:

1.

2.

3.

4.

5.

The Shutdown Margin Monitor provides the reactor operator adequate warning if an unintentional loss of shutdown margin occurs. It monitors the contrite from the neutron flux at the reactor core for a statistically significant increase that demonstrates a loss of shutdown margin.

2.5 Service Conditions

2.5.1 Normal and Abnormal Service Conditions

The components of the Wide Range Amplifier, Optical Isolator, Source Range RMSP, Intermediate Range RMSP, Wide Range RMSP and Shutdown Margin Monitor are designed to operate in the range of service conditions presented in Appendix C.

2.5.2 Design Basis Accident Conditions

All Wide Range Assemblies are qualified to Design Basis Event (DBE) conditions based on similarity to tested assemblies. This includes the Wide Range Amplifier, Optical Isolator, Source Range RMSP, Intermediate Range RMSP, Wide Range RMSP and Shutdown Margin Monitor Assemblies. The specific conditions simulated during DBE testing are presented within the qualification section of these assemblies, later in this report.

2.6 Margin

percent margin should be added to the seismic Required Response Spectra (RRS) when comparing the Test Response Spectra (TRS) with the RRS for qualifying the equipment at specific site installations. Note that the RRS and TRS appearing in Appendix C are conservative envelopes of the actual spectra that appears in the individual seismic test reports. Figure C.1 thru C.4 include margin in the RRS.

3. QUALIFICATION PROGRAM

The qualification program, as required by IEEE-323 (Ref. 2), for the Source, Intermediate and Wide Range Channels is presented in Appendix A.

4. SURVEILLANCE/MAINTENANCE REQUIREMENTS

There are no components in the Wide Range Amplifier Assembly, the Optical Isolator Assembly, Source Range RMSP, Intermediate Range RMSP, Wide Range RMSP or the Shutdown Margin Monitor which require surveillance and/or maintenance to maintain the Class 1E qualification of the system. Component failures of a random nature will be detected and repaired through periodic inspections during the operating life of the equipment without affecting its qualified life.

Periodic adjustment may be required to maintain the accuracy of the Wide Range Amplifier, Optical Isolator, Source and Intermediate Range RMSP, Wide Range RMSP and Shutdown Margin Monitor Assemblies within the limits of Table 2.1 thru 2.6. The plant Instruction Manual includes procedures and recommended intervals to meet plant specific requirements.

5. SAFETY FUNCTIONS TO BE DEMONSTRATED

All of the safety functions described for the equipment in Section 2 are shown to have been performed during qualification testing.

6. TEST PLAN

No new testing is being reported in this report. Therefore, no new test plans are required by IEEE-323 (Ref. 2). Qualification test plans were written for all testing and appear in the individual test reports.

7. DESCRIPTION OF ANALYTICAL METHODS

No formal analytical models are required for the qualification of the equipment due to the similarity in design with previously qualified units. Most of the proof required to satisfy the acceptance criteria can be gleaned from comparisons of design details.

8. CLASS 1E QUALIFICATION OF WIDE RANGE DETECTOR 900596-101

The Class 1E qualification of Wide Range Detector 900596-101 is based on extrapolation from previously qualified detectors. The detector is seismically qualified at the levels tested on

To summarize the analyses presented below, Wide Range Detector 900596-101 is qualified for years of Class 1E operation.

8.1 SEISMIC QUALIFICATION

8.1.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the Class 1E qualification of Wide Range Detector 900596-101. The 900596-101 assembly is compared with previously qualified assemblies which in total contain all of the parts which are comparable to those that affect the Class 1E functions of the detector. The assembly-level sections verify the similarities between the detectors at the assembly level. The component-level sections compare each part within the 900596-101 assembly, which affects the Class 1E functions of the detector, with a similar qualified part.

The following assembly contains parts which are used to qualify similar parts within the 900596-101 detector:

200668-101 Detector Assy

8.1.1.1 Material

The 900596-101 detector is constructed from similar materials as those of the tested units. Both the qualified assemblies and 900596-101 are constructed with housings. The fission chambers within these assemblies are housed in . The only difference in material is that used for the cables which are qualified individually by comparison with those tested in QTR 40 (Ref. 7). From an assembly-level standpoint, there are no material differences which would affect the qualification of the detector.

8.1.1.2 Size

The size of the 200889-128 detector assembly, a subassembly of 900596-101 which does not include cabling or support parts, is similar to the equivalent assemblies within detector assembly 200688-101. The outer dimensions of these assemblies are approximately long by ' outer diameter of the spacing disk. The detectors weigh lbs.

The parts added to suspend and support the detector are of different size but do not affect the seismic qualification of the detector. The 900596-101 detector is lowered into its well by the suspension parts until it rests on its support parts. The length of the suspension cable or support pedestal does not affect the seismic qualification of the detector because it is not fastened at either end and is constrained in the horizontal plane by the detector well.

8.1.1.3 Shape

The shape of the 900596-101 detector is the same as that of the qualified units and presents no qualification issues.

8.1.1.4 Stress

The seismic stresses endured by the test units are presented within this section to use in qualifying the 201799 detector for site-specific seismic conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy.

8.1.1.4.1 Seismic Stress Comparison

The Test Response Spectra (TRS) is presented for the 200688-101 detector on which the 900596-101 detector seismic qualification is based. It is seismically qualified for all sites with Required Response Spectra (RRS) that are enveloped by the TRS. In addition, the dynamic response of 200688-101 is shown to be resonant-free. No dynamic analyses are required if no resonances, other than those attributable to the test fixture, occurred during seismic testing.

8.1.1.4.2 Seismic Excitation

Wide Range Detector 200688-101 was tested inside of a 7" ID steel pipe which simulated a typical detector well. The detector rested on its pedestal support on the bottom of the well. The well was welded to the shake table at approximately its centerline, as shown in QTR 169 (Ref. 4).

The parts within this detector are qualified to the Test Response Spectra (TRS) presented in Appendix C. Figures C.1 through C.4 show the response spectra in the three axes for one of the OBE's and the SSE. In order to qualify the 900596-101 assembly for a specific site location, the Required Response Spectra at the installation location must be enveloped by the TRS over the required frequency range.

8.1.1.4.3 Dynamic Response

A resonance search was performed on detector 200688-101 during seismic qualification tests. This was done to identify any resonances within the structure. No resonances were measured in either the vertical or horizontal axes in the frequency range below 33 Hz. It is therefore justifiable to consider the detector assembly as a rigid structure. In addition, none of the physical differences between the tested 200688-101 detector and the 900596-101 assembly affect the rigidity of the detector. Therefore, if presented with the same excitation, the 900596-101 detector will respond similarly to the tested unit, with negligible dynamic response.

8.1.1.5 Aging

The 900596-101 detector is shown within this report to be similar to the qualified detector by meeting the criteria for qualification by extrapolation given in IEEE-323 (Ref. 2). In doing so, this detector is age qualified to the extent of the detector and cables on which its qualification is based. An Aging Mechanisms and Effects Analysis (AMEA) was conducted for detector 200126-101. The components within the 200688-101 detector are identical to the 200126-101 detector for aging purposes. The basic components of this assembly were analyzed to determine whether the assembly has any aging mechanisms which may be significant during the its design life. Thermal, radiation, wear, and vibration aging mechanisms were considered. Where the AMEA determined a significant aging mechanism, these components were aged to end of life conditions per the applicable Qualification Test Plan.

8.1.1.6 Function

The tested detectors performed similar safety functions as those of detector 900596-101 during the qualification testing. That is, the tested detectors provided neutron count rate indication to the amplifier before, during, and after testing. This was confirmed by monitoring the output of the amplifier routed through the signal processor. The electrical characteristics of the detector were also measured before and after testing, including alpha current, leakage resistance, and capacitance checks. Therefore, the safety functions performed by the 900596-101 detector have been shown to be performed during and following design basis events on similar detectors.

8.1.2 Component-Level Qualification

The 900596-101 parts must be shown to be physically similar to the qualified parts. All differences which impact seismic performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed.

Traceability between the 900596-101 parts and their qualified origins is given in Table 8.1 and is described below:

1) 200889-128 Detector Assy - The 200889-128 detector assembly consists of everything between the detector suspension assembly (item 10) and the detector support (item 5). The parts that make up this assembly are similar to the equivalent parts within the 200688-101 detector assembly. All detector assemblies are of similar material, size, shape, and function as was discussed in the assembly-level section. The "-128" dash number represents the customer specific cable lengths and has no effect on qualification.

The seismic qualification of 200889-128 detector assembly is based on multiple parts within the assembly, as shown in Table 8.1. All of the parts within the 200889-128 are similar to those within the 200688-101 detector assembly, seismically qualified in QTR

assembly is therefore seismically qualified to the levels tested for the 200688-101 assembly.

5) 200254-014 Support, Det. Ext Tube - The only difference between the two This does not affect the seismic qualification of the part.

6) 200255-001 Plate, Base, Support, Det - This part is the same as the seismically qualified part.

7) 200258-001 Plate, Base, Support, Det - This part is the same as the seismically qualified part.

8) 200259-001 Plate, Base, Support, Det - This part is the same as the seismically qualified part.

10) 200267-102 Suspension Assy - The only difference between the two assemblies is the This does not affect the seismic qualification of the part.

Table 8.1 Seismic Qualification Traceability for Wide Range Detector 900596-101

Item Number[1]	201799-101 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1	200889-128	200688-101	200688-101	QTR 169
5	200254-014	200254-007	200688-101	QTR 169
6	200255-001	same	200688-101	QTR 169
7	200258-001	same	200688-101	QTR 169
8	200259-001	same	200688-101	QTR 169
10	200267-102	200267-101	200688-101	QTR 169

[1] Corresponds to item # on parts list PL900596-101 - see Appendix B.

8.2 ENVIRONMENTAL QUALIFICATION

8.2.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the Class 1E qualification of Wide Range Detector 900596-101. The 900596-101 assembly is compared with previously qualified assemblies which in total contain all of the parts which are comparable to those that affect the Class 1E functions of the detector. The assembly-level sections verify the similarities between the detectors at the assembly level. The component-level sections compare each part within the 900596-101 assembly, which affects the Class 1E functions of the detector, with a similar qualified part.

The following assembly contains parts which are used to qualify similar parts within the 900596-101 detector:

<u>200126-101 Detector, SST, RCS Qualification</u>
<u>200587-101 Cable, Mineral Insulated</u>

8.2.1.1 Material

The 900596-101 detector is constructed from similar materials as those of the tested units. Both the qualified assemblies and 900596-101 are constructed with stainless steel housings. The fission chambers within these assemblies are housed in aluminum with alumina insulators. The only difference in material is that used for the cables which are qualified individually by comparison with those tested in QTR 40 (Ref. 7). From an assembly-level standpoint, there are no material differences which would affect the qualification of the detector.

8.2.1.2 Size

The size of the 200889-128 detector assembly, a subassembly of 900596-101 which does not include cabling or support parts, is similar to the equivalent assemblies within detector assembly 200126-101. The outer dimensions of these assemblies are approximately outer diameter of the spacing disk. The detectors weigh lbs.

The parts added to suspend and support the detector are of different size but do not affect the environmental qualification of the detector. The 900596-101 detector is lowered into its well by the suspension parts until it rests on its support parts. The length of the suspension cable or support pedestal does not affect the environmental qualification of the detector. There is no effect on environmental qualification because all assemblies are sealed in the same manner and the heat transfer path to the fission chamber, which is the only component sensitive to test temperatures, is similar.

8.2.1.3 Shape

The shape of the 900596-101 detector is the same as that of the qualified units and presents no qualification issues.

8.2.1.4 Stress

The environmental stresses endured by the test units are presented within this section to use in qualifying the 900596-101 detector for site-specific environmental conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy.

The environmental qualification of detector 900596-101 is based on tests conducted on the 200126-101 detector assembly and the 200587-101 cable assembly. The 200126-101 detector is used to environmentally qualify everything except the mineral insulated cables, qualified by 200587-101 testing. The environmental conditions at which the 200126-101 detector and the 200587-101 cable assembly were tested are presented in Table 8.2. In order to qualify the 900596-101 detector with mineral-insulated cables, the required environmental conditions must be enveloped by the test conditions presented in Table 8.2.

Both detector assembly 200126-101 and cable assembly 200587-101 were tested at Loss of Coolant Accident (LOCA) conditions shown in Figure 8.1. The 200126-101 detector included an organic cable assembly which was completely enclosed in a pressure tight envelope of flexible steel hose. The cable itself was thereby protected from chemical spray and changes in pressure. The subsequent tests to qualify the 200587-101 mineral-insulated cables did not need to include pressure or humidity conditions because the means for protecting the cables had not changed.

The 200587-101 test cables were not enclosed within the flexible steel hose for the environmental conditions shown in Table 8.2. This ensured that the test conditions were conservative in terms of enveloping LOCA conditions. In addition, the time at the
eliminated the need to test for longer time durations at the lower temperatures.

Table 8.2 Environmental Qualification Basis for Wide Range Detector 900596-101

Parameter	Assembly 200126-101[1]		Assembly 200587-101[2]		Qualified Detector Conditions	
	Extremes	DBE	Extremes	DBE	Extremes	DBE
Temperature (°F)		see Figure 8.1				
Pressure (psig)		see Figure 8.1				
Relative Humidity (% saturation)		steam environment w/ chemical spray see Figure 8.1				
Radiation Dose (R/hr) (RADS) (nvt)		n/a additional 2 x 10^8		a [illegible] 8		

[1] See Refs. 5 and 6
[2] See Ref. 7
[3] Actual temperature reached 460 °F during an unplanned event. See Ref. 6.

Figure 8.1 Loss of Coolant Accident Test Conditions

PWR

8.2.1.5 Aging

The 900596-101 detector is shown within this report to be similar to the qualified detector by meeting the criteria for qualification by extrapolation given in IEEE-323 (Ref. 2). In doing so, this detector is age qualified to the extent of the detector and cables on which its qualification is based. An Aging Mechanisms and Effects Analysis (AMEA) was conducted for detector 200126-101. The basic components of this assembly were analyzed to determine whether the assembly has any aging mechanisms which may be significant during its design life. Thermal, radiation, wear, and vibration aging mechanisms were considered. Where the AMEA determined a significant aging mechanism, these components were aged to end of life conditions per the applicable Qualification Test Plan.

8.2.1.6 Function

The tested detectors performed similar safety functions as those of detector 900596-101 during the qualification testing. That is, the tested detectors provided neutron count rate indication to the amplifier before, during, and after testing. This was confirmed by monitoring the output of the amplifier routed through the signal processor. The electrical characteristics of the detector were also measured before and after testing, including alpha current, leakage resistance, and capacitance checks. Therefore, the safety functions performed by the 900596-101 detector have been shown to be performed during and following design basis events on similar detectors.

8.2.2 Component-Level Qualification

The 900596-101 parts must be shown to be physically similar to the qualified parts. All differences which impact environmental performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed.

Traceability between the 900596-101 parts and their qualified origins is given in Table 8.3 and is described below:

1) <u>200889-128 Detector Assy</u> - The 200889-128 detector assembly consists of everything between the detector suspension assembly (item 10) and the detector support (item 5). The parts that make up this assembly are similar to the equivalent parts within the 200126-101 detector assembly. Both detector assemblies are of similar material, size, shape, and function as was discussed in the assembly-level section. The "-128" dash number represents the customer specific cable lengths and has no effect on qualification.

The environmental qualification of 200889-128 is based on assembly 200126-101, as shown in Table 8.3. The only component within this assembly that is potentially affected

The new fission chamber is of the same material and shape and is mounted the same. The internal construction of the chambers is also similar, as dictated by both being unguarded fission chambers. The length of the new chamber is slightly shorter (<1") than the tested chamber.

Table 8.7 Environmental Qualification Traceability for Wide Range Detector 900596-101

Item Number[1]	900596-101 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1	200889-128	multiple	200126-101 200587-101	QTR 10, QTR 12 QTR 40

[1] Corresponds to item # on parts list PL900596-101 - see Appendix B.

9. CLASS 1E QUALIFICATION OF CABLES AND JUNCTION BOX

The Class 1E qualification of Cable Assemblies 201712-xxx and 201722-xxx, as well as Junction Box 202394-101 is based on extrapolation from previously tested assemblies. All of the cables are seismically qualified as part of assembly 200225-101

. Environmental qualification of the cable assemblies between the detector and the junction box is also based on assembly 200225-101 tests. The Junction Box is seismically qualified at the levels reported in QTR 104 (Ref. 8). Environmental of the Junction Box is based on extrapolation from previously tested equipment.

9.1 SEISMIC QUALIFICATION

9.1.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the Class 1E qualification of the cables and junction box. The assembly-level sections verify the similarities at the assembly level. The component-level sections compare each part within the cable and junction box assemblies, which affects the Class 1E functions of the assemblies, with a similar qualified part.

The following assembly contains parts which are used to qualify similar parts within the cable and junction box assemblies:

200225-101	In-Cont Cable Assy. 2 Conductor
201517-101	Detector Assy. PR Suspension
202366-102	Junction Box Assy. Expanded (Silicone Seal)

The 200225 assembly consisted of the cable assemblies between the detector cable ends and the amplifier, through a similar junction box. The 201517 assembly consisted of a detector, cables and connectors. The 202366-102 assembly consisted of a junction box with similar components.

9.1.1.1 Material

The cable and junction box assemblies are constructed from identical and similar materials as those of the tested units. Minor changes to the components of these assemblies will be discussed in the component-level qualification section. None of the changes affect the qualification of the assemblies.

9.1.1.2 Size

The cable and junction box assemblies are identical and similar in size to the tested assemblies. The only difference is in the length of the cables, which varies between sites but does not affect the qualification of the assembly.

9.1.1.3 Shape

The shapes of the assemblies are identical and similar. The only shape change to the junction box is one of the connection nipples mounted on the side of the junction box was moved to the opposite side to facilitate cable routing. This difference does not affect the qualification of the junction box.

9.1.1.4 Stress

The seismic stresses endured by the test units are presented within this section to use in qualifying the junction box and cable assemblies for site-specific seismic conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy.

9.1.1.4.1 Seismic Stress Comparison

The Test Response Spectra (TRS) is presented for the 200225-101 assembly on which some cables and the junction box assembly seismic qualification is based. They are seismically qualified for all

The Test Response Spectra (TRS) is presented for the 201517-101 and 201510-101 assembly on which some cable assemblies' seismic qualification is based. They are seismically qualified for all

9.1.1.4.2 Seismic Excitation

<u>In-Cont Cable Assy. 2 Conductor 200225-101</u>

Cable assembly 200225-101 was tested together with the 200126-101 detector assembly as reported in QTR 10 (Ref. 5) and QTR 012 (Ref. 6). The junction box was mounted on a test fixture directly above the detector assembly at approximately 3 feet above the seismic table. The detector cable ends were connected to the 200225-101 cables inside of the junction box. The cables were routed from the junction box, down to the seismic table, and across the table to the amplifier, also mounted on the table. The cables between the amplifier and signal processor were also routed along the seismic table. The cables secured to the table to simulate typical plant installations.

The parts within the 200225-101 assembly are qualified to the Test Response Spectra (TRS) presented in Appendix C. The TRS is taken from accelerometers mounted on top of the junction

Detector Assy. PR Suspension 201517-101

A series of biaxial tests were conducted in one of the horizontal axis directions. Then the test fixture/rack was rotated 90° and the tests were repeated for the remaining horizontal axis.

The parts within the 201517-101 assembly are qualified to the Test Response Spectra (TRS) presented in Appendix C. The TRS is taken from accelerometers mounted on the table. Figures C.5 through C.8 show the response spectra in the three axes for one of the OBE's and the SSE. In order to qualify the 201517-101 assembly for a specific site location, the Required Response Spectra at the installation location must be enveloped by the TRS over the required frequency range.

Junction Box Assy. Expanded (Silicone Seal) 202366-102

A series of biaxial tests were conducted in one of the horizontal axis directions. Then the test fixture/rack was rotated 90° and the tests were repeated for the remaining horizontal axis.

The parts within the 202366-102 assembly are qualified to the Test Response Spectra (TRS) presented in Appendix C. The TRS is taken from accelerometers mounted on the table. Figures C.5 through C.8 show the response spectra in the three axes for one of the OBE's and the SSE. In order to qualify the 202366-102 assembly for a specific site location, the Required Response Spectra at the installation location must be enveloped by the TRS over the required frequency range.

9.1.1.4.3 Dynamic Response

A resonance search was performed during seismic qualification tests. This was done to identify any resonances within the tested assemblies. Assembly 200225-101 was measured by comparing the accelerometer signal on top of the junction box with the floor accelerometer signal in each axis. Cables are not rigid structures and must be secured to prevent damage during seismic events. No resonances were measured in either the vertical or horizontal axes in the frequency range below 33 Hz. It is therefore justifiable to consider the junction box as a rigid structure. In addition, none of the physical differences between the tested junction box and the 202394-101 assembly affect the rigidity of the assembly. Therefore, if presented with the same excitation, the 202394-101 junction box will respond similarly to the tested unit, with negligible dynamic response.

A resonance search was performed during seismic qualification tests. This was done to identify any resonances within the tested assemblies. Assembly 201517-101 was measured by comparing the accelerometer signal on top of the simulated detector well with the floor accelerometer signal in each axis. Cables are not rigid structures and must be secured to prevent damage during seismic events. No resonances associated with the components considered here were measured in either the vertical or horizontal axes in the frequency range below 33 Hz. It is therefore justifiable to consider the components of concern as rigid structures. In addition, none of the physical differences between the tested components and the components to be qualified affect the rigidity of the component. Therefore, if presented with the same excitation, the components will respond similarly to the tested units, with negligible dynamic response.

A resonance search was performed during seismic qualification tests. This was done to identify any resonances within the tested assemblies. Assembly 202366-102 was measured by comparing the accelerometer signal on top of the test fixture with the floor accelerometer signal in each axis. No resonances associated with the components considered here were measured in either the vertical or horizontal axes in the frequency range below 33 Hz. It is therefore justifiable to consider the components of concern as rigid structures. In addition, none of the physical differences between the tested components and the components to be qualified affect the rigidity of the component. Therefore, if presented with the same excitation, the components will respond similarly to the tested units, with negligible dynamic response.

9.1.1.5 Aging

The cables and junction box are shown within this report to be similar to the qualified assembly by meeting the criteria for qualification by extrapolation given in IEEE-323 (Ref. 2). In doing so, these parts are age qualified to the extent of the cables and junction box on which their qualification is based. An Aging Mechanisms and Effects Analysis (AMEA) was conducted for the originally tested THERMO FISHER SCIENTIFIC cables and junction box. The basic components of these assemblies were analyzed to determine whether they have any aging mechanisms which may be significant during their design life. Thermal, radiation, wear, and vibration aging mechanisms were considered. Where the AMEA determined a significant aging mechanism, these components were aged to end of life conditions per the applicable Qualification Test Plan. The only component that cannot meet the 40 year design life of the system due to aging affects is the silicone rubber O-ring in the junction box. It is required to be replaced every 10 years.

9.1.1.6 Function

The tested cables and junction box performed the same safety function as those intended for operation in Westinghouse PWR's. That is, the cables and junction box provided suitable protection of the signals from the detector to the signal processor. This was confirmed by monitoring the output of the amplifier routed through the signal processor. Therefore, the safety function performed by the cables and junction box has been shown to be performed during and following design basis events on similar equipment.

The tested amplifier to signal processor and signal processor interconnect cables performed the same safety function as those intended for operation in Westinghouse PWR's. That is, the cables provided suitable protection of the signals from the amplifier to the signal processor, and between signal processors. This was confirmed by monitoring the output of the signal processor. Therefore, the safety function performed by the cables has been shown to be performed during and following design basis events on similar equipment.

9.1.2 Component-Level Qualification

The cables and junction box parts must be shown to be physically similar to the qualified parts. All differences which impact seismic performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed.

Traceability between the cables and junction box parts and their qualified origins is given in Tables 12.1 to 12.5. Only those parts which have changed since qualification are discussed. The changes are described below:

202394-101, Junction Box Assembly

1) 200205-101, Cover, Junction Box - This part is the same as the qualified part.

3) 200203-102, Junction Box Assy - The tested junction box is of the same shape, material and function as 200203-102. The difference is the tested box is larger than the 200203-102 assembly. The size does not adversely affect qualification.

4) 002151-001 SEMS, Captive Hardware - The new part replaces items 4 through 6 of the tested part. This change makes the mounting hardware for the junction box cover captive for ease of installation. The size, shape, material and function are identical to the replaced parts. The difference does not adversely qualification.

7) 000286-002 Seal, O-ring Silicone Rubber - This part is the same as the qualified part. Furthermore, the qualification of this part was substantiated in QTR 104 (Ref. 8).

8) 000287-001, Union, Pipe, Threaded - This part is the same as the qualified part.

13) 200623-001 Insulator, Junction Box - The only difference between this part and the tested part is the size. The size is consistent with item 3. The shape, material and function are identical to the tested part. The difference does not adversely affect qualification.

16) 000126-139, Fitting, Tubing – This part is the same as the qualified part.

17) 000126-140, Fitting, Tubing – This part is the same as the qualified part.

201712-xxx, Cable Assembly, In-Containment., 2 Conductor

1) 200881-109, Splitter Assy. Cable. NFMS - Splitter 200881-109 replaces the original 200118-101 part. The change involved manufacturing the new splitter from a welded assembly of stainless steel tubing rather than from a solid block of machined stainless steel. There was no change in the material. The total mass of the part was reduced, and the angle of exit of the cables was changed to reduce the potential for damage during installation. The change has no affect on seismic qualification.

2) 200210-002. Fitting. Conduit. Pipe Thread - This part is the same as the qualified part.

3) 200086-103. Connector. Triaxial. Male - This part is identical to the tested 200086-001 Connector except for coaxial shield connection. The tested part used a coaxial cable swage fitting soldered to the connector inner shield. The 200086-102 connector uses a fitting that is soldered both to the coaxial cable and the connector inner shield. The change has no effect on seismic qualification.

6) 200037-003. Connector Assy. Coaxial - This part is the same as the qualified part.

9) 000958-001. Fitting. Seal. Conn. Single Cond. - This part is the same as the qualified part.

10) 000122-003. Cable. Coaxial. Rigid Nylon Coated - The newer cable is the same as the qualified cable except it contains a nylon outer coating to protect it from damage during manufacturing. The length of the cable dictates the part number of the assembly. This change has no effect on seismic qualification of the cable assembly.

11) 000123-002. Conduit. Flexible Metal - This part is the same as the qualified part.

201722-xxx, Cable Assembly, Amplifier, 2 Conductor

1) 200881-102. Splitter Assy. Cable. NFMS - Splitter 200881-102 replaces the original 200118-101 part. The change involved manufacturing the new splitter from a welded assembly of stainless steel tubing rather than from a solid block of machined stainless steel. There was no change in the material. The total mass of the part was reduced, and the angle of exit of the cables was changed to reduce the potential for damage during installation. The change has no effect on seismic qualification.

3) 200086-102. Connector. Triaxial. Male - This part is identical to the tested 200086-001 Connector except for coaxial shield connection. The tested part used a coaxial cable swage fitting soldered to the connector inner shield. The 200086-102 connector uses a fitting that is soldered both to the coaxial cable and the connector inner shield. The change has no effect on seismic qualification.

6) 200037-002, Connector Assy, Coaxial - This part is the same as the qualified part.

8) 000122-003, Cable, Coaxial, Rigid Nylon Coated - The newer cable is the same as the qualified cable except it contains a nylon outer coating to protect it from damage during manufacturing. The length of the cable dictates the part number of the assembly. This change has no affect on seismic qualification of the cable assembly.

9) 000123-002, Conduit, Flexible Metal - This part is the same as the qualified part.

12) 000958-001, Fitting, Seal, Conn. Single Cond. - This part is the same as the qualified part.

24) 000124-002, Fitting, Conduit - This part is the same as the qualified part.

Table 9.1 Seismic Qualification Traceability for Junction Box 202394-101

Item Number[1]	202394-101 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1	200205-101	same	202366-102	QTR 834
3	200203-102	202386-101	202366-102	QTR 834
4	002151-001	000240-095	202366-102	QTR 834
		000241-004	202366-102	QTR 834
		000242-004	202366-102	QTR 834
7	000286-002	same	202366-102	QTR 834
8	000287-001	same	202366-102	QTR 834, QTR 104
13	200263-001	200263-002	202366-102	QTR 834
16	000126-139	same	202366-102	QTR 834
17	000126-140	same	202366-102	QTR 834

[1] Corresponds to item # on parts list PL202366-102 - see Appendix B.

Table 9.2 Seismic Qualification Traceability for In-Containment Cables 201712-xxx

Item Number[1]	201712-xxx Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1	200881-109	200118-002	200225-101	QTR 12
2	200210-002	same	200225-101	QTR 12
3	200086-102	200086-001	200225-101	QTR 12
6	200037-003	same	200225-101	QTR 12
9	000958-001	same	201517-101	QTR 239
10	000122-003	000122-002	200225-101	QTR 12
11	000123-002	same	200225-101	QTR 12

[1] Corresponds to item # on parts list PL201712-xxx - see Appendix B.

Table 9.3 Seismic Qualification Traceability for Amplifier Cables 201722-xxx

Item Number[1]	201722-xxx Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1	200881-102	200118-002	200225-101	QTR 12
3	200086-102	200086-001	200225-101	QTR 12
6	200037-002	same	200225-101	QTR 12
8	000122-003	000122-002	200225-101	QTR 12
9	000123-002	same	200225-101	QTR 12
12	000958-001	same	201517-101	QTR 239

24	000124-002	same	200225-101	QTR 12

[1] Corresponds to item # on parts list PL201722-xxx - see Appendix B.

9.2 ENVIRONMENTAL QUALIFICATION

9.2.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the Class 1E qualification of the cables and junction box. The assembly-level sections verify the similarities at the assembly level. The component-level sections compare each part within the cable and junction box assemblies, which affects the Class 1E functions of the assemblies, with a similar qualified part.

The following assembly contains parts which are used to qualify similar parts within the cable and junction box assemblies:

200225-101 In-Containment Cable Assy, 2 Conductor
012018-102 Test Fixture, Cable Assy

The In-Containment Cable assembly consisted of the cable assemblies between the detector cable ends and the amplifier, through a similar junction box. The Test Fixture Cable assembly consisted of penetration cable assemblies.

9.2.1.1 Material

The cable assemblies are constructed from similar materials as those of the tested units. Minor changes to the components of these assemblies will be discussed in the component-level qualification section. None of the changes affect the qualification of the assemblies.

Junction box assembly 202366-102, cover assembly 202404-101, -102 and cover No. 201035-101 are constructed from identical and similar materials as those of the qualified unit. Junction box assembly 202366-102 is identical to the tested unit as far as material is concerned. Cover assembly

9.2.1.2 Size

The cable assemblies are similar in size to the tested assemblies. The only difference is in the length of the cables, which varies between sites but does not affect the qualification of the assembly.

Junction box assembly 202366-102, cover assemblies 202404-101, -102 and cover no. 201035-101 are identical and similar in size to the qualified unit. Junction box assembly 202366-102 is larger than the qualified unit. The dimensions of Junction box assembly environmental qualification of these parts or the junction box assembly these parts are used on.

9.2.1.3 Shape

The shapes of the cable assemblies are similar. Junction box assembly 202366-102, cover assemblies 202404-101, -102 and cover no. 201035-101 have the same general shape as those used on the qualified unit. Junction box assembly 202366-102 is identical in shape to the tested unit.

9.2.1.4 Stress

The environmental stresses endured by the test units are presented within this section to use in qualifying the junction box and cable assemblies for site-specific environmental conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy.

The environmental qualification of the 201712 and 201722 cables and 202366-102 junction box is based on tests conducted on cable assembly 200225-101, reported in QTR 010 (Ref. 5) and QTR 012 (Ref. 6), test cable 012018-102, reported in QTR 230 (Ref. 9). These assemblies were subjected to both extremes of normal and Loss of Coolant Accident (LOCA) conditions.

9.2.1.5 Aging

The cables and junction box are shown within this report to be similar to the qualified assembly by meeting the criteria for qualification by extrapolation given in IEEE-323 (Ref. 2). In doing so, these parts are age qualified to the extent of the cables and junction box on which their qualification is based. An Aging Mechanisms and Effects Analysis (AMEA) was conducted for the originally tested THERMO FISHER SCIENTIFIC cables and junction box. The basic components of these assemblies were analyzed to determine whether they have any aging mechanisms which may be significant during their design life. Thermal, radiation, wear, and vibration aging mechanisms were considered. Where the AMEA determined a significant aging mechanism, these components were aged to end of life conditions as reported in the applicable Qualification Test Report. Radiation aging values appear in the tables.

Table 9.4A Environmental Qualification Basis for Cables and Junction Box

Parameter	Assembly 200225-101[1]	
	Extremes	DBE
Temperature (°F)		
Pressure (psig)		
Relative Humidity (% saturation)		
Radiation Dose (RAD's)		

[1] See Refs. 5 and 6.

[2] Actual temperature reached during an unplanned event. See Ref. 6.

Table 9.4B Environmental Qualification Basis for Junction Box O-Ring and Penetration Connectors

Parameter	Assembly 200225-101[1]	
	Extremes	DBE
Temperature (°F)		
Pressure (psig)		
Relative Humidity (% saturation)		
Radiation Dose (RAD's)		

[1] See Refs. 5 and 6.
[2] Applies only to penetration seal connector. See Ref. 8.
[3] Actual temperature reache F during an unplanned event. See Ref. 6.

Figure 9.1 Loss of Coolant Accident Test Conditions

PWR

MSLB/LOCA TEST PROFILE

9.2.1.6 Function

The tested cables and junction box performed the same safety function as those intended for operation in Westinghouse PWR's. That is, the cables and junction box provided suitable protection of the signals from the detector to the signal processor. This was confirmed by monitoring the output of the amplifier routed through the signal processor. Therefore, the safety function performed by the cables and junction box has been shown to be performed during and following design basis events on similar equipment.

The tested amplifier to signal processor and signal processor interconnect cables performed the same safety function as those intended for operation in Westinghouse PWR's. That is, the cables provided suitable protection of the signals from the amplifier to the signal processor, and between signal processors. This was confirmed by monitoring the output of the signal processor. Therefore, the safety function performed by the cables has been shown to be performed during and following design basis events on similar equipment.

9.2.2 Component-Level Qualification

The cables and junction box parts must be shown to be physically similar to the qualified parts. All differences which impact environmental performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323-1983 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed.

Traceability between the cables and junction box parts and their qualified origins is given in Tables 9.5 to 9.7. Only those parts which have changed since qualification are discussed. The changes are described below:

202394-101, Junction Box Assembly

1)

3)

4)

7)

8) <u>000287-001, Union, Pipe, Threaded</u> - This part is the same as the qualified part.

13) <u>200623-001 Insulator, Junction Box</u> - This part is the same as the qualified part.

16)

17)

201712-xxx, Cable Assembly, In-Containment., 2 Conductor

1)

2) 200210-002, Fitting, Conduit/Pipe Thread - This part is the same as the qualified part.

3)

6) 200037-003, Connector, Assy, Coaxial - This part is the same as the qualified part.

9)

Therefore, the 000958-001 connector is qualified to the conditions listed in table 9.4B

10) 000122-003, Cable, Coaxial, Rigid Nylon Coated - The 000122-003 Cable is the same as the qualified cable

manufacturing. This change has no affect on environmental qualification of the cable assembly.

11) 000123-002, Conduit, Flexible Metal - This part is the same as the qualified part.

12) 000282-002, Sleeving, Braided Fiberglass - This part is the same as the qualified part.

16) 000156-001, Tape, Glass Cloth - This part is the same as the qualified part.

201722-xxx, Cable Assembly, Amplifier, 2 Conductor

1)

3)

6) 200037-002, Connector, Assy, Coaxial - This part is the same as the qualified part.

8) 000122-003, Cable, Coaxial, Rigid Nylon Coated - The 000122-003 Cable is the same as

9) 000123-002, Conduit, Flexible Metal - This part is the same as the qualified part.

10) 000282-002, Sleeving, Braided Fiberglass - This part is the same as the qualified part.

12) 000958-001, Fitting, Seal, Connector - These cable seals were not qualified as part of the original qualification of the cable assembly. The shell of this connector is made of identical material and is similar in size, shape and construction as the fitting used as part of the

qualification.

> The 000958-001 connector contains a solid glass insulator to electrically isolate the coaxial cable from the outer metal shell. The cable tested as part of the original qualification used glass cloth tape to electrically isolate the coaxial cable from the fitting. The 000958-001 connector was included as part of a similar cable assembly (012018-102) which was environmentally tested and qualified at LOCA conditions as reported in QTR 230 (Ref. 9). This included thermal and radiation aging of the connector with glass insulator. The connector was exposed to temperature (up to 572 °F) and pressure (up to 130 psig) conditions greater than those indicated in figure 9.1. The total test time (92 hours) was less than that shown in figure 9.1. However, the material properties of glass and steel are such that no changes are expected once the material reaches equilibrium temperature. Therefore, the 000958-001 connector is qualified to the conditions listed in table 9.6.

16) 000156-001, Tape, Glass Cloth - This part is the same as the qualified part.

24) 000124-002, Fitting, Conduit - This part is the same as the qualified part.

Table 9.7 Environmental Qualification Traceability for Junction Box 202394-101

Item Number[1]	202394-101 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1	200205-101	200205-001	200225-101	QTR 10
3	200203-102	200203-101	200225-101	QTR 10
4	002151-001	000240-095	200225-101	QTR 10
		000241-004	200225-101	QTR 10
		000242-004	200225-101	QTR 10
7	000286-002	000286-001	200225-101	QTR 10, QTR 104
8	000287-001	same	200225-101	QTR 10
13	200263-001	same	200225-101	QTR 10
16	000126-139	n/a	200225-101	QTR 10
17	000126-140	n/a	200225-101	QTR 10

[1] Corresponds to item # on parts list PL202366-102 - see Appendix B.

Table 9.8 Environmental Qualification Traceability for In-Containment Cables 201712-xxx

Item Number[1]	201712-xxx Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1	200881-109	200118-002	200225-101	QTR 10
2	200210-002	same	200225-101	QTR 10
3	200086-103	200086-001	200225-101	QTR 10
6	200037-003	same	200225-101	QTR 10

9	000958-001	same	201517-101	QTR 230
10	000122-003	000122-002	200225-101	QTR 10
11	000123-002	same	200225-101	QTR 10
12	000282-002	same	200225-101	QTR 10
16	000156-001	same	200225-101	QTR 10

[1] Corresponds to item # on parts list PL201712-xxx - see Appendix B.

Table 9.9 Environmental Qualification Traceability for Amplifier Cables 201722-xxx

Item Number[1]	201722-xxx Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1	200881-102	200118-002	200225-101	QTR 10
3	200086-102	200086-001	200225-101	QTR 10
6	200037-002	same	200225-101	QTR 10
8	000122-003	000122-002	200225-101	QTR 10
9	000123-002	same	200225-101	QTR 10
10	000282-002	same	200225-101	QTR 10
12	000958-001	same	201517-101	QTR 230
16	000156-001	same	200225-101	QTR 10
24	000124-002	same	200225-101	QTR 10

[1] Corresponds to item # on parts list PL201722-xxx - see Appendix B.

10. CLASS 1E QUALIFICATION OF WIDE RANGE AMPLIFIER 202406-101

The Class 1E qualification of Wide Range Amplifier 202406-101 is accomplished by seismic analysis and environmental analysis. Seismic and environmental qualification of this assembly is predominantly based on extrapolation from previously qualified THERMO FISHER SCIENTIFIC Wide Range Amplifier 200617-103 and Power Range Amplifier 200956-101. The WR Amplifier

10.1 SEISMIC QUALIFICATION

10.1.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the Class 1E qualification of Wide Range Amplifier 202406-101. The 202406-101 assembly is compared with a previously qualified assembly which contains similar parts that affect the Class 1E functions of the amplifier. The assembly-level sections verify the similarities between the amplifiers at the assembly level. The component-level sections compare each part within the 202406-101 assembly, which affects the Class 1E functions of the amplifier, with a similar qualified part.

The following assembly contains parts which are used to seismically qualify similar parts within the 202406-101 amplifier:

200617-103	Amplifier Assy, Wide Range
200956-101	Amplifier Assy, Power Range

10.1.1.1 Material

The 202406-101 amplifier is constructed from similar materials as those of the tested unit. From an assembly-level standpoint, there are no material differences which would affect the qualification of the amplifier.

10.1.1.2 Size

Both the qualified unit and the 202406-101 amplifier are housed within a NEMA 12 enclosure of identical size and weight. In addition, the overall weight and weight distribution of the assemblies is essentially the same. Therefore there are no size differences which would impact the qualification of the amplifier.

10.1.1.3 Shape

The shape of the 202406-101 amplifier is the same as that of the qualified unit and presents no qualification issues.

10.1.1.4 Stress

The seismic stresses endured by the test unit are presented within this section to use in qualifying the 202406-101 amplifier for site-specific seismic conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy.

10.1.1.4.1 Seismic Stress Comparison

10.1.1.4.2 Seismic Excitation

10.1.1.4.3 Dynamic Response

10.1.1.5 Aging

10.1.1.6 Function

On an assembly level, the 200617-103 and 200956-101 performed similar safety functions as those of amplifier 202406-101 during the qualification testing. That is, the tested amplifier provided high voltage to the detectors and amplified the signals for processing in the Source and Intermediate Range Signal Processors. Therefore, the safety functions performed by the 202406-101 amplifier have been shown to be performed during and following design basis events on a similar amplifier.

10.1.2 Component-Level Seismic Qualification

The 202406-101 parts must be shown to be physically similar to the qualified parts. All differences which impact seismic performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed. Traceability between the 202406-101 parts and their qualified origins is given in Table 10.1.

The 202406-101 amplifier incorporates a 201652 Test Generator and several improved modules and components, including the 201401 High Voltage Power Supply, the 100852 Test/Non Operate PCA, the 100340 High Frequency Discriminator, and the 100879 Backplane PCA. The 100004 Preamplifier was upgraded from -001 to -104. Additionally, the AC input power filter module and all AC wiring were removed from the Backplane PCA. Each change from the qualified 200617-103 and 200956-101 are justified below. Some parts are a newer revision of the original qualified part. THERMO FISHER SCIENTIFIC Quality Procedure QP 6.04.001 states that all revisions must be interchangeable in terms of the part's functional, physical, and durability characteristics. Therefore, the newer revision of the qualified part is qualified for seismic conditions.

2) <u>100340-101 PC Assembly, Discriminator, High Frequency</u> - This PCA was qualified in

QTR 160 (Ref. 14). QTR 160 based seismic qualification on similarity to the 100008-001 PCA tested in QTR 137 (Ref. 11).

3) 100012-104 PC Assembly, Discriminator and Band Pass Filter - These PCA's are similar in material, size, shape, and function. The 100012-104 has minor changes in component values and one component replaced by a jumper wire. Changes to the board components will not affect the ability of the 100012-001 assembly to withstand similar seismic conditions.

4) 100852-101 PC Assembly, Test/Non-Operate - The Class 1E qualification of this PCA is based on the 100015-001 Linear, Test/Trouble PCA which was tested as part of the 200617-103 qualification. Some of the functions performed by the 100015-001 PCA were moved to the standard half-height PCA 100852-101, located in the slot closest to the preamplifiers. Although the 100015-001 PCA was mounted within a Preamplifier-type housing, the PC board within the housing is similar in material, size, shape and function as the 100852-101 assembly. The boards are similarly fixed from movement during seismic events and would therefore experience similar excitation. The added weight due to the additional PCA on the backplane will be justified as part of the backplane PCA qualification. There are no differences which would impact the seismic performance of the 100852-101 PCA.

6) 200626-001 Bracket, Mounting, Power Supply - This part is identical to the qualified part.

7) 201282-101 Cover Assembly, Discriminator - The covers are identical in all respects

9) 200995-103 Panel, Mounting -The test unit panel and the 200995-103 panel are made of identical material and are identical in overall size and shape. The only difference between

10) 000001-089 Resistor, 1/4 watt, 1%, 4.99 kΩ - This part is no longer installed at the 202406-101 Wide Range amplifier assembly level but a similar qualified resistor is installed at the 201401-101 High Voltage Power Supply level in the same physical location as the qualified part. This has no effect on the seismic performance of the amplifier.

11) 000001-098 Resistor, 1/4 watt, 1%, 10 kΩ - This part is no longer installed at the 202406-101 Wide Range amplifier assembly level but a similar qualified resistor is installed at the 201401-101 High Voltage Power Supply level in the same physical location

as the qualified part. This has no effect on the seismic performance of the amplifier.

13) 000309-008 Power Supply, +/- 15VDC – The qualification of the 000309-008 Low Voltage Power Supply is documented in Test Report 826 (Ref 16). The 000309-008 is nearly identical to the qualified 200636-001 power supply which consists of a 000309-002 supply with wiring modifications. These wiring modifications were called out on the 200636-001 drawing but are now part of the amplifier's wire list. The 000309-008 power supply is the same design as the 000309-002 except that the component reliability and quality rating have been improved. These changes have no impact on seismic performance.

16) 200625-005 Enclosure, Amplifier, NEMA 12 - The enclosures are identical in material, size, shape, and function. The only difference is the two holes added to the side of the 200625-005 enclosure for mounting the AC Line filter. The changes in weight and weight distribution within the enclosure due to differences between the 202406-101 and 200617-103 amplifier parts are negligible.

20) 000188-004 Coaxial Cable 59/U Low Noise - This part is identical to the qualified part.

25) 201401-101 Power Supply, High Voltage 120 VAC Input, 0-1 kVDC Output - The qualification of the 201401-101 High Voltage Power Supply is documented in QTR 815 (Ref. 17).

35) 000471-036 Standoff, Male/Female - This part is identical to the qualified part.

36) 000471-019 Standoff, Male/Female - This part is identical to the qualified part.

55) 100004-104 Preamplifier Assembly - The seismic qualification of this assembly is based on the 100004-001 Preamplifier which was seismically shaken as part of the 200617-103 qualification. This Preamplifier is made of identical material and is of similar size and shape as the test unit's. It is also mounted the same. The difference in weight between the two preamplifiers is negligible in terms of its impact on either the amplifier or the Preamplifier itself. There are therefore no differences which would impact the seismic performance of the 100004-104 assembly.

56)

57) <u>201652-102 Test Generator Assembly</u> - The seismic qualification of this PCA is based on the 100015-001 Linear Test/Trouble PCA which was seismically shaken as part of the

60) <u>200186-001 Bracket. Mounting, Circuit Breaker</u> - A 000222-001 circuit breaker and 200186-001 mounting bracket were added. They are identical to the circuit breaker and mounting bracket used on the 200956-101 Power Range Amplifier, qualified in QTR 137 (Ref. 11) and QTR 139 (Ref. 12). The addition of these parts does not affect the seismic qualification of the 202406-101 amplifier.

61) <u>000135-058 Terminal Block</u> - The 000135-058 terminal block is identical to the terminal block used on the 200956-101 Power Range Amplifier also qualified in QTR 137 (Ref. 11). There are no differences which would affect the seismic qualification of the 202406-101 amplifier.

62) <u>000222-001 Circuit Breaker</u> - The 000222-001 circuit breaker is identical to the circuit breaker used on the 200956-101 Power Range Amplifier also qualified in QTR 137 (Ref. 11). There are no differences which would affect the seismic qualification of the 202406-101 amplifier.

63) <u>000136-009 Filter. AC Line</u> - The AC line filter, which was mounted on the backplane for the test unit, was moved to the inner side wall of the enclosure, between the power supplies. The filter does not affect the seismic performance of the enclosure. The weight of the filter is insignificant compared to the weight of the power supplies mounted and tested in this location.

Table 10.1 Class 1E Seismic Qualification Traceability for Wide Range Amplifier 202406-101

Item Number[1]	202406-101 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
2	100340-101	100008-001	200617-103	QTR 137(QTR 160)
3	100012-104	100012-001	200617-103	QTR 137
4	100852-101	100015-001	200617-103	QTR 137
6	200626-001	same	200617-103	QTR 137
7	201282-101	200052-001	200617-103	QTR 137
9	200995-101	200629-001	200617-103	QTR 137
13	000309-008	200636-001 same	200617-103 N/A	QTR137 QTR 826
16	200625-005	same	200617-103	QTR 137
20	000188-004	same	200617-103	QTR 137
25	201401-101	000288-001 same	200617-103 N/A	QTR 137 QTR 815
35	000471-036	same	200617-103	QTR 137
36	000471-019	same	200617-103	QTR 137
55	100004-104	100004-001	200617-103	QTR 137
56	100879-101	100146-104	200617-103	QTR 137
57	201652-102	100015-001	200617-103	QTR 137
60	200186-001	same	200956-101	QTR 137
61	000135-058	same	200956-101	QTR 137
62	000222-001	same	200956-101	QTR 137
63	000136-009	000136-001	200617-103	QTR 137

[1] Corresponds to item # on parts list PL202406-101 - see Appendix B.

10.2 ENVIRONMENTAL QUALIFICATION

10.2.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the Class 1E qualification of Wide Range Amplifier 202406-101. The 202406-101 assembly is compared with a previously qualified assembly which contains similar parts that affect the Class 1E functions of the amplifier. The assembly-level sections verify the similarities between the amplifiers at the assembly level. The component-level sections compare each part within the 202406-101 assembly, which affects the Class 1E functions of the amplifier, with a similar qualified part.

The following assembly contains parts which are used to environmentally qualify similar parts within the 202406-101 amplifier:

200617-103	Amplifier Assy, Wide Range
200956-101	Amplifier Assy, Power Range

10.2.1.1 Material

The 202406-101 amplifier is constructed from similar materials as those of the tested unit. From an assembly-level standpoint, there are no material differences which would affect the qualification of the amplifier.

10.2.1.2 Size

Both the qualified unit and the 202406-101 amplifier are housed within a NEMA 12 enclosure of identical size. Therefore there are no size differences which would impact the qualification of the amplifier.

10.2.1.3 Shape

The shape of the 202406-101 amplifier is the same as that of the qualified unit and presents no qualification issues.

10.2.1.4 Stress

The environmental stresses endured by the test unit are presented within this section to use in qualifying the 202406-101 amplifier for site-specific environmental conditions. The test

Table 10.2 Environmental Qualification Basis for Wide Range Amplifier 202406-101

Parameter	Assembly 200617-103[1]	Assembly 200956-101[2]	Required Conditions
Temperature (°F)			
Pressure (psig)			
Relative Humidity (% saturation)			
Radiation Dose (RADS)			
Vibration			
Power Supply (VAC) (Hz)			

[1] See Ref. 13
[2] See Refs. 11 & 12

10.2.1.5 Aging

10.2.1.6 Function

On an assembly level, the 200617-103 performed similar safety functions as those of amplifier 202406-101 during the qualification testing. That is, the tested amplifier provided high voltage to the detectors and amplified the signals for processing in the Source and Intermediate Range Signal Processors. Therefore, the safety functions performed by the 202406-101 amplifier have been shown to be performed during and following design basis events on a similar amplifier.

10.2.2 Component-Level Environmental Qualification

The 202406-101 parts must be shown to be physically similar to the qualified parts. All differences which impact environmental performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed. Traceability between the 202406-101 parts and their qualified origins is given in Table 10.3.

2)

3) <u>100012-104 PC Assembly, Discriminator and Band Pass Filter</u> - These PCA's are similar in material, size, shape, and function. The 100012-104 has minor changes in component values and one component replaced by a jumper wire. Changes to the board components will not affect the ability of the 100012-004 assembly to withstand similar environmental conditions.

4) <u>100852-101 PC Assembly, Test/Non-Operate</u> - The Class 1E qualification of this PCA is based on the 100015-001 Linear, Test/Trouble PCA which was tested as part of the

The capability of the 100852-101 PCA to withstand environmental test conditions has not changed from its qualified origin. The differences in power consumption and heat transmission are negligible. The 100852-101 PCA is therefore environmentally qualified to the test conditions of the 200617-103 amplifier assembly.

7) <u>201282-101 Cover Assembly, Discriminator</u> - The covers are identical in all respects except for the width. The 201282-101 cover is wider because it covers four PCA slots whereas 200052-001 is designed to cover three slots. Since the covers are made from aluminum, the difference in weight is negligible. There are no differences between these covers which would impact the environmental performance of the amplifier.

9) 200995-101 Panel, Mounting -The test unit panel and the 200995-101 panel are made of identical material and are identical in overall size and shape. The only difference between

10) 000001-089 Resistor, 1/4 watt, 1%, 4.99 kΩ - This part is no longer installed at the 202406-101 Wide Range amplifier assembly level but a similar qualified resistor is installed at the 201401-101 High Voltage Power Supply level in the same physical location as the qualified part. This has no effect on the environmental performance of the amplifier.

11) 000001-098 Resistor, 1/4 watt, 1%, 10 kΩ - This part is no longer installed at the 202406-101 Wide Range amplifier assembly level but a similar qualified resistor is installed at the 201401-101 High Voltage Power Supply level in the same physical location as the qualified part. This has no effect on the environmental performance of the amplifier.

13) 000309-008 Power Supply, +/- 15VDC – The qualification of the 000309-008 Low Voltage Power Supply is documented in QTR 826 (Ref 15). The 000309-008 is nearly

16) 200625-005 Enclosure, Amplifier, NEMA 12 - The enclosures are identical in material,

20) 000188-004 Coaxial Cable 59/U Low Noise - This part is identical to the qualified part.

25) 201401-101 Power Supply, High Voltage 120 VAC Input, 0-1 kVDC Output - The qualification of the 201401-101 High Voltage Power Supply is documented in QTR 815 (Ref. 17).

55) 100004-104 Preamplifier Assembly -The capability of the 100004-104 assembly to withstand environmental test conditions has not changed from its qualified origin. The differences in power consumption and heat transmission are negligible. The 100004-104 amplifier is therefore environmentally qualified to the test conditions of the 200617-103 amplifier assembly.

56) 100879-101 PC Assembly, Backplane -The capability of the 100879-101 PCA to withstand environmental test conditions has not changed from its qualified origin. The differences in power consumption and heat transmission are negligible. The 100879-101 PCA is therefore environmentally qualified to the test conditions of the 200617-103 amplifier assembly.

57) 201652-102 Test Generator Assembly -The capability of the 201652-102 PCA to withstand environmental test conditions has not changed from its qualified origin. Since circuitry and calibrate outputs are only enabled when the wide range amplifier is in calibrate mode, the additional heat generated by the 201652 Test Generator Assembly is insignificant. The 201652-102 PCA is therefore environmentally qualified to the test conditions of the 200617-103 amplifier assembly.

62) 000222-001 Circuit Breaker - This part is identical to the qualified part.

63) 000136-009 Filter, AC Line -The tested filter and the 000136-009 filter are made of identical material and are similar in size and shape. The manufacturers are the same. The filter is now mounted on a heat sink (enclosure). The electrical differences between the qualified filter and the 000136-009 filter are component value changes only.

Table 10.3 Class 1E Environmental Qualification Traceability for Wide Range Amplifier 202406-101

Item Number[1]	202406-101 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
2	100340-101	100008-001	200617-103	QTR 140 (QTR 160)
3	100012-104	100012-001	200617-103	QTR 140
4	100852-101	100015-001	200617-103	QTR 140
7	201282-101	200052-001	200617-103	QTR 140
9	200995-101	200629-001	200617-103	QTR 140
13	000309-008	200636-001 same	200617-103 N/A	QTR 140 QTR 826
16	200625-005	same	200617-103	QTR 140
20	000188-004	same	200617-103	QTR 140
25	201401-101	000288-001 same	200617-103 N/A	QTR 140 QTR 815
55	100004-104	100004-001	200617-103	QTR 140
56	100879-101	100146-104	200617-103	QTR 140
57	201652-102	100015-001	200617-103	QTR 140
62	000222-001	same	200956-101	QTR 137
63	000136-009	000136-001	200617-103	QTR 140

[1] Corresponds to item # on parts list PL202406-101 - see Appendix B.

11. CLASS 1E QUALIFICATION OF OPTICAL ISOLATOR 201893-102

The Class 1E qualification of Optical Isolator 201893-102 is accomplished by seismic analysis and environmental analysis. Seismic qualification is based on extrapolation from previously qualified THERMO FISHER SCIENTIFIC Optical Isolator 200292-103, Power Range Amplifier 200956-101, and Audible Count Rate 200959-101. Isolator 200292-103 was qualified in QTR 137 (Ref. 11). PR Amplifier 200956-101 and Audible Count Rate 200959-101 were qualified in QTR 137 (Ref. 11) and QTR 139 (Ref. 12). The environmental qualification is based on tests conducted on Isolator 200292-101. Amplifier 200956-101, and Processor Assy, Signal PR Rackmount 200957-101. Isolator 200292-101 was qualified in QTR 026 (Ref. 18) and QTR 027 (Ref. 19). Amplifier 200959-101 and Signal Processor 200957-101 were qualified in QTR 137 (Ref. 11) and QTR 139 (Ref. 12).

11.1 SEISMIC QUALIFICATION

11.1.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the Class 1E qualification of Optical Isolator 201893-102. The 201893-102 assembly is compared with a previously qualified assembly which contains similar parts that affect the Class 1E functions of the isolator. The assembly-level sections verify the similarities between the isolators at the assembly level. The component-level sections compare each part within the 201893-102 assembly, which affects the Class 1E functions of the isolator, with a similar qualified part.

The following assembly contains parts which are used to seismically qualify similar parts within the 201893-102 isolator:

200292-103	Isolator Assy, Optical
200956-101	Amplifier Assy, Power Range
200959-101	Audible Count Rate

11.1.1.1 Material

The 201893-102 isolator is constructed from similar materials as those of the tested unit. From an assembly-level standpoint, there are no material differences which would affect the qualification of the isolator.

11.1.1.2 Size

qualification of the isolator.

11.1.1.3 Shape

The shape of the 201893-102 isolator is the same as that of the qualified unit and presents no qualification issues.

11.1.1.4 Stress

The seismic stresses endured by the test unit are presented within this section to use in qualifying

11.1.1.4.1 Seismic Stress Comparison

The Test Response Spectra (TRS), presented for the isolator on which the 201893-102 isolator seismic qualification is based, must be shown to envelope the site-specific Required Response Spectra (RRS). In addition, the dynamic response of the 200292-103 is shown to be resonant-free. No dynamic analyses are required if no resonances, other than those attributable to the test fixture, occurred during seismic testing.

11.1.1.4.2 Seismic Excitation

11.1.1.4.3 Dynamic Response

11.1.1.5 Aging

11.1.1.6 Function

On an assembly level, the 200292-103 performed similar safety functions as those of isolator

Components from 200956-101 and 200959-101 performed like function in the 201893-102 assembly.

11.1.2 Component-Level Seismic Qualification

The 201893-102 parts must be shown to be physically similar to the qualified parts. All differences which impact seismic performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed. Traceability between the 201893-102 parts and their qualified origins is given in Table 11.1. A justification of the differences is provided below:

1) <u>101122-103 PC Assembly, Backplane</u> - The seismic qualification of this backplane is based on the 100080-101 backplane which was seismically shaken as part of the 200292-103 qualification. This backplane is made of identical material and is of similar size and shape as the test unit's. It is also mounted the same. The 101122-103 uses less components than the 100080-101. The difference in the number of components between the two backplane's is negligible, therefore the backplane is seismically qualified to the test conditions of the 100080-101 assembly.

2) <u>101119-102 PC Assy, SP INTFC, O/I</u> - The seismic qualification of this PCA is based on the 100083-102 and 100086-102 PCAs which were tested as part of the 200292-103 qualification. This PCA is made of identical material, is of identical size and shape, and is also mounted the same as the 100083-102 and 100086-102 PCAs tested. The physical difference between the PCA's is that the 101119-102 PCA uses some different component values and a different circuit wiring. Changes in component location on the PCA do not affect the seismic stress on the components because the PCA is effectively a rigid structure. Changes in component location on the PCA also do not affect the seismic stress on the PCA because the weight of the components is small compared to the loading ability of the PCA. Component values and a different circuit do not have any seismic effects. There are no other differences which would impact the seismic performance of the assembly. The 101119-102 PCA is therefore seismically qualified to the test conditions of the 200292-103 assembly.

3) <u>101173-101 PC Assy, Amp INTFC, I/O</u> - The seismic qualification of this PCA is based on the 100089-103 PCA which was tested as part of the 200292-103 qualification. This PCA is made of identical material, is of identical size and shape, and is also mounted the same as the 100089-103 PCA tested. The physical difference between the PCA's is that the 101173-101 PCA uses some different component values and a different circuit wiring. No new component types or orientations were used. Changes in component location on the PCA do not affect the seismic stress on the components because the PCA is effectively a rigid structure. Changes in component location on the PCA also do not affect the seismic stress on the PCA because the weight of the components is small compared to the loading ability of the PCA. Component values and a different circuit do not have any seismic effects. There are no other differences which would impact the seismic performance of the

assembly. The 101173-101 PCA is therefore seismically qualified to the test conditions of the 200292-103 assembly.

4) 101119-101 PC Assy, SP INTFC, O/I - The seismic qualification of this PCA is based on the 100083-102 and 100086-102 PCAs which were tested as part of the 200292-103 qualification. This PCA is made of identical material, is of identical size and shape, and is also mounted the same as the 100083-102 and 100086-102 PCAs tested. The physical difference between the PCA's is that the 101119-101 PCA uses some different component values and a different circuit wiring. No new component types or orientations were used. Changes in component location on the PCA do not affect the seismic stress on the components because the PCA is effectively a rigid structure. Changes in component location on the PCA also do not affect the seismic stress on the PCA because the weight of the components is small compared to the loading ability of the PCA. Component values and a different circuit do not have any seismic effects. There are no other differences which would impact the seismic performance of the assembly. The 101119-101 PCA is therefore seismically qualified to the test conditions of the 200292-103 assembly.

8) 201064-101 Panel, MTG, Optical ISOL - The test unit panel and the 201064-101 panels are made of identical material and are identical in overall size and shape. The only

There are no differences between these panels which would impact the seismic performance of the isolator.

10) 000135-011 Terminal Block - This part is identical to the qualified part.

11) 000154-005 Enclosure, HNG CVR, NEMA 12 Steel - This part is identical to the qualified part.

18) 000309-008 Power Supply, +/- 15VDC – This component was qualified in QTR 826 (Ref. 16) for this application. The 000309-001 power supplies used in the tested unit are similar to the 000309-008 power supplies from a seismic standpoint. They weigh nearly the same and are mounted in the same place on the mounting panel. The 000309-001 power supply

reliability and quality rating are superior to the tested power supply. This difference does not affect the seismic qualification of the 000309-008. This power supply is therefore qualified for Class 1E operation in optical isolator assembly 201893-102.

25) 200186-001 Bracket, MTG, CB - This part is identical to the qualified part.

28) 000222-001 Circuit Breaker - This part is identical to the qualified part.

36) 000868-002 Switch, Rotary, Wafer - The tested switch and the 000868-002 are made of identical material and are similar in size and shape. The manufacturers are the same and they are also mounted the same. The only difference related to the seismic qualification is the 000868-001 has six decks and the 000868-002 has only one deck. This difference does not affect the seismic qualification of the part.

Table 11.1 Class 1E Seismic Qualification Traceability for Optical Isolator 201893-102

Item Number[1]	201893-102 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1				
2				
3				
4				
8				
10				
11				
18				
25				
28				
36				

[1] Corresponds to item # on parts list PL201893-102 - see Appendix B.

11.2 ENVIRONMENTAL QUALIFICATION

11.2.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the Class 1E qualification of Optical Isolator 201893-102. The 201893-102 assembly is compared with a previously qualified assembly which contains similar parts that affect the Class 1E functions of the isolator. The assembly-level sections verify the similarities between the isolators at the assembly level. The component-level sections compare each part within the 201893-102 assembly, which affects the Class 1E functions of the isolator, with a similar qualified part.

The following assembly contains parts which are used to environmentally qualify similar parts within the 201893-102 isolator:

Isolator Assy, Optical
Amplifier Assy, Power Range
Processor Assy, Sig, PR Rm

11.2.1.1 Material

The 201893-102 isolator is constructed from similar materials as those of the tested unit. From an assembly-level standpoint, there are no material differences which would affect the qualification of the isolator.

11.2.1.2 Size

Both the qualified unit and the 201893-102 isolator are housed within a NEMA 12 enclosure of identical size. Therefore there are no size differences which would impact the qualification of the isolator.

11.2.1.3 Shape

The shape of the 201893-102 isolator is the same as that of the qualified unit and presents no qualification issues.

11.2.1.4 Stress

The environmental stresses endured by the test unit are presented within this section to use in qualifying the 201893-102 isolator for site-specific environmental conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy. The environmental conditions at which the 201893-102 isolator is qualified are presented in Table 11.2.

Table 11.2 Environmental Qualification Basis for Optical Isolator 201893-102

Parameter	Assembly 200292-101[1]	Assembly 200956-101[2]	Assembly 200957-101[3]	Required Conditions
Temperature (°F)				
Pressure (psig)				
Relative Humidity (% saturation)				
Radiation Dose (RADS)				
Vibration				
Power Supply (VAC) (Hz)				

[1] See Ref. 18
[2] See Refs. 11 and 12
[3] See Refs. 11, 12 and 10

11.2.1.5 Aging

The 201893-102 isolator is shown within this report to be similar to the qualified isolator by meeting the criteria for qualification by extrapolation given in Ref. 1. In doing so, this isolator is age qualified to the extent of the isolator on which its qualification is based. An Aging Mechanisms and Effects Analysis (AMEA) was conducted for assembly 200292-101 and 200956-101. The basic components of this assembly were analyzed to determine whether the assembly has any aging mechanisms which may be significant during its design life. Thermal, radiation, wear, and vibration aging mechanisms were considered. Where the AMEA determined a significant aging mechanism, these components were aged to end of life conditions per the applicable Qualification Test Plan. There were no aging mechanisms identified which would significantly increase the probability of failure during a Design Basis Event. The 200957-101 000868-002 switch radiation dose of 10^6 RADS was from an AMEA for the THERMO FISHER SCIENTIFIC RCS Series of Neutron-Flux Monitoring Systems (Ref. 10). Section 3.3.2 of the AMEA (Ref. 10) states that other plastics found in the outside-of-containment equipment are much more tolerant of radiation than Teflon ($>10^6$), and for them, the radiation levels outside of containment are not significant.

11.2.1.6 Function

On an assembly level, the 200292-101 performed similar safety functions as those of isolator 201893-102 during the qualification testing. That is, the tested isolator provided isolation for the detector and amplifier assemblies from the signal processor, rack mount signal processors, and shutdown margin monitor. Therefore, the safety functions performed by the 201893-102 isolator have been shown to be performed during and following design basis events on a similar isolator. Components from 200956-101 and 200959-101 performed like function in the 201893-102 assembly.

11.2.2 Component-Level Environmental Qualification

The 201893-102 parts must be shown to be physically similar to the qualified parts. All differences which impact environmental performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed. Traceability between the 201893-102 parts and their qualified origins is given in Table 11.3. A justification of the differences is provided below:

1) 101122-103 PC Assembly, Backplane - These PCA's are similar in material, size, shape, function. The 101122-103 has less components and minor changes in component values. These differences will not affect the environmental qualification of the part.

Note on Items 2 - 4

The following provides functional traceability to the originally qualified PCA's:

2) 101119-102 PC Assy, SP INTFC, O/I - This PCA is made of identical material, is of identical size and shape, and is also mounted the same as the 100083-102 and 100086-102

3) 101173-101 PC Assy, Amp INTFC, I/O - This PCA is made of identical material, is of identical size and shape, and is also mounted the same as the 100089-103 PCA tested. The

4) 101119-101 PC Assy, SP INTFC, O/I - This PCA is made of identical material, is of identical size and shape, and is also mounted the same as the 100083-102 and 100086-102

8) 201064-101 Panel, MTG, Optical ISOL - The test unit panel and the 201064-101 panels are made of identical material and are identical in overall size and shape. The only

10) 000135-011 Terminal Block - This part is identical to the qualified part.

11) 000154-005 Enclosure, HNG CVR, NEMA 12 Steel - This part is identical to the qualified part.

18) 000309-008 Power Supply, +/- 15VDC – This component was qualified in QTR 826 (Ref. 16) for this application. The 000309-001 power supplies used in the tested unit are similar

28) <u>000222-001 Circuit Breaker</u> - This part is identical to the qualified part.

36) <u>000868-002 Switch, Rotary, Wafer</u> - The tested switch and the 000868-002 are made of similar material and are similar in size and shape. They are also mounted a similar manner.

Table 11.3 Class 1E Environmental Qualification Traceability for Optical Isolator 201893-102

Item Number[1]	201893-102 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1				
2				
3				
4				
8				
10				
11				
18				
28				
36				

[1] Corresponds to item # on parts list PL201893-102 - see Appendix B.

12. CLASS 1E QUALIFICATION OF SOURCE RANGE RMSP 202384-103

The Class 1E qualification of Source Range Signal Processor 202384-103 is based on extrapolation from previously qualified signal processors. Seismic qualification of this assembly is

To summarize the analyses and test results presented below, Source Range Signal Processor 202384-103 is qualified

12.1 SEISMIC QUALIFICATION

12.1.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the seismic qualification of Source Range Signal Processor 202384-103. The 202384-103 assembly is compared with previously qualified assemblies which in total contain all of the parts which are comparable to those that affect the Class 1E functions of the signal processor. The assembly-level sections verify the similarities between the signal processors at the assembly level. The component-level sections compare each part within the 202384-103 assembly, which affects the Class 1E functions of the signal processor, with a similar qualified part.

The following assemblies contain parts which are used to seismically qualify similar parts within the 202384-103 signal processor:

IR Monitor Assy
PR Monitor Assy
WR Monitor Assy
Meter Panel Assy

12.1.1.1 Material

The 202384-103 signal processor is constructed from similar materials as the tested unit. From an assembly-level standpoint, there are no material differences which would affect the qualification of this signal processor.

12.1.1.2 Size

The 202384-103 signal processor is sized to fit into a standard 19" rack like the qualified unit. The overall size is therefore the same and has no impact on the qualification of the signal processor.

12.1.1.3 Shape

The shape of the 202384-103 signal processor is the same as the qualified unit and presents no qualification issues.

12.1.1.4 Stress

The seismic stresses endured by the test unit are presented within this section for use in qualifying the 202384-103 signal processor for site-specific seismic conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy.

12.1.1.4.1 Seismic Stress Comparison

The seismic stresses endured by the test unit are presented within this section for use in qualifying the 202384-103 signal processor for site-specific Required Response Spectra (RRS). In addition, the dynamic response of each tested signal processor is presented. Qualified assembly is shown to be resonant-free. No dynamic analyses are required if no resonances, other than those attributable to the test fixture, occurred during seismic testing.

12.1.1.4.2 Seismic Excitation

One monitor assembly is used for qualifying the 202384-103 Source Range Signal Processor by similarity. Details of the seismic excitation of the signal processor are provided below:

12.1.1.4.3 Dynamic Response

A resonance search was performed on the Intermediate Range Monitor Assembly 013115-101, Power Range Monitor Assembly 013116-101, Wide Range Monitor Assembly 013117-101, and Meter Panel Assembly 013118-101 during seismic qualification tests. This was done to identify any resonances within the structure. No resonances were measured below 5 Hz. A single

. This was attributed to the rack used to mount the monitor assembly to the shake table. It is therefore justifiable to consider the monitor assembly as a rigid structure. In addition, none of the physical differences between the tested Intermediate Range Monitor Assembly 013115-101, Power Range Monitor Assembly 013116-101, Wide Range Monitor Assembly 013117-101, and Meter Panel Assembly 013118-101 and the 202384-103 assembly affect the rigidity of the Rack Mount Signal Processor

013115-101, Power Range Monitor Assembly 013116-101, Wide Range Monitor Assembly 013117-101, and Meter Panel Assembly 013118-101 with negligible dynamic response.

12.1.1.5 Aging

The 202384-103 signal processor is shown within this report to be similar to the qualified monitor assembly by meeting the criteria for qualification by extrapolation given in IEEE-323 (Ref. 2). In doing so, this signal processor is age qualified to the extent of the monitor assembly on which its qualification is based.

12.1.1.6 Function

On an assembly level, the previously qualified monitor assembly performs similar safety functions as those of the 202384-103 Source Range Signal Processor. That is, the tested monitor assembly provides reactor power indication to the Reactor Protection System and isolates Class 1E equipment from non-Class 1E equipment. Therefore, the safety functions performed by the 202384-103 Source Range Signal Processor have been shown to be performed during and following design basis events on similar signal processors.

12.1.2 Component-Level Seismic Qualification

The 202384-103 parts must be shown to be physically similar to the qualified parts. All differences which impact seismic performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed. Traceability between the 202384-103 parts and their qualified origins is given in Table 12.1. A justification of the differences is provided below:

1) <u>202389-103 Panel, Front, SR, RMSP</u> -The test unit panel and the 202389-103 front panel are made of identical material and are similar in size and shape. They are also mounted the

front panel is as rigid as the tested panel. The difference in weight supported by the panels is negligible. The 202389-103 front panel is therefore seismically qualified.

2) 201807-002 Panel, Rear, SR, RMSP - The test unit panel and the 201807-002 rear panel are made of identical material and are similar in size and shape. They are also mounted the

3) 201808-001 Plate, Base, IR/SR, RMSP - The test unit base plate and the 201808-001 base plate are made of identical material and are similar in size and shape. They are also mounted the same. The test unit base plate contains extra cutouts. The total area of material removed from the two plates is similar. The 201808-001 base plate is as rigid as the tested panel. The difference in weight supported by the plates is negligible. The 201808-001 base plate is therefore seismically qualified.

4) 200823-101 Panel, Side -This part is identical to the qualified part.

5) 200823-102 Panel, Side -This part is identical to the qualified part.

6) 200826-101 Cover, Bottom -This part is identical to the qualified part.

7) 200829-102 Card Box - The test unit card box and the 200829-102 are made of

card boxes is negligible. The 200829-102 is therefore seismically qualified.

8) 200830-002 Cover, Card Box - The test unit cover and the 200830-002 cover are made of identical material and are similar in size and shape. They are also mounted the same. The

therefore seismically qualified.

9) 200828-001 Angle, Support, Baseplate -This part is identical to the qualified part.

12) 202341-106 Meter Assy, Hybrid - The test unit meter and the 202341-106 are made of the same material and are similar in size and shape. They are also mounted the same. The cutouts on the tested unit and the 202341-106 are slightly different and the 202341-106

Changes to the board components will not affect the ability of the 101712-106 assembly to withstand similar seismic conditions. The 202341-106 is therefore seismically qualified.

13) <u>202341-103 Meter Assy. Hybrid</u> - The test unit meter and the 202341-103 are made of the same material and are similar in size and shape. They are also mounted the same. The

contains PCA 101712-103. This PCA is similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 101712-103 assembly to withstand similar seismic conditions. The 202341-103 is therefore seismically qualified.

18) <u>101033-106 PC Assy. Isolator Quad</u> - These PCA's are similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 101033-106 assembly to withstand similar seismic conditions. All components and circuits used previously existed on the 101033-103 PCA.

19) <u>100660-107 PC Assy. Bistable Trip</u> - These PCA's are similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 100660-107 assembly to withstand similar seismic conditions. All components and circuits used previously existed on the 100660-103 PCA.

20) <u>100660-108 PC Assy. Bistable Trip</u> - These PCA's are similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 100660-108 assembly to withstand similar seismic conditions. All components and circuits used previously existed on the 100660-103 PCA.

21) <u>101778-102 PC Assy. Backplane RCS-300</u> – This PCA is similar in material and shape.

22) 000549-012 Resistor, Variable, Pn Mt - This part is identical to the qualified part.

31) 200831-002 Switch, Rotary, Wafer - This part is identical to the qualified part.

33) 000868-007 Switch, Rotary, Wafer – This switch is similar to the test unit in size and

36) 000838-001 Housing, Indicator - This part is identical to the qualified part.

38) 000317-003 Relay, Socket Mt - This part is identical to the qualified part, with the

39) 000300-003 Socket, Octal - This part is identical to the qualified part.

40) 200632-101 Pulse Buffer Assy, Islr- This part is identical to the qualified part.

41) 000136-009 Filter, AC Line - This part is similar in design and construction as the qualified

43) 200079-102 Capacitor Assy - This part is identical to the qualified part.

44) 000135-009 Block, Terminal - This part is identical to the qualified part.

61) 200856-001 Clip, Retaining - This part is identical to the qualified part.

62) 200856-002 Clip, Retaining - This part is identical to the qualified part.

116) 000222-001 Circuit Breaker - This part is identical to the qualified part.

Table 12.1 Seismic Qualification Traceability for Source Range RMSP 202384-103

Item number[1]	202384-103 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1				
2				
3				
4				
5				
6				
7				
8				
9				
12				
13				
18				
19				
20				
21				
22				
31				
33				
36				
38				
39				
40				
41				
43				
44				
61				
62				
116				

[1] Corresponds to item # on parts list PL202384-103 - see Appendix B.

12.2 ENVIRONMENTAL QUALIFICATION

12.2.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the qualification of Source Range Signal Processor 202384-103. The 202384-103 assembly is compared with previously qualified assemblies which in total contain all of the parts which are comparable to those that affect the Class 1E functions of the signal processor. The assembly-level sections verify the similarities between the signal processors at the assembly level. The component-level sections compare each part within the 202384-103 assembly, which affects the Class 1E functions of the signal processor, with a similar qualified part.

The following assembly contains parts which are used to environmentally qualify similar parts within the 202384-103 signal processor:

Processor Assy, IR, RMSP
Monitor Assy, WR Rack Mount

12.2.1.1 Material

The 202384-103 signal processor is constructed from similar materials as those of the tested units. From an assembly-level standpoint, there are no material differences which would affect the qualification of this signal processor.

12.2.1.2 Size

The 202384-103 signal processor is sized
The overall size is therefore the same and has no impact on the qualification of the signal processor.

12.2.1.3 Shape

The shape of the 202384-103 signal processor is the same as those of the qualified units and presents no qualification issues.

12.2.1.4 Stress

The environmental stresses endured by the test units are presented within this section to use in qualifying the 202384-103 signal processor for site-specific environmental conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy. The environmental tests on the 201801-101 assembly are used to qualify the 202384-103 assembly. The environmental stresses on the components within the 202384-103 assembly will be less than those of the 201801-101 processor because there is less heat generated within the source range processor. The environmental conditions at which the 202384-103 signal processor is qualified are presented in Table 12.2.

Table 12.2 Environmental Qualification Basis for Source Range RMSP 202384-103

Parameter	Assembly 201801-101[1]	Assembly 201371-101[2]	Required Response
Temperature (°F)			
Pressure (psig)			
Relative Humidity (% saturation)			
Radiation Dose (RADS)			
Vibration			
Power Supply (VAC) (Hz)			

[1] See Ref. 21
[2] See Ref. 22 & 10

12.2.1.5 Aging

The 202384-103 processor is shown within this report to be similar to the qualified processor by meeting the criteria for qualification by extrapolation given in IEEE-323 (Ref. 2). In doing so, this processor is age qualified to the extent of the processor on which its qualification is based. An

12.2.1.6 Function

On an assembly level, each of the previously qualified signal processors perform similar safety functions as those of the 202384-103 Source Range Signal Processor. That is, all of the tested signal processors provide reactor power indication to the Reactor Protection System and isolate Class 1E equipment from non-Class 1E equipment. Therefore, the safety functions performed by the 202384-103 Source Range Signal Processor have been shown to be performed during and following design basis events on similar signal processors.

12.2.2 Component-Level Environmental Qualification

The 202384-103 parts must be shown to be physically similar to the qualified parts. All differences which impact environmental performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed. Traceability between the 202384-103 parts and their qualified origins is given in Table 10.3. A justification of the differences is provided below:

1) 202389-103 Panel, Front, SR, RMSP - There are no environmental issues associated with the differences in the front panel design other than in considering the heat resistance between the ambient and the chassis internals due to the panel. The difference in heat resistance is negligible, having no affect on the environmental qualification of the assembly.

2) 201807-002 Panel, Rear, SR, RMSP - There are no environmental issues associated with

3) 201808-001 Plate, Base, IR/SR, RMSP - This part is identical to the qualified part.

4) 200823-101 Panel, Side -This part is identical to the qualified part.

5) 200823-102 Panel, Side -This part is identical to the qualified part.

6) 200826-101 Cover, Bottom -This part is identical to the qualified part.

7) 200829-102 Card Box - This part is identical to the qualified part.

8) 200830-002 Cover, Card Box - This part is identical to the qualified part.

12) 202341-106 Meter Assy, Hybrid - The environmental qualification of this meter is based on the 201373-101 front panel assembly which was tested as part of the 201371-101 qualification. The 101712-106 PCA is made of identical material as the 100653-101 test

13) 202341-103 Meter Assy, Hybrid - The environmental qualification of this meter is based on the 201373-101 front panel assembly which was tested as part of the 201371-101 qualification. The 101712-106 PCA is made of identical material as the 100653-101 test unit. The physical difference between the PCA's is that 101712-103 supports only one display and the 100653-101 supports four. All components on the 101712-103 PCA are identical or similar to the tested unit. There are no differences which would impact the environmental performance of the assembly. The 101712-103 PCA and the 202341-103 assembly are therefore environmentally qualified to the test conditions of the 201373-101 assembly.

18) 101033-106 PC Assy, Isolator, Quad - This part is identical to the qualified part.

19) 100660-107 PC Assy, Bistable Trip - This part is identical to the qualified part.

20) 100660-108 PC Assy, Bistable Trip - This part is identical to the qualified part with There is no effect on the environmental qualification.

21) 101778-102 PC Assy, Backplane RCS-300 - This part is identical to the tested part with

22) 000549-012 Resistor, Variable, Pn Mt - This part is identical to the qualified part.

31) 200831-002 Switch, Rotary, Wafer - This part is identical to the qualified part.

33) 000868-007 Switch, Rotary, Wafer - This switch is similar to the test unit in size and construction. The only difference is the layout of the terminal numbers which poses no environmental issues. The 000868-007 switch is therefore environmentally qualified.

36) 000838-001 Housing, Indicator - This part is identical to the qualified part.

37) 002033-003 Lamp, Sub-Miniature, LED - This part is similar to the parts qualified in the

38) 000317-003 Relay, Socket Mt - This part is identical to the qualified part.

40) <u>200632-101 Pulse Buffer Assy, Islr</u> - This part is identical to the qualified part with R103 changed from 2.49 kΩ, 1%, .125 W to 7.50 kΩ, 1%, .125 W. There is no effect on the environmental qualification.

41) <u>000136-009 Filter, AC Line</u> - This part is identical to the qualified part.

43) <u>200079-102 Capacitor Assy</u> - This part is identical to the qualified part.

44) <u>000135-009 Block, Terminal</u> - This part is identical to the qualified part.

116) <u>000222-001 Circuit Breaker</u> - This part is identical to the qualified part.

Table 12.3 Environmental Qualification Traceability for Source Range RMSP 202384-103

Item number[1]	202384-103 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1				
2				
3				
4				
5				
6				
7				
8				
12				
13				
18				
19				
20				
21				
22				
31				
33				
36				
37				
38				
40				
41				
43				
44				
116				

[1] Corresponds to item # on parts list PL202384-103 - see Appendix B.

13. CLASS 1E QUALIFICATION OF INTERMEDIATE RANGE RMSP 202383-103

The Class 1E qualification of Intermediate Range Signal Processor 202383-103 is based on extrapolation from previously qualified signal processors. Seismic qualification of this assembly is predominantly based on extrapolation from previously qualified THERMO FISHER SCIENTIFIC Intermediate Range Monitor Assembly 013115-101, Power Range Monitor Assembly 013116-101, Wide Range Monitor Assembly 013117-101, and Meter Panel Assembly 013118-101. Monitor Assemblies 013115-101 thru 013117-101 and Meter Panel Assembly were qualified in QTR 760 (Ref. 20). The majority of the parts within Intermediate Range Signal Processor 202383-103 are similar to those used within the 013115-101 assembly. The environmental qualification is based on tests conducted on Intermediate Range RMSP 201801-101 and WR Monitor Assembly 201371-101. The IR RMSP 201801-101 and WR Monitor Assembly 201371-101 were qualified in QTR 709 (Ref. 21) and QTR 190 (Ref. 22), respectively.

To summarize the analyses and test results presented below, Intermediate Range Signal Processor 202383-103 is qualified for 40 years of Class 1E operation.

13.1 SEISMIC QUALIFICATION

13.1.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the seismic qualification of Intermediate Range Signal Processor 202383-103. The 202383-103 assembly is compared with a previously qualified assembly which in total contain all of the parts which are comparable to those that affect the Class 1E functions of the signal processor. The assembly-level sections verify the similarities between the signal processors at the assembly level. The component-level sections compare each part within the 202383-103 assembly, which affects the Class 1E functions of the signal processor, with a similar qualified part.

The following assemblies contain parts which are used to seismically qualify similar parts within the 202383-103 signal processor:

- <u>IR Monitor Assy</u>
- <u>PR Monitor Assy</u>
- <u>WR Monitor Assy</u>
- <u>Meter Panel Assy</u>

13.1.1.1 Material

The 202383-103 signal processor is constructed from similar materials as the tested unit. From an assembly-level standpoint, there are no material differences which would affect the qualification of this signal processor.

13.1.1.2 Size

The 202383-103 signal processor is sized

l has no impact on the qualification of the signal processor.

13.1.1.3 Shape

The shape of the 202383-103 signal processor is the same as the qualified unit and presents no qualification issues.

13.1.1.4 Stress

The seismic stresses endured by the test unit is presented within this section to use in qualifying the 202383-103 signal processor for site-specific seismic conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy.

13.1.1.4.1 Seismic Stress Comparison

The seismic stresses endured by the test unit is presented within this section to use in qualifying the 202383-103 signal processor for site-specific Required Response Spectra (RRS). In addition, the

13.1.1.4.2 Seismic Excitation

One monitor assembly is used for qualifying the 202383-103 Intermediate Range Signal Processor by similarity. Details of the seismic excitation of the signal processor are provided below:

13.1.1.4.3 Dynamic Response

13.1.1.5 Aging

The 202383-103 signal processor is shown within this report to be similar to the qualified monitor assembly by meeting the criteria for qualification by extrapolation given in IEEE-323 (Ref. 2). In doing so, this signal processor is age qualified to the extent of the monitor assembly on which its qualification is based.

13.1.1.6 Function

On an assembly level, the previously qualified monitor assembly performs similar safety functions as those of the 202383-103 Intermediate Range Signal Processor. That is, the tested monitor

13.1.2 Component-Level Seismic Qualification

The 202383-103 parts must be shown to be physically similar to the qualified parts. All differences which impact seismic performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed. Traceability between the 202383-103 parts and their qualified origins is given in Table 13.1. A justification of the differences is provided below:

1) <u>202387-103 Panel, Front, IR, RMSP</u> - The test unit panel and the 202387-103 front panel

2) 201806-002 Panel, Rear, IR, RMSP - The test unit panel and the 201806-002 rear panel are made of identical material and are similar in size and shape. They are also mounted the

3) 201808-001 Plate, Base, IR/SR, RMSP - The test unit base plate and the 201808-001 base plate are made of identical material and are similar in size and shape. They are also

4) 200823-101 Panel, Side -This part is identical to the qualified part.

5) 200823-102 Panel, Side -This part is identical to the qualified part.

6) 200826-101 Cover, Bottom -This part is identical to the qualified part.

7) 200829-102 Card Box - The test unit card box and the 200829-102 are made of identical material and are similar in size and shape. They are also mounted the same. The

8) 200830-002 Cover, Card Box - The test unit cover and the 200830-002 cover are made of identical material and are similar in size and shape. They are also mounted the same. The test unit cover contains extra flanges. The 200830-002 cover is as rigid as the tested cover.

9) 200828-001 Angle, Support, Baseplate -This part is identical to the qualified part.

12) 202341-105 Meter Assy, Hybrid - The test unit meter and the 202341-105 are made of the same material and are similar in size and shape. They are also mounted the same. The cutouts on the tested unit and the 202341-105 are slightly different and the 202341-105 contains slightly more material than the tested unit. The 202341-105 is as rigid as the tested

13) <u>101033-106 PC Assy, Isolator Quad</u> - These PCA's are similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 101033-106 assembly to withstand similar seismic conditions. All components and circuits used previously existed on the 101033-103 PCA.

14) <u>101819-101 PC Assy, Test Control, WR</u> - These PCA's are similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 101819-101 assembly to withstand similar seismic conditions.

15) <u>100953-115 PC Assy, Log Ct & Rate</u> - These PCA's are similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 100953-115 assembly to withstand similar seismic conditions.

16) <u>100950-106 PC Assy, Log Ampl & Rate</u> - These PCA's are similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 100950-106 assembly to withstand similar seismic conditions.

17) <u>100953-111 PC Assy, Log Ct & Rate</u> - These PCA's are similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 100953-111 assembly to withstand similar seismic conditions.

18) <u>100660-110 PC Assy, Bistable Trip</u> - These PCA's are similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 100660-110 assembly to withstand similar seismic conditions. All components and circuits used previously existed on the 100660-103 PCA.

19) <u>100660-115 PC Assy, Bistable Trip</u> - These PCA's are similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 100660-115 assembly to withstand similar seismic conditions. All components and circuits used previously existed on the 100660-103 PCA.

20) <u>100660-107 PC Assy, Bistable Trip</u> - These PCA's are similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 100660-107 assembly to withstand similar seismic conditions. All components and circuits used previously existed on the 100660-103 PCA.

21) <u>101778-101 PC Assy, Backplane RCS-300</u> – This PCA is similar in material and shape.

cage. The 101778-101 PCA extends under the base plate (201808-001, item 3) whereas the tested PCA has no other structural components other than the card cage in its vicinity.

There is one potential seismic issue due to the mechanical differences between the two PCA's and that is adequate clearance between the 101778-101 PCA and the base plate

22) 000549-012 Resistor, Variable, Pn Mt - This part is identical to the qualified part.

23) 202341-103 Meter Assy, Hybrid - The test unit meter and the 202341-103 are made of the same material and are similar in size and shape. They are also mounted the same. The

31) 200831-002 Switch, Rotary, Wafer - This part is identical to the qualified part.

32) 000868-008 Switch, Rotary, Wafer - This part is similar in design and construction to the

33) 000868-007 Switch, Rotary, Wafer - This switch is similar to the test unit in size and construction.

36) 000838-001 Housing, Indicator - This part is identical to the qualified part.

38) 000317-003 Relay, Socket Mt - This part is identical to the qualified part, with the exception that the 00317-003 relay has a dust cover installed. This addition of a dust cover

39) 000300-003 Socket, Octal - This part is identical to the qualified part.

40) 000309-008 Power Supply, ±15VDC - This component was qualified in QTR 826 (Ref. 16) for this application. The 000309-007 power supplies used in the tested unit are similar

41) 000136-009 Filter, AC Line - This part is similar in design and construction as the qualified

43) 200079-102 Capacitor Assy - This part is identical to the qualified part.

44) 000135-009 Block, Terminal - This part is identical to the qualified part.

62) 200856-002 Clip, Retaining - This part is identical to the qualified part.

116) 000222-001 Circuit Breaker - This part is identical to the qualified part.

Table 13.1 Seismic Qualification Traceability for Intermediate Range RMSP 202383-103

Item number[1]	202383-103 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1				
2				
3				
4				
5				
6				
7				
8				
9				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
31				
32				
33				
36				
38				
39				
40				
41				
43				
44				
62				
116				

[1] Corresponds to item # on parts list PL202383-103 - see Appendix B.

13.2 ENVIRONMENTAL QUALIFICATION

13.2.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the qualification of Intermediate Range Signal Processor 202383-103. The 202383-103 assembly is compared with previously qualified assemblies which in total contain all of the parts which are comparable to those that affect the Class 1E functions of the signal processor. The assembly-level sections verify the similarities between the signal processors at the assembly level. The component-level sections compare each part within the 202383-103 assembly, which affects the Class 1E functions of the signal processor, with a similar qualified part.

The following assembly contains parts which are used to environmentally qualify similar parts within the 202383-103 signal processor:

201801-101 Processor Assy, IR, RMSP
201371-101 Monitor Assy, WR Rack Mount

13.2.1.1 Material

The 202383-103 signal processor is constructed from similar materials as those of the tested units. From an assembly-level standpoint, there are no material differences which would affect the qualification of this signal processor.

13.2.1.2 Size

The 202383-103 signal processor is sized
The overall size is therefore the same and has no impact on the qualification of the signal processor.

13.2.1.3 Shape

The shape of the 202383-103 signal processor is the same as those of the qualified units and presents no qualification issues.

13.2.1.4 Stress

The environmental stresses endured by the test units are presented within this section to use in qualifying the 202383-103 signal processor for site-specific environmental conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy. The environmental tests on the 201801-101 assembly are used to qualify the 202383-103 assembly. The environmental conditions at which the 202383-103 signal processor is qualified are presented in Table 13.2.

Table 13.2 Environmental Qualification Basis for Intermediate Range RMSP 202383-103

Parameter	Assembly 201801-101[1]	Assembly 201371-101[2]	Required Response
Temperature (°F)			
Pressure (psig)			
Relative Humidity (% saturation)			
Radiation Dose (RADS)			
Vibration			
Power Supply (VAC) (Hz)			

[1] See Ref. 21
[2] See Ref. 22 & 10

13.2.1.5 Aging

The 202383-103 processor is shown within this report to be similar to the qualified processor by meeting the criteria for qualification by extrapolation given in IEEE-323 (Ref. 2). In doing so, this processor is age qualified to the extent of the processor on which its qualification is based. An

13.2.1.6 Function

On an assembly level, each of the previously qualified signal processors perform similar safety functions as those of the 202383-103 Intermediate Range Signal Processor. That is, all of the tested signal processors provide reactor power indication to the Reactor Protection System and isolate Class 1E equipment from non-Class 1E equipment. Therefore, the safety functions performed by the 202383-103 Intermediate Range Signal Processor have been shown to be performed during and following design basis events on similar signal processors.

13.2.2 Component-Level Environmental Qualification

The 202383-103 parts must be shown to be physically similar to the qualified parts. All differences which impact environmental performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed. Traceability between the 202383-103 parts and their qualified origins is given in Table 13.3. A justification of the differences is provided below:

1) 202387-103 Panel, Front, IR, RMSP - There are no environmental issues associated with

2) 201806-002 Panel, Rear, IR, RMSP - There are no environmental issues associated with

3) 201808-001 Plate, Base, IR/SR, RMSP - This part is identical to the qualified part.

4) 200823-101 Panel, Side -This part is identical to the qualified part.

5) 200823-102 Panel, Side -This part is identical to the qualified part.

6) 200826-101 Cover, Bottom -This part is identical to the qualified part.

7) 200829-102 Card Box - This part is identical to the qualified part.

8) 200830-002 Cover, Card Box - This part is identical to the qualified part.

12) 202341-105 Meter Assy, Hybrid - The environmental qualification of this meter is based on the 201373-101 front panel assembly which was tested as part of the 201371-101 qualification.

13) 101033-106 PC Assy, Isolator, Quad - This part is identical to the qualified part.

14) 101819-101 PC Assy, Test Control, WR - These PCA's are similar in material, size, shape, and function.

15) 100953-115 PC Assy, Log Ct & Rate - These PCA's are similar in material, size, shape, and function. This circuit has been environmentally qualified on similar boards. Therefore the 100953-115 PCA is environmentally qualified.

16) 100950-106 PC Assy, Log Ampl & Rate - These PCA's are similar in material, size, shape, and function. This circuit has been environmentally qualified on similar boards. Therefore the 100950-106 PCA is environmentally qualified.

17) 100953-111 PC Assy, Log Ct & Rate - These PCA's are similar in material, size, shape, and function. This circuit has been environmentally qualified on similar boards. Therefore the 100953-111 PCA is environmentally qualified.

18) 100660-110 PC Assy, Bistable Trip - This part is identical to the qualified part.

19) 100660-115 PC Assy, Bistable Trip - These PCA's are similar in material, size, shape, and function. Changes to the board components will not affect the ability of the 100660-115 assembly to withstand similar environmental conditions. All components and circuits used previously existed on the 100660-107 PCA.

20) 100660-107 PC Assy, Bistable Trip - This part is identical to the qualified part originally

21) 101778-101 PC Assy, Backplane RCS-300 - This part is identical to the tested part except

22) 000549-012 Resistor, Variable, Pn Mt - This part is identical to the qualified part.

23) 202341-103 Meter Assy. Hybrid - The environmental qualification of this meter is based on the 201373-101 front panel assembly which was tested as part of the 201371-101

31) 200831-002 Switch, Rotary, Wafer - This part is identical to the qualified part.

32) 000868-008 Switch, Rotary, Wafer - This switch is similar to the test unit in size and construction. no environmental issues. The 000868-008 switch is therefore environmentally qualified.

33) 000868-007 Switch, Rotary, Wafer - This switch is similar to the test unit in size and construction. no environmental issues. The 000868-007 switch is therefore environmentally qualified.

36) 000838-001 Housing, Indicator - This part is identical to the qualified part.

37) 002033-003 Lamp, Sub-Miniature, LED - This part is similar to the part qualified in the 201801-101 assembly. . This difference does not affect the environmental qualification of the part.

38) 000317-003 Relay, Socket Mt - This part is identical to the qualified part.

40) 000309-008 Power Supply, +/- 15VDC – This component was qualified in QTR 826 (Ref. 16) for this application. The 000309-001 power supplies used in the tested unit are similar to the 000309-008 power supplies from an environmental standpoint. The 000309-001

41) 000136-009 Filter, AC Line - This part is identical to the qualified part.

43) 200079-102 Capacitor Assy - This part is identical to the qualified part.

44) 000135-009 Block, Terminal - This part is identical to the qualified part.

116) 000222-001 Circuit Breaker - This part is identical to the qualified part.

Table 13.3 Environmental Qualification Traceability for Intermediate Range RMSP 202383-103

Item Number[1]	202383-103 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1				
2				
3				
4				
5				
6				
7				
8				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
31				
32				
33				
36				
37				
38				
40				
41				
43				
44				
116				

[1] Corresponds to item # on parts list PL202383-103 - see Appendix B.

14. CLASS 1E QUALIFICATION OF SHUTDOWN MARGIN MONITOR 202646-101

The Class 1E qualification of Shutdown Margin Monitor 202646-101 is accomplished by

14.1 SEISMIC QUALIFICATION

14.1.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the seismic qualification of Shutdown

The following assembly contains parts which are used to seismically qualify similar parts within the 202646-101 Shutdown Margin Monitor:

<u>013120-101</u> <u>Shutdown Margin Monitor Assy</u>

14.1.1.1 Material

The 202646-101 shutdown margin monitor is constructed from similar materials as the tested unit. From an assembly-level standpoint, there are no material differences which would affect the qualification of this shutdown margin monitor.

14.1.1.2 Size

The 202646-101 shutdown margin monitor is sized
unit. The overall size is therefore the same and has no impact on the qualification of the shutdown margin monitor.

14.1.1.3 Shape

The shape of the 202646-101 shutdown margin monitor is the similar to the qualified unit and

14.1.1.4 Stress

The seismic stresses endured by the test unit are presented within this section to use in qualifying the 202646-101 shutdown margin monitor for site-specific seismic conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy.

14.1.1.4.1 Seismic Stress Comparison

The seismic stresses endured by the test unit are presented within this section to use in qualifying the 202646-101 shutdown margin monitor for site-specific Required Response Spectra (RRS). In addition, the dynamic response of each tested signal processor is presented. Qualified assembly is

14.1.1.4.2 Seismic Excitation

Details of the seismic excitation of the shutdown margin monitor are provided below:

Shutdown Margin Monitor Assembly 013120-101 was mounted in a test fixture with other equipment to be qualified, as reported in QTR 760 (Ref. 20). The accelerometers were located on

14.1.1.4.3 Dynamic Response

A resonance search was performed on the Shutdown Margin Monitor Assembly 013120-101 addition, none of the physical differences between the tested 013120-101 monitor assembly and the current 202646-101 assembly affect the rigidity of the shutdown margin monitor assembly. Therefore, if presented with the same excitation, the 202646-101 Shutdown Margin Monitor will respond similarly to the 013120-101 Shutdown Margin Monitor, with negligible dynamic response.

14.1.1.5 Aging

The 202646-101 Shutdown Margin Monitor is shown within this report to be similar to the qualified monitor assembly by meeting the criteria for qualification by extrapolation given in IEEE-323 (Ref. 2). In doing so, this shutdown margin monitor is age qualified to the extent of the monitor assembly on which its qualification is based.

14.1.1.6 Function

On an assembly level, the tested Shutdown Margin Monitor 013120-101 performed identical safety functions as those of the current Shutdown Margin Monitor 202646-101 during the qualification testing.

14.1.2 Component-Level Seismic Qualification

The 202646-101 parts must be shown to be physically similar to the qualified parts. All differences which impact seismic performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed. Traceability between the 202646-101 parts and their qualified origins is given in Table 14.1. A justification of the differences is provided below:

1) <u>100042-105 PC Assy, Main, Shutdown, Mon</u> - The seismic qualification of this PCA is based on the 100042-101 PCA which was tested as part of the 013120-101 qualification. This PCA is made of identical material, is of identical size and shape, and is also mounted the same as the 100042-101 PCA tested. The physical difference between the PCA's is that

   100042-105 PCA is therefore seismically qualified to the test conditions of the 013120-101 assembly.

4) <u>202695-001 Rear Panel, Shutdown Monitor</u> - This part is similar to the qualified part. It is made of identical material.

The 202695-001 Rear Panel is therefore seismically qualified.

5) 200176-001 Cover Safety - This part is identical to the qualified part.

6) 202696-101 Cover, Shutdown Monitor - This part is similar to the qualified part. It is made

8) 202694-101 Chassis, Shutdown Monitor - This part is similar to the qualified part. It is

9) 202672-001 Mounting Panel, SDMM - This part is similar to the qualified part. It is made

10) 000236-001 Holder Fuse - This part is identical to the qualified part.

11) 000174-011 Fuse, 3AG, Normal Blow - This part is identical to the qualified part.

12) 000135-143 Terminal Block - This part is similar to the qualified part. It is made of the

13) 000135-005 Terminal Block - This part is identical to the qualified part.

14) 000262-001 Connector, Coax Isolated Ground - This part is identical to the qualified part.

15) 000119-008 Connector, Card Edge - This part is identical to the qualified part.

16) 000246-009 Power Supply, IC Regulated - This part is similar to the qualified part.

It is made of similar material and similar construction and meets the same electrical

55) 100045-102 PC Assy. Shtdn Mon - The seismic qualification of this PCA is based on the 100045-101 PCA which was tested as part of the 013120-101 qualification. This PCA is

56) 200181-101 Cable Assy. FR Pnl I/F SDM - This part is identical to the qualified part.

58) 000169-005 LED Mtg Hardware - This part is identical to the qualified part.

Table 14.1 Seismic Qualification Traceability for Shutdown Margin Monitor 202646-101

Item Number[1]	202646-101 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1				
4				
5				
6				
8				
9				
10				
11				
12				
13				
14				
15				
16				
55				
56				
58				

[1] Corresponds to item # on parts list PL202646-101 - see Appendix B.

14.2 ENVIRONMENTAL QUALIFICATION

14.2.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the qualification of Shutdown Margin Monitor 202646-101. The 202646-101 assembly is compared with previously qualified assemblies which in total contain all of the parts which are comparable to those that affect the Class 1E functions of the shutdown monitor. The assembly-level sections verify the similarities between the shutdown monitors at the assembly level. The component-level sections compare each part within the 202646-101 assembly, which affects the Class 1E functions of the shutdown monitor, with a similar qualified part.

The following assembly contains parts which are used to environmentally qualify similar parts within the 202646-101 shutdown monitor:

200171-101 Shutdown Monitor Assy

14.2.1.1 Material

The 202646-101 shutdown monitor is constructed from similar materials as those of the tested units. From an assembly-level standpoint, there are no material differences which would affect the qualification of this shutdown monitor.

14.2.1.2 Size

The 202646-101 shutdown monitor is sized
The overall size is similar to the tested unit and therefore has no impact on the qualification of the shutdown monitor.

14.2.1.3 Shape

The shape of the 202646-101 shutdown monitor is similar to the qualified unit and presents no qualification issues.

14.2.1.4 Stress

The environmental stresses endured by the test units are presented within this section to use in qualifying the 202646-101 shutdown monitor for site-specific environmental conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy. The environmental tests on the 200171-101 assembly are used to qualify the 202646-101 assembly. The environmental conditions at which the 202646-101 shutdown monitor is qualified are presented in Table 14.2.

Table 14.2 Environmental Qualification Basis for Shutdown Margin Monitor 202646-101

Parameter	Assembly 200171-101[1]	Required Response
Temperature (°F)		
Pressure (psig)		
Relative Humidity (% saturation)		
Radiation Dose (RADS)		
Vibration		
Power Supply (VAC) (Hz)		

[1] See Ref. 5

14.2.1.5 Aging

The 202646-101 monitor is shown within this report to be similar to the qualified monitor by meeting the criteria for qualification by extrapolation given in IEEE-323 (Ref. 2). In doing so, this monitor is age qualified to the extent of the monitor on which its qualification is based.

14.2.1.6 Function

On an assembly level, the 200171-101 performed similar safety functions as those of shutdown monitor 202646-101 during the qualification testing. That is, the tested monitor provided a count rate from the neutron flux at the reactor core for an indication of shutdown margin. Therefore, the safety functions performed by the 202646-101 Shutdown Margin Monitor have been shown to be performed during and following design basis events on a similar monitor.

14.2.2 Component-Level Environmental Qualification

The 202646-101 parts must be shown to be physically similar to the qualified parts. All differences which impact environmental performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed. Traceability between the 202646-101 parts and their qualified origins is given in Table 14.3. A justification of the differences is provided below:

1) 100042-105 PC Assy, Main, Shutdown, Mon - These PCA's are similar in material, size, shape, and function.

4) 202695-001 Rear Panel, Shutdown Monitor - This part is similar to the qualified part but is about 1.00" wider to accommodate housing the new power supply. This difference has no effect on environmental qualification.

5) 200176-001 Cover Safety - This part is identical to the qualified part.

6) 202696-101 Cover, Shutdown Monitor - This part is similar to the qualified part but is This difference has no effect on environmental qualification.

8) 202694-101 Chassis, Shutdown Monitor - This part is similar to the qualified part but is

9) 202672-101 Mounting Panel, SDMM - The test unit panel and the 202672-101 panel are

11) 000174-011 Fuse, 3AG, Normal Blow - This part is identical to the qualified part.

12) 000135-143 Terminal Block - This part is similar to the qualified part. It is made of the same material and is the same size. The difference is the manufacturer and the qualified

13) 000135-005 Terminal Block - This part is identical to the qualified part.

55) 100045-102 PC Assy, Shtdn Mon - These PCA's are similar in material, size, shape, and function.

places. These additions will not affect the environmental qualification.

56) 200181-101 Cable Assy. FR Pnl I/F SDM - This part is identical to the qualified part.

Table 14.3 Environmental Qualification Traceability for Shutdown Margin Monitor 202646-101

Item Number[1]	202646-101 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1				
4				
5				
6				
8				
9				
11				
12				
13				
15				
55				
56				

[1] Corresponds to item # on parts list PL202646-101 - see Appendix B.

15. CLASS 1E QUALIFICATION OF WIDE RANGE RMSP 201951-103

The Class 1E qualification of Wide Range Signal Processor 201951-103 is based on extrapolation from previously qualified signal processors. Seismic qualification of this assembly is predominantly based on extrapolation from previously qualified THERMO FISHER SCIENTIFIC Wide Range Monitor Assembly 200172-101, Wide Range Monitor Assembly 013117-101, and Intermediate Range RMSP 201801-101. Monitor Assembly 200172-101 was qualified in QTR 010 (Ref. 5). Monitor Assembly 013117-101 was qualified in QTR 760 (Ref. 20). IR RMSP assembly 201801-101 was qualified in QTR 709 (Ref. 21). The majority of the parts within Wide Range Signal Processor 201951-103 are similar to those used within the 200172-101 assembly. The environmental qualification is based on tests conducted on Intermediate Range RMSP 201801-101, WR Monitor Assembly 200172-101 and WR Monitor Assembly 013117-101. The IR RMSP 201801-101, WR Monitor Assembly 200172-101 and WR Monitor Assembly 012117-101 were qualified in QTR 709 (Refs. 21), QTR 010 (Ref. 5) and QTR 760 (Ref. 20) respectively.

To summarize the analyses and test results presented below, Wide Range Signal Processor 201951-103 is qualified for 40 years of Class 1E operation.

15.1 SEISMIC QUALIFICATION

15.1.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the seismic qualification of Wide Range Signal Processor 201951-103. The 201951-103 assembly is compared with previously qualified assemblies which in total contain all of the parts which are comparable to those that affect the Class 1E functions of the signal processor. The assembly-level sections verify the similarities between the signal processors at the assembly level. The component-level sections compare each part within the 201951-103 assembly, which affects the Class 1E functions of the signal processor, with a similar qualified part.

The following assemblies contain parts which are used to seismically qualify similar parts within the 201951-103 signal processor:

WR Monitor Assy
WR Monitor Assy
Processor Assy, IR, RMSP

15.1.1.1 Material

The 201951-103 signal processor is constructed from similar materials as the tested unit. From an assembly-level standpoint, there are no material differences which would affect the qualification of this signal processor.

15.1.1.2 Size

The 201951-103 signal processor is sized to fit into a standard 19" rack like the qualified unit. The overall size is therefore the same and has no impact on the qualification of the signal processor.

15.1.1.3 Shape

The shape of the 201951-103 signal processor is the same as the qualified unit and presents no qualification issues.

15.1.1.4 Stress

The seismic stresses endured by the test unit is presented within this section to use in qualifying the 201951-103 signal processor for site-specific seismic conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy.

15.1.1.4.1 Seismic Stress Comparison

The seismic stresses endured by the test unit is presented within this section to use in qualifying the 201951-103 signal processor for site-specific Required Response Spectra (RRS). In addition, the dynamic response of each tested signal processor is presented. Qualified assembly is shown to be resonant-free. No dynamic analyses are required if no resonances, other than those attributable to the test fixture, occurred during seismic testing.

15.1.1.4.2 Seismic Excitation

One monitor assembly is used for qualifying the 201951-103 Intermediate Range Signal Processor by similarity. Details of the seismic excitation of the signal processor are provided below:

15.1.1.4.3 Dynamic Response

A resonance search was performed on the Intermediate Range Monitor Assembly 013115-101, Power Range Monitor Assembly 013116-101, Wide Range Monitor Assembly 013117-101, and

15.1.1.5 Aging

The 201951-103 signal processor is shown within this report to be similar to the qualified monitor assembly by meeting the criteria for qualification by extrapolation given in IEEE-323 (Ref. 2). In doing so, this signal processor is age qualified to the extent of the monitor assembly on which its qualification is based.

15.1.1.6 Function

On an assembly level, the previously qualified monitor assembly performs similar safety functions as those of the 201951-103 Wide Range Monitor.

15.1.2 Component-Level Seismic Qualification

The 201951-103 parts must be shown to be physically similar to the qualified parts. All differences which impact seismic performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed. Traceability between the 201951-103 parts and their qualified origins is given in Table 15.1. A justification of the differences is provided below:

1) <u>100055-101</u> <u>PC Assy, Backplane, RMSP</u> - This part is identical to the qualified part.

3) <u>200182-101 Card Cage Assy, RMSP</u> - This part is identical to the qualified part.

4) <u>200187-001 Chassis, RMSP</u> - This part is identical to the qualified part.

5) 201651-001 Cover, Chassis. RMSP -This part is similar to the qualified part

10) 200202-101 Panel Assy, Rear, RMSP -This part is identical to the qualified part.

11) 201621-101 Isolator Assy, Single Channel – This part was not included in the test unit but has been qualified in QTR 256 (Ref. 23) for the same seismic conditions in a similar configuration. The 201621-101 is therefore seismically qualified.

13) 200632-102 Pulse Buffer Assy, Single Channel - This part was not included in the test unit. It is similar to the test unit qualified in QTR 760 (Ref. 20) but has component differences that have no effect on seismic qualification. The 200632-102 is therefore seismically qualified.

14) 000246-002 Power Supply, +15 VDC -This part is identical to the qualified part.

16) 000136-001 Filter, AC Line - This part is identical to the qualified part.

17) 000135-009 Terminal Block - This part is identical to the qualified part.

20) 100150-101 PC Assy, Isolator Socket - This part is identical to the qualified part.

21) 000222-001 Circuit Breaker - This part is identical to the qualified part.

22) 000135-143 Terminal Block - This part is similar to the qualified part. It is made of the same material and is the same size. The difference is the manufacturer and the qualified

31) 000301-001 Clip, Retaining, Plug-In Module – This part is identical to the qualified part.

42) 201950-102 Panel Assy, Front, RMSP – This Front Panel Assy is similar to the qualified part. Like the qualified part it has several sub-components all of which are similar to the

The 100892-101 PC Assy is similar to the LCD Display PCA from the 013007-101 Wide

79) 200079-001 Capacitor Assy – This part is similar to the tested part. The only difference is the size of the ring terminal which has no effect on seismic qualification. The 200079-001 is therefore seismically qualified.

82) 100895-101 PC Assy, Bistable Trip – This PCA is similar in material, size, shape

86) 100019-102 PC Assy, Log Count & Rate – This PCA is identical to the qualified unit except for component changes which have no effect on seismic qualification. The 100019-102 PCA is therefore seismically qualified.

87) 100019-001 PC Assy, Log Count & Rate – This PCA is identical to the qualified PCA.

88) 100623-101 PC Assy, Log Ampl & Rate – This PCA is identical to the qualified PCA.

90) 100025-116 PC Assy, Test Generator – This PCA is similar in material, size, shape and function to the qualified PCA.

93) 200207-101 Cable Assy, Front Panel, RMSP – This part is identical to the qualified part.

Table 15.1 Seismic Qualification Traceability for Wide Range Monitor Assy 201951-103

Item number[1]	201951-103 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1				
3				
4				
5				
10				
11				
13				
14				
16				
17				
20				
21				
22				
31				
42				
79				
82				
86				
87				
88				
90				
93				

[1] Corresponds to item # on parts list PL201953-103 - see Appendix B.

15.2 ENVIRONMENTAL QUALIFICATION

15.2.1 Assembly-Level Qualification

The following presents the assembly-level issues related to the qualification of Wide Range Monitor Assembly 201951-103. The 201951-103 assembly is compared with previously qualified assemblies which in total contain all of the parts which are comparable to those that affect the Class 1E functions of the signal processor. The assembly-level sections verify the similarities between the signal processors at the assembly level. The component-level sections compare each part within the 201951-103 assembly, which affects the Class 1E functions of the signal processor, with a similar qualified part.

The following assembly contains parts which are used to environmentally qualify similar parts within the 202383-103 signal processor:

<u>WR Monitor Assy</u>
<u>WR Monitor Assy</u>
<u>Processor Assy, IR, RMSP</u>

15.2.1.1 Material

The 201951-103 signal processor is constructed from similar materials as those of the tested units. From an assembly-level standpoint, there are no material differences which would affect the qualification of this signal processor.

15.2.1.2 Size

The 201951-103 signal processor is sized to fit into a standard 19" rack as are the qualified units. The overall size is therefore the same and has no impact on the qualification of the signal processor.

15.2.1.3 Shape

The shape of the 201951-103 signal processor is the same as those of the qualified units and presents no qualification issues.

15.2.1.4 Stress

The environmental stresses endured by the test units are presented within this section to use in qualifying the 201951-103 signal processor for site-specific environmental conditions. The test conditions must envelope the required conditions unless further analysis is provided which justifies the discrepancy. The environmental tests on the 200172-101 assembly are used to qualify the 201951-103 assembly. The environmental conditions at which the 201951-103 signal processor is qualified are presented in Table 15.2.

Table 15.2 Environmental Qualification Basis for Wide Range Monitor Assy 201951-103

Parameter	Assembly 200172[1]	Assembly 201801-101[2]	Assembly 201371-101[3]	Required Response
Temperature (°F)				
Pressure (psig)				
Relative Humidity (% saturation)				
Radiation Dose (RADS)				
Vibration				
Power Supply (VAC) (Hz)				

[1] See Ref. 5 & 6
[2] See Ref. 21
[3] See Ref. 22

15.2.1.5 Aging

The 201951-103 is shown within this report to be similar to the qualified processor by meeting the criteria for qualification by extrapolation given in IEEE-323 (Ref. 2). In doing so, this processor is age qualified to the extent of the processor on which its qualification is based.

15.2.1.6 Function

On an assembly level, the previously qualified monitor assembly performs similar safety functions as those of the 201951-103 Wide Range Monitor. That is, the tested monitor assembly provides reactor power indication in a remote location in order to satisfy 10CFR50 Appendix R and isolates Class 1E equipment from non-Class 1E equipment. Therefore, the safety functions performed by the 201951-103 Wide Range Monitor have been shown to be performed during and following design basis events on similar signal processors.

15.2.2 Component-Level Environmental Qualification

The 201951-103 parts must be shown to be physically similar to the qualified parts. All differences which impact environmental performance are reviewed within this section. Each difference is evaluated by the material, size, shape, stress, aging, and function criteria given in IEEE-323 (Ref. 2). Only those parts which potentially impact Class 1E qualification are reviewed. Traceability between the 201951-103 parts and their qualified origins is given in Table 15.3. A justification of the differences is provided below:

1) <u>100055-101 PC Assy, Backplane, RMSP</u> - This part is identical to the qualified part.

3) <u>200182-101 Card Cage Assy, RMSP</u> - This part is identical to the qualified part.

4) <u>200187-001 Chassis, RMSP</u> - This part is identical to the qualified part.

5) <u>201651-001 Cover, Chassis, RMSP</u> -This part is similar to the qualified part.

10) <u>200202-101 Panel Assy, Rear, RMSP</u> -This part is identical to the qualified part.

11) <u>201621-101 Isolator Assy, Single Channel</u> – This part was not included in the test unit but has been qualified in QTR 256 (Ref. 23) for the same environmental conditions in a similar configuration. The 201621-101 is therefore environmentally qualified.

13) <u>200632-102 Pulse Buffer Assy, Single Channel</u> – This part is identical to the qualified part.

14) <u>000246-002 Power Supply, +15 VDC</u> -This part is identical to the qualified part.

16) <u>000136-001 Filter, AC Line</u> - This part is identical to the qualified part.

17) <u>000135-009 Terminal Block</u> - This part is identical to the qualified part.

20) <u>100150-101 PC Assy, Isolator Socket</u> - This part is identical to the qualified part.

21) <u>000222-001 Circuit Breaker</u> - This part is identical to the qualified part.

22) <u>000135-143 Terminal Block</u> - This part is similar to the qualified part. It is made of the same material and is the same size. The difference is the manufacturer and the qualified

31) <u>000301-001 Clip. Retaining. Plug-In Module</u> – This part is identical to the qualified part.

42) <u>201950-102 Panel Assy. Front. RMSP</u> – This Front Panel Assy is similar to the qualified part. Like the qualified part it has several sub-components all of which are similar to the

The 100892-101 PC Assy is similar to the LCD Display PCA from the 013007-101 Wide Range Monitor Assy that was qualified in QTR 760 (Ref 20).

79) <u>200079-001 Capacitor Assy</u> – This part is similar to the tested part.

82) <u>100895-101 PC Assy. Bistable Trip</u> – This PCA is similar in material, size, shape and function as the qualified PCA.

86) <u>100019-102 PC Assy. Log Count & Rate</u> – This PCA is identical to the qualified unit except for component changes which have no effect on envrionmental qualification. The 100019-102 PCA is therefore environmentally qualified.

87) <u>100019-001 PC Assy. Log Count & Rate</u> – This PCA is identical to the qualified PCA.

88) <u>100623-101 PC Assy. Log Ampl & Rate</u> – This PCA is identical to the qualified PCA.

90) 100025-116 PC Assy, Test Generator – This PCA is similar in material, size, shape and function to the qualified PCA.

93) 200207-101 Cable Assy, Front Panel, RMSP – This part is identical to the qualified part.

Table 15.3 Environmental Qualification Traceability for Wide Range Monitor Assy 201951-103

Item number[1]	201951-103 Part Number	Qualified Part Number	Qualified Assembly	Qualification Report Reference
1				
3				
4				
5				
10				
11				
13				
14				
16				
17				
20				
21				
22				
31				
42				
79				
82				
86				
87				
88				
90				
93	[illegible]		[illegible]	[illegible]

[1] Corresponds to item # on parts list PL201951-103 - see Appendix B.

16. REFERENCES

1) Design Specification No. 6417, Rev. 1, Tennessee Valley Authority, 11/89.

2) IEEE-323-1983, "Qualifying Class 1E Equipment for Nuclear Power Generating Stations." See attachment for compliance to multiple revisions.

3) IEEE-344-1975, "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations."
See attachment for compliance to multiple revisions.

4) THERMO FISHER SCIENTIFIC Report QTR 169, "GAMMA-METRICS RCS Series Detector Assemblies 201174 and 200688 Seismic Test Report," Revision 0, 2/91.

5) THERMO FISHER SCIENTIFIC Report QTR 010, "GAMMA-METRICS RCS Series Neutron Flux Monitoring System Qualification Test Report," Revision 1, 1/84.

6) THERMO FISHER SCIENTIFIC Report QTR 012, "Seismic and MSLB/LOCA Test Report for the RCS Series Neutron Flux Monitoring System" Revision 0, 4/83.

7) THERMO FISHER SCIENTIFIC Report QTR 040, "Test Report for Class 1E Qualification of Mineral Insulated Cable in the Detector Cable Assembly, Addendum to GAMMA-METRICS RCS Series Qualification Test Report No. 010," Revision 3, 11/85.

8) THERMO FISHER SCIENTIFIC Report QTR 104, "Qualification Test Report for Silicone Rubber O-Ring Seal in GAMMA-METRICS Junction Box," Revision 2, 1989.

9) THERMO FISHER SCIENTIFIC Report QTR 230, "Qualification Report for GAMMA-METRICS In-Containment Cables and Connectors," Revision A, 8/94.

10) Document No. 007 "Aging Mechanisms and Effects Analysis for the GAMMA-METRICS RCS Series of Neutron-Flux Monitoring Systems," Revision 0, 8/82.

11) THERMO FISHER SCIENTIFIC Report QTR 137, "GAMMA-METRICS RCS Series Neutron Flux Monitoring System for Connecticut Yankee Per Specification SP-EE-252 Qualification Test Report," Revision 1, 6/89.

12) THERMO FISHER SCIENTIFIC Report QTR 139, "GAMMA-METRICS Neutron Flux Monitoring System for Connecticut Yankee Seismic Test Report," Revision 0, 5/89.

13) THERMO FISHER SCIENTIFIC Report QTR 140, "GAMMA-METRICS RCS Series Amplifier Assembly, Addendum to Qualification Test Report 010," Revision 0, 6/89.

14) THERMO FISHER SCIENTIFIC Report QTR 160, "Qualification Test Report for High Frequency Discriminator," Revision 0, 8/90.

15) N3-92-4003 R8, "System Description for Neutron Monitoring System." Tennessee Valley Authority, 4/06.

16) THERMO FISHER SCIENTIFIC Report QTR 826, "Low Voltage Power Supply P/N 000309-008 and -009," Revision 0, 5/05.

17) THERMO FISHER SCIENTIFIC Report 815, "High Voltage Power Supply Assembly 201401," Revision 2, 5/05.

18) THERMO FISHER SCIENTIFIC Report QTR 026, "GAMMA-METRICS RCS Series Optical Isolator, Fiber Optic Transmission System, and RCS-211 Amplifier," Revision 3, 6/88.

19) THERMO FISHER SCIENTIFIC Report QTR 027, "GAMMA-METRICS RCS Series Optical Isolator, Fiber Optic Transmission System, and RCS-211 Amplifier," Revision 0, 6/84.

20) THERMO FISHER SCIENTIFIC Report QTR 760, "GAMMA-METRICS In-Cabinet Seismic Qualification Test Report," Revision 0, 5/00.

21) THERMO FISHER SCIENTIFIC Report QTR 709, "GAMMA-METRICS Class 1E Qualification of Source and Intermediate Range Nuclear Instrument Channels for Westinghouse Power Plants," Revision 2, 3/01.

22) THERMO FISHER SCIENTIFIC Report QTR 190, "GAMMA-METRICS Neutron Flux Monitoring System for Wide Range Monitor Assembly," Revision 1, 4/93.

23) THERMO FISHER SCIENTIFIC Report QTR 256, "GAMMA-METRICS Single Channel Isolators Qualification Test Report," Revision 1, 3/96.

24) THERMO FISHER SCIENTIFIC Report QTR 834, "Qualification Test Report No. 834, Rev 0, Junction Box Assembly 202366-102, Junction Box Cover Assembly 202404-101 and -102, Junction Box Cover 201035-101," Revision 0, 4/07.

25) THERMO FISHER SCIENTIFIC Report QTR 239, "Seismic Test Report for GAMMA-METRICS RCS Series Neutron Flux Monitoring System for Zorita," Revision 0, 4/95.

26) THERMO FISHER SCIENTIFIC Report QTR 220, "Qualification Analysis Report for the High Voltage Power Supply Assembly 201400-101 and Assembly 201400-102," Revision 1, 10/02.

COMPLIANCE TO MULTIPLE REVISIONS OF IEEE STANDARDS

Reference 1) IEEE Std 323.

This report was written to be in compliance with both the 1974 and 1983 revisions of IEEE Std 323. The 1983 revision has several added documentation requirements and no deletions of any 1974 revision requirements for this application. Therefore, this report was written to include all 1983 and 1974 documentation requirements. The forward of IEEE Std 323-1983 states: Electrical equipment qualified in accordance with either IEEE Std 323-1974 or IEEE Std 323-1983 will meet the requirements of IEEE Std 627-1980 which provides the basic principles for design qualification for all safety systems equipment for use in Nuclear Power Generating Stations. The 1983 revision to IEEE Std 323-1974 was made to clarify its requirements and imposes no additional requirements for qualifying Class 1E equipment. For this application, any qualification performed under the 1983 revision would also be in compliance with the 1974 revision.

The 1983 revision made the following changes:

a) Added a reference section.
b) Changed "Principles of Qualification" to Qualification Methods".
c) Deleted "On-Going Qualification" as a valid method.
Note: THERMO FISHER SCIENTIFIC has not used this method.
d) Added Qualification Program Document Requirements.
Note: A program document was written for this qualification effort.
e) Increase qualification plan minimum requirements.
Note: Recent plans meet the newer requirements.
f) Eliminated monitoring categories.
Note: The monitoring requirements for the 1974 revision were met for all tests.
g) Expanded section on aging.
h) Added section on extension of qualified life.
Note: THERMO FISHER SCIENTIFIC does not use these methods.
i) Increased documentation requirements.
Note: This report meets both revision requirements.

Based on the statement above and a comparison of both revisions, it can be concluded that equipment qualification principals and methods used by THERMO FISHER SCIENTIFIC meet the qualification requirements of both the 1983 revision and the 1974 revision.

Reference 2) IEEE Std 344.

This report was written to be in compliance with both the 1975 and 1987 revisions of IEEE Std 344. The 1987 revision has several added documentation requirements and no deletions of any 1975 revision requirements for this application. Therefore, this report was written to include all 1987 and 1975 documentation requirements. The forward of IEEE Std 344-1987 states: This revision of ANSI/IEEE Std 344-1975 was developed to expand and amplify guidance for developing programs to seismically qualify Class 1E equipment for Nuclear Power Generating Stations. For this application, any qualification performed under the 1987 revision would also be in compliance with the 1975 revision.

The 1987 revision made the following changes:

a) Added a reference section.
b) Moved the section on Damping.
c) Expanded the Testing Introduction section.
d) Expanded the Analysis section.
e) Added section on Experience.
Note: THERMO FISHER SCIENTIFIC does not use these methods.
f) Increased documentation requirements.
Note: This report meets both revision requirements.
e) Added Appendixes A through E.

Based on the statement above and a comparison of both revisions, it can be concluded that equipment qualification principals and methods used by THERMO FISHER SCIENTIFIC meet the qualification requirements of both the 1987 revision and the 1975 revision.

APPENDIX A

QUALIFICATION PROGRAM PLAN NO. 872

APPENDIX B

ASSEMBLY DRAWINGS AND PARTS LISTS

APPENDIX C

SEISMIC TEST RESPONSE SPECTRA

EDCR 55385 Excerpts Including Scope, Intent, Unit Difference And Technical Evaluation

BECHTEL

EDCR COVER SHEET

GENERAL INFORMATION		Page No.	1
EDCR TYPE (Check One Box Only)	☒ EDCR # 55385	Rev.	A
	☐ EDCR-2 #	Rev.	

☐ Check here if this is a Streamlined EDCR.

☐ Check here if this EDCR is for Documentation change only & No construction work is required.

☒ SR ☐ QR Check appropriate box if field material procurement quality requirements included.

System	Building	Elevation	Quality Class	Lead Discipline	Code/Class
068	RB/AB	various	SR	I&C	ASME CL 2

WORK SCOPE STATEMENT:

EDCR 55385 installs and inspects the instrumentation and local panels 2-L-388 & 2-L-340 for the Unit 2 RVLIS.

PREPARED:			VERIFIED:	
Joe Temples	x8188	12/15/10	DALE MATHER	12-15-10
Design Engineer	Phone	Date	Engineer	Date

APPROVALS:		INTER DISCIPLINE REVIEWS:	
A. R. LONE	12/16/10	(D. BOSE)	12-16-10
Civil EGS	Date	Civil Engineer	Date
	12-15-10	~~DALE M~~ 12-15-10	N/A
I&C EGS	Date	I&C Engineer	Date
N/A		N/A	
Electrical EGS	Date	Electrical Engineer	Date
N/A		N/A	
Mechanical EGS	Date	Mechanical Engineer	Date
N/A		N/A	
Plant Design EGS	Date	Plant Design Engineer	Date
Roger E. Smith	12/16/10		
Project Engineering Manager	Date	DELETED	Date

ACCEPTANCE:		OTHER ORGANIZATIONS:	
See Page 1A		MICHAEL OVERSTREET	12/16/10
Responsible Superintendent (If Constructability Walkdown is waived, this is N/A)	Date	PQAM REVIEW FOR MATERIAL ONLY Signature/Org'n.:	Date
See Page 1A		N/A	
Field Engineer (If Constructability Walkdown is waived, this is N/A)	Date	Signature/Org'n.:	Date
STEVEN A HILMES	12/17/10	N/A	
TVA Engineering Manager	Date	Signature/Org'n.:	Date

Refer to the electronic documents in TVA Business Support Library (BSL) for current revision.

25402-3DP-G04G-00081 Effective 5/19/10

LEGIBILITY EVALUATED AND ACCEPTED FOR ISSUE
Initials: [signature] Date: 12/17/10
for ALL pages Rev A

EDCR COVER SHEET

GENERAL INFORMATION			Page No.	1A
EDCR TYPE	☒ EDCR #	55385	Rev.	A
(Check One Box Only)	☐ EDCR-2 #		Rev.	

☐ Check here if this is a Streamlined EDCR.

☐ Check here if this EDCR is for Documentation change only & No construction work is required.

☒ SR ☐ QR Check appropriate box if field material procurement quality requirements included:

System	Building	Elevation	Quality Class	Lead Discipline	Code/Class
068	RB/AB	various	SR	I&C	ASME CL 2

WORK SCOPE STATEMENT:

EDCR 55385 installs and inspects the instrumentation and local panels 2-L-388 & 2-L-340 for the Unit 2 RVLIS.

PREPARED:

Joe Temples x8188

Design Engineer Phone Date

VERIFIED:

Engineer Date

APPROVALS:

Civil EGS Date

I&C EGS Date

Electrical EGS Date

Mechanical EGS Date

Plant Design EGS Date

Project Engineering Manager Date

INTER DISCIPLINE REVIEWS:

Civil Engineer Date

I&C Engineer Date

Electrical Engineer Date

Mechanical Engineer Date

Plant Design Engineer Date

DELETED Date

ACCEPTANCE:

James C. Calbaugh 12/15/10

Responsible Superintendent (If Constructability Walkdown is waived, this is N/A) Date

12/15/10

Field Engineer (If Constructability Walkdown is waived, this is N/A) Date

TVA Engineering Manager Date

OTHER ORGANIZATIONS:

Signature/Org'n.: Date

Signature/Org'n.: Date

Signature/Org'n.: Date

EDCR COVER SHEET (continued)

EDCR# 55385 Rev. A Page No. 2

WORK SCOPE STATEMENT (CONTINUED):

NOTE 1: EDCR 52601 is a predecessor to this EDCR.

Scope

This EDCR installs and inspects the local panel instruments (hydraulic isolator indicating switches, level transmitters, pressure transmitters, fill valve assemblies, isolation valves, & interconnecting panel capillary lines) and local panels (2-L-388 & 2-L-340) to complete the Unit 2 Reactor Vessel Level Indicating System (RVLIS). All other portions of the RVLIS system including capillary lines, capillary tray unistruts, sleeve/SCV penetrations, piping, interface drawings, seal bellows, high point vents (fill valves), tee above seal table, and compensating RTDs are worked under EDCR 52601 which is a co-requisite to this EDCR. This EDCR will also provide the design requirements for filling the capillary lines for the Unit 2 RVLIS. All electrical scope associated with connections to the local panels instrumentation will be conducted in EDCR 52351.

Co-requisite Packages: EDCR 52601

Associated Packages: EDCR 52351

Seismic Building Local Panel Installation and Inspection

This EDCR allows for the complete installation/inspection of the specified local panel and associated equipment located in the Room A19 – Unit 2 Penetration Room at EL 713. The local panel numbers covered by this change are 2-L-388 and 2-L-340. The scope of the EDCR includes all applicable installation and inspection attributes including local panel mounting, instrumentation, isolation valves, and capillary lines. Overall instrument and instrument line installation and inspection requirements are specified in Project Specification N3E-934. Specific installation requirements including: instrument mounting location, mounting plate, valve and capillary line material, mounting plate type, are shown on the local panel drawings.

The following work activities are within the scope of this EDCR. The Work Scope Boundaries are as follows (as applicable):

- Local panel capillary tubing between the local panel instruments and panel isolation valves. Capillary tubing for the Unit 2 RVLIS sensing line from the Reactor Building to the Auxiliary Building are worked in EDCR 52601.
- Instruments, local panel, instrument mounting plates, panel isolation valve mounting, fill valve assembly mounting, etc, as shown on design drawings.

Level Transmitter Span Change

DCN 38619 increased the span of the dynamic head transmitter by 5% due to results obtained in power operation testing. The actual DP across the core with all four RCPs running and highest density was higher than anticipated. Therefore the transmitter was re-spanned to the maximum extent possible of 5%. This DCN updated the SSDs appropriately.

- Westinghouse requested from Bechtel on the span of the new transmitters in letter WBT-D-0289 to be supplied for Unit 2. Bechtel responded that it is desired to have the same span that would have been desired if the 5% re-spanning limit was not the limiting factor. This corresponds to **-315.25 – 0 – 1760" WC**
    - Original span was **-315.25" – 0 – 1540" WC** (total span 1855.25" WC)
    - It was anticipated that the highest head was 1540" H_2O, but was actually 1760" H_2O.
    - The span was increased to **-313.25 – 0 – 1633** (total span of 1948.25" H_2O) corresponding to a 5% increase in the Unit 1 DCN 38619.
    - For unit 2, actual span is **-315.25 – 0 – 1760" WC** supplied from Westinghouse.

Note that this differential pressure is dependent on the internals for the reactor vessel, some of which may change per WINCISE EDCR 52321. Therefore, this is assumed value of what is required. MEL is updated to include this span. EDCR 52601 will address the span changes in the SSDs for the level transmitters.

Instrumentation

The following instruments will be replaced in this EDCR:

TABLE A - Panel 2-L-388

Instrument No.	Westinghouse Tag	Replacement	Drawing	Group	PAM	EQ	Unit 1 Device
2-PT-68-63	2PT406	Barton 763A[1&2]	8765D46	G03	Cat 1	Yes	Barton 763
2-LT-68-367	2LT1312	Barton 764[1]	8765D45	G01	Cat 1	Yes	Barton 764
2-LT-68-368	2LT1311	Barton 764[1]	8765D45	G03	Cat 1	Yes	Barton 764
2-LT-68-369	2LT1310	Barton 764[1]	8765D45	G03	Cat 1	Yes	Barton 764
2-XIS-68-387	2LIS1312	Cameron 581A-4	9557D89	G01	N/A	No	Barton 581-4
2-XIS-68-388	2LIS1311	Cameron 581A-4	9557D89	G01	N/A	No	Barton 581-4
2-XIS-68-389	2LIS1310	Cameron 581A-4	9557D89	G01	N/A	No	Barton 581-4

NOTE: [1]Barton was bought by Cameron; therefore, some of the vendor drawings/documents may state either manufacturer name.
[2]The Model 763A is equivalent to Model 763 according to the vendor manual 9A-C10880W. The model number was changed due to modifications which impacted the original qualifications. However, the qualification between the two models was determined to be identical based on additional analysis.

TABLE B - Panel 2-L-340

Instrument No.	Westinghouse Tag	Replacement	Drawing	Group	PAM	EQ	Unit 1 Device
2-PT-68-64	2PT407	Weed DTN2010[3]	N/A	N/A	Cat 2	Yes	Tobar 32PA1212
2-LT-68-370	2LT1322	Barton 764[1]	8765D45	G01	Cat 2	Yes	Barton 764
2-LT-68-371	2LT1321	Barton 764[1]	8765D45	G03	Cat 2	Yes	Barton 764
2-LT-68-372	2LT1320	Barton 764[1]	8765D45	G03	Cat 2	Yes	Barton 764
2-XIS-68-390	2LIS1322	Cameron 581A-4	9557D89	G01	N/A	No	Barton 581-4
2-XIS-68-391	2LIS1321	Cameron 581A-4	9557D89	G01	N/A	No	Barton 581-4
2-XIS-68-392	2LIS1320	Cameron 581A-4	9557D89	G01	N/A	No	Barton 581-4

NOTE: [1]Barton was bought by Cameron; therefore, some of the vendor drawings/documents may state either manufacturer name.
[2]The Model 763A is equivalent to Model 763 according to the vendor manual 9A-C10880W. The model number was changed due to modifications which impacted the original qualifications. However, the qualification between the two models was determined to be identical based on additional analysis.
[3]The Tobar Model 32 design was bought by Weed and replaced with model DTN2010 due to re-design to remove sources of mechanical stress & drift, and add temperature compensation which were associated with the Model 32. The DTN2010 model has undergone its own seismic and LOCA/MSLB qualifications.

Instrument isolation valves are 1/4" ball valve Autoclave models identified on drawing 30-9480 and supplied by Westinghouse for Unit 2.

Fill valve assemblies for the level transmitters and off the pressure transmitters are 1/4" shutoff valve Autoclave models identified on Westinghouse drawing 2656C12 and supplied by Westinghouse for Unit 2.

Fitting Mk# 222D (1/4" x 1/4" tube socket weld union) will need to be supplied by the field to connect the 2-PT-68-64 transmitter (Weed DNT2010 model) which comes equipped with a 1/4" tube extension (1" in length) to the 1/4" capillary tubing (Mk #16B) on the panel.

System Field-Fill

The RVLIS capillary system will be field-filled according to N3E-934 Section 3.21 once all lines, instruments, and valves are installed per EDCR 52601 and this EDCR. This will be conducted by Startup through a Work Order.

Material Requisitions

- WB2-09-0406 (WBS 2.6.2.7) - Westinghouse Contract 65717 for Barton/Cameron Instrumentation, Panel Isolation Valves, Panel Fill Valves
- WB2-09-0346 (WBS 3.2) - Westinghouse Contract 65717 for Barton 763A Pressure Transmitters
- 25402-011-MRA-JXF0-00015 - Piping, tubing, & fittings for RVLIS
- 25402-011-MRA-JP02-00012 - Wide Range Pressure Transmitter (2-PT-68-64)

Note: Field to procure any nuts, bolts, washers, unistruts, plates, or fittings as specified on DRAs or per N3E-934 as SR, Seismic I. Fittings are to be supplied as ASME Section III Class 2 (TVA Class B).

The EDCR material requirements were reviewed with the PQAM or designee.

Labeling

Notify and supply information to Unit 2 Operations Labeling for any equipment labels.

GENERAL ISSUES

PERs

PER 172592 (NCO830234002) were identified as impacting this design change and is resolved by this change.

UNIT 1 DCNs

The DCN 51287, 38619, & 08058 from Unit 1 was reviewed and used as a basis of design for Unit 2 in this design package.

NCOs

No Unit 1 or Unit 2 "open" or "closed" NCOs were identified as impacting this design change.

BSL Review

BSL was reviewed on 12/15/10 and predecessors are identified as applicable on the DRAs.

Constructability Walkdown

A constructability walkdown was performed on 12/13/10.

EPIX

Industry and in-house experience data were reviewed. No Issues were identified that impact the design of this EDCR. All EPIX items are discussed in the Technical Evaluation Other #5.

SPF

A failure evaluation in accordance with DS-E2.0.2 is not required since this change does not alter any control feature or change any equipment operating design.

ALARA

An ALARA screen and review are included in the EDCR.

HFE

An HFE screen is included in the EDCR. No HFE review is required since no main or auxiliary control room feature is affected by this change.

BITs

There are not BITs associated with this EDCR.

Sense Line Interface Drawings
The following are the sense line interface drawings associated with EDCR 52601 and are only referenced in this EDCR which performs the local panel connections to the lines.

TABLE 1

SENSE LINE UNID	INTERFACE DWG NO.
2-SENL-068-0387A (H)	2-47W600-1917
2-SENL-068-0454A (L)	2-47W600-1919
2-SENL-068-0453A (H)	2-47W600-1920
2-SENL-068-0455A (L)	2-47W600-1918

NOTE: The interface drawings and installation are conducted in EDCR 52601 and referenced in this EDCR.

IMPLEMENTATION OF INSTRUMENTATION CORRECTIVE ACTION PROGRAMS

The following table is a summary of instrumentation corrective action programs and their impact to this EDCR:

CORRECTIVE ACTION PROGRAM DESCRIPTION	*AFFECTED INSTRUMENTS/ INSTRUMENT LINES*	*REQUIRED INSTALLER ACTIONS TO IMPLEMENT C/A*
SENSE LINE SLOPE Note 1. (PER 143705)	*None*	*None*
COMPRESSION FITTING CONNECTIONS Note 2. (PER 144969)	*All compression fittings associated with capillary sense lines in TABLE 1.*	*Pressure test shall be conducted on the sense lines including panel tubing to verify leak tightness. Any leaking fittings shall be reworked in accordance with N3E-934, Section 3.15.2.*
CONDENSING CHAMBERS	*None*	*None*
SEPARATION OF REDUNDANT INSTR LINES	*All capillary sense lines in TABLE 1.*	*N3E-934, Section 3.7.2.3.2 requires a minimum separation distance of 18-inches between each Prot Set designated sense lines.*
INTERFACE DRAWINGS (PER 143535)	*None*	*None*
THREADED FITTING CONNECTIONS Note 3 (PER 144968)	*All threaded fittings capillary sense lines identified in TABLE 1.*	*Pressure test shall be conducted on the sense lines including panel tubing to verify leak tightness. Any leaking threaded fittings shall be reworked in accordance with N3E-934, Section 3.15.3.*
CAPILLIARY LINES (PER 144951)	*All capillary sense lines identified in TABLE 1.*	*Capillary lines shall be installed in accordance with N3E-934, Section 3.21.*
CAPILLIARY TRAY (PER 144154)	*All capillary sense lines identified in TABLE 1.*	*Capillary tray installation and capillary line support attachment shall be in accordance with 47A051 series drawings.*

RADIOACTIVE DRAIN/VENT LINES Note 4 (PER 144696)	*None*	*None*
PIPE AND TUBE BENDING DEVICES (Note 5) NCR 6276	*None*	*None*
FIELD ROUTED SENSE LINE TYPICAL SUPPORT DOCUMENTATION WAS LOST OR INCORRECT. (PER 144947 UNIT 2) (NCRW334PSCA UNIT 1)	*None*	*None*

Notes:

1. *New sense lines shall comply with slope requirements found in N3E-934, Section 3.6. Slope requirements for installed sense lines will be specifically identified.*
2. *Corrective Action applies to compression fittings associated with Seismic Cat I or I(L) lines, only. New compression fitting installations or rework shall comply with N3E-934, Section 3.15.2. Certification is required for all craftsmen.*
3. *Corrective Action applies to Seismic Cat I or I(L) lines, only. New installations or rework shall comply with N3E-934, Section 3.15.3*
4. *Corrective action applies to instrument lines associated with Systems 62, 63, 68, 72, 74, 77, 78, and 81.*
5. *Existing sense line bends are acceptable based on corrective action to NCR 6276. No inspections are required. New sense line bends shall be in accordance with site procedures.*
6. *New, modified or re-worked supports on instrument sense line in the field routed portion of the line shall be installed and inspected in accordance with design output requirement as addressed within applicable construction procedure(s).*
7. *Installed supports on instrument sense line in the field routed portion of the line shall be inspected for adequacy. An adequate support inspection shall meet either of the following requirements:-*

   a. *QC inspection record that is retrievable from the WBN Permanent Storage Facility.*

   b. *Construction to develop inspection records in accordance within applicable construction procedures (s).*

   Additionally, Construction shall inspect that proper clamps are installed per 47A051 typical series.

<u>WITEL Codes</u>

The following is a list of Corrective Action Program and Special Program Codes per Engineering Program Analysis 25402-3DP-G04G-00084 that apply to this EDCR.

CP6	Equipment Seismic Qualification
CP11	Instrument Sensing Lines
CP11.3	Compression Fittings
XP9	ASME Related
AP1	Old ECN/DCN
AP2	New DCN/EDCR
AP3	Old Corrective Action Program (CAQR, SCAR, PER, etc.)
AP4	New Corrective Action Program (CAQR, SCAR, PER, etc)
CP3.3.3	Instrument Baseline Calculations

<u>Conclusions</u>

The subject EDCR contains changes which are commensurate with the design function of the associated system as it relates to the operational and functional requirements of the plant. EDCR 55385 contains design documentation providing detailed acceptability and justification that this change is safe from a nuclear standpoint. See the Technical Evaluation for a complete review of the considerations addressed by this change.

EDCR OPEN ITEM FORM

EDCR# **55385** **Rev. A** **Page No. 12**

Open Item Type	Check all Applicable
Calculation	X
Vendor Information	X
ICRDS Reports	
Drawing/DRA	X
DELETED	
DELETED	
Environmental Qualification – EQCS Issuance	X
Appendix R	
DELETED	
Other:	

Open Item Details:

Open Item Number	Open Item Description:
OI-55385-01	Issue EQCS to add the EQ components (level transmitters - Barton 764) identified in the MEL package to the applicable EQ binder (WBNEQ-XMTR-001).
OI-55385-02	Issue EQCS to add the EQ components identified (pressure transmitter - 2-PT-68-63-D - Barton 763A) in the MEL package to the applicable EQ binder (WBNEQ-XMTR-004).
OI-55385-03	Issue Civil ESQ Calculation WCG-ACQ-1099 for local panels 2-L-388 & 2-L-340.
OI-55385-04	Vendor Manual Request shall be completed for UNIDs 2-PT-68-63.
OI-55385-05	Vendor Manual Request shall be completed for UNIDs 2-LT-68-367, 2-LT-68-368, 2-LT-68-369, 2-LT-68-370, 2-LT-68-371, & 2-LT-68-372.
OI-55385-06	Vendor Manual Request shall be completed for UNIDs 2-XIS-68-387, 2-XIS-68-388, 2-XIS-68-389, 2-XIS-68-390, 2-XIS-68-391, & 2-XIS-68-392.
OI-55385-07	Issue EQCS to add the EQ components identified (pressure transmitter - 2-PT-68-64-E - Weed DNT2010) in the MEL package to the applicable EQ binder (WBNEQ-IPT-003).
OI-55385-08	Vendor Manual Request shall be completed for UNIDs 2-PT-68-64.

EDCR OPEN ITEM FORM

Action Plan for Open Item:

Open Item Number	Open Item Action Plan
OI-55385-01	Ensure the completion of an EQCS to add EQ components (level transmitters - Barton 764) identified in the MEL package to the applicable EQ binder (WBNEQ-XMTR-001). Addition to this EQ binder is contingent upon receipt of the Westinghouse certification that the WCAP documents are applicable. Closure of this open item will not require a revision to this EDCR.
OI-55385-02	Ensure the completion of an EQCS to add EQ components (pressure transmitters - 2-PT-68-63-D - Barton 763A) identified in the MEL package to the applicable EQ binder (WBNEQ-XMTR-004). Addition to this EQ binder is contingent upon receipt of the Westinghouse certification that the WCAP documents are applicable. Closure of this open item will not require a revision to this EDCR.
OI-55385-03	Civil ESQ calculation group shall issue calculation WCG-ACQ-1099 to seismically qualify local panels 2-L-388 and 2-L-340. This will not require a revision to this EDCR.
OI-55385-04	Vendor Manual Requests shall be completed once necessary vendor information for UNIDs 2-PT-68-63 has been received. Resolution of this Open Item will require a revision to this EDCR.
OI-55385-05	Vendor Manual Requests shall be completed once necessary vendor information for UNIDs 2-LT-68-367, 2-LT-68-368, 2-LT-68-369, 2-LT-68-370, 2-LT-68-371, & 2-LT-68-372 has been received. Resolution of this Open Item will require a revision to this EDCR.
OI-55385-06	Vendor Manual Requests shall be completed once necessary vendor information for UNIDs 2-XIS-68-387, 2-XIS-68-388, 2-XIS-68-389, 2-XIS-68-390, 2-XIS-68-391, & 2-XIS-68-392 has been received. Resolution of this Open Item will require a revision to this EDCR.
OI-55385-07	Ensure the completion of an EQCS to add EQ components (pressure transmitters - 2-PT-68-64-E - Weed DNT2010) identified in the MEL package to the applicable EQ binder (WBNEQ-IPT-003). Closure of this open item will not require a revision to this EDCR.
OI-55385-08	Vendor Manual Requests shall be completed once necessary vendor information for UNIDs 2-PT-68-64 has been received. Resolution of this Open Item will require a revision to this EDCR.

Action Taken:

Open Item Number	Action Taken for Closure:
OI-55385-01	
OI-55385-02	
OI-55385-03	
OI-55385-04	
OI-55385-05	
OI-55385-06	
OI-55385-07	
OI-55385-08	

Completed By: **Date:**

Verified By: **Date:**

EDCR UNIT DIFFERENCE FORM

EDCR# 55385 Rev. A Page No. 14

Operations Difference is identified as follows:

This change authorizes the completion of local panel installations 2-L-388 & 2-L-340 for the Unit 2 RVLIS and replacement of missing instrumentation, isolation valves, fill valve assemblies, and interconnecting capillary tubing at the panel. The replacement transmitters and hydraulic indicating switches will be of the same design and function as the originals. The replacements of transmitters do not constitute a unit difference for Operations.

N/A	**N/A**
Unit 2 TVA Operations Acceptance (Mgr or Designee):	**Date:**

Maintenance Difference is identified as follows:

This change authorizes the completion of local panel installations 2-L-388 & 2-L-340 for the Unit 2 RVLIS and replacement of missing instrumentation, isolation valves, fill valve assemblies, and interconnecting capillary tubing at the panel. The replacement transmitters and hydraulic indicating switches will be of the same design and function as the original. Transmitter (2-LT-68-63) is replaced with a Barton (Cameron) 763A which is an equivalent qualified model to the Barton 763 on Unit 1. Transmitter (2-LT-68-64) is replaced with a Weed DTN2010 which is equivalent qualified model to the Tobar 32PA1212 on Unit 1. Transmitters (2-LT-68-367, -368, -369, -370, -371, & -372) are replaced with Barton (Cameron) 764 models the same as Unit 1. Hydraulic indicating switches (2-XIS-68-387, -388, -389, -390, -391, & -392) are replaced with Cameron (Barton) 581A-4 which are equivalent models to the Barton 581-4 on Unit 1. **The replacement transmitters are selected: 1) to resolve obsolescence issues, 2) to provide proven performance, and 3) to provide manufacturer standardization.** The above described replacement equipment is used in the plant. Maintenance activities associated with the replacement equipment will be in accordance with referenced vendor manual instructions and the maintenance work performed will be similar, if not the same, to that of the originally supplied instruments.

N/A	**N/A**
Unit 2 TVA Maintenance Acceptance (Mgr or Designee):	**Date:**

Design Difference is identified as follows:

This change authorizes the completion of local panel installations 2-L-388 & 2-L-340 for the Unit 2 RVLIS and replacement of missing instrumentation, isolation valves, fill valve assemblies, and interconnecting capillary tubing at the panel. The replacement transmitters, hydraulic indicating switches, isolation valves, and fill valve assemblies will be of the same design and function as the original. Transmitter (2-LT-68-63) is replaced with Barton (Cameron) 763A which is an equivalent qualified model to the Barton 763 on Unit 1. The Model 763A is equivalent to Model 763 according to the vendor manual 9A-C10880W. The model number was changed due to modifications which impacted the original qualifications. However, the qualification between the two models was determined to be identical based on additional analysis. Transmitter (2-LT-68-64) is replaced with a Weed DTN2010 which is an equivalent qualified model to the Tobar 32PA121 on Unit 1. The

Tobar Model 32 design was bought by Weed and replaced with model DTN2010 due to re-design to remove sources of mechanical stress & drift, and add temperature compensation which were associated with the Model 32. The DTN2010 model has undergone its own seismic and LOCA/MSLB qualifications. Transmitters (2-LT-68-367, -368, -369, -370, -371, & -372) are replaced with Barton (Cameron) 764 models the same as Unit 1. Both the pressure and level transmitters utilize 4-20 mA signals instead of the 10-50 mA signals used on Unit 1 in order to comply with the Unit 2 Common Q and Eagle 21 systems. Hydraulic indicating switches (2-XIS-68-387, -388, -389, -390, -391, & -392) are replaced with Cameron (Barton) 581A-4 which are equivalent models to the Barton 581-4 on Unit 1. Barton was bought by Cameron; therefore, some of the vendor drawings/documents may state either manufacturer name in addition to Westinghouse the supplier. The instrument panel isolation valves and panel fill valve assemblies are the same Autoclave models as Unit 1 identified on Drawings 30-9480 and 2656C12 supplied by Westinghouse. Capillary tubing interconnection at the local panels will be the same configuration as Unit 1. This EDCR does not affect any system function or logic feature.

On Unit 1 DCN 38619, the span of the level transmitters (2-LT-68-367, -368, -369, -370, -371, & -372) for the Barton 764 models was increased by 5% from a span of -315.25" – 0 – 1540" WC (total span 1855.25" WC) to -313.25 – 0 – 1633 (total span of 1948.25" H_2O). This was due to actual DP across the core with all four RCPs running and at the highest density was higher than anticipated. Therefore, on Unit 2 it is desired to have the same span that would have been desired if the 5% re-spanning limit was not the limiting factor. The Barton (Cameron) 764 models on Unit 2 will be supplied with a span of -315.25 – 0 – 1760" WC as discussed in Westinghouse letter WBT-D-0289.

SAHilmes for NJW — 12-17-10
Unit 2 TVA Engineering Acceptance (Mgr or Designee): **Date:**

Joe Temples Joe T. Temples — 12/14/10
Prepared By: **Date:**

Streamlined EDCR approved by TVA Oversight N/A

SESG TO ROUTE A COPY OF THIS COMPLETED FORM TO TVA TRAINING MANAGER AND TO UNIT 2 LICENSING.

EDCR No. 55385-A
Page 31

EDCR TECHNICAL EVALUATION

TECHNICAL EVALUATION CONSIDERATIONS

This attachment provides topics to be considered when evaluating the technical and safety aspect of changes. It is not intended to be an all inclusive list of items to be considered. It is to be used as an aid in determining attributes that should be addressed in a technical evaluation. Information is also provided to aid in determining coordination interfaces. These are minimum guidelines. It should be recognized that many topics and changes involve multiple disciplines and organizations and technical considerations must be coordinated accordingly. All parts of Attachment I must be considered for applicability for the associated EDCR.

Attachment I has been formatted to facilitate proposed modifications during the WB2CCP. If the proposed modification potentially impact WBN Unit 1 power generations, operability (as defined by the WBN Unit 1 Technical Specifications), or any licensing basis, then terminate the use of this procedure, and use TVA Procedure Standard Program & Processes SPP-9.3, *Plant Modification & Engineering Change Control.* EDCR(s) are permitted to modify selected WBN Unit 0 and/or Unit 1 SSC(s) via WBN procedure 0-TI-2. (Reference 0-TI-2.)

NOTE: If the change involves an ASME Section III component or boundary that has not been previously included on the Unit 1 N-5 report, an EDCR is required to meet the ASME Section III requirements. If it is determined that the change affects Unit 1/0 and that it cannot be done by an EDCR-2, coordinate with Mechanical EGS to determine the process needed to implement the modification.

EDCR Potential Impacts on Unit 0 and/or Unit 1 Systems, Structures and Components			
NOTE: If the answer to the following question is "YES", reference WBN Technical Instruction 0-TI-2, "Criteria for Issuing Engineering Document Construction Releases (EDCR) Potentially Impacting WBN Unit 0 and/or Unit 1 Design" and do not complete this EDCR Technical Evaluation.			
☐ YES	☒ NO	1.	Does the EDCR activity involve Unit 2 modifications, changes, repairs, and/or refurbishments that interface physically with Unit 1 or Unit 0 and/or that affect drawings under Unit 1 control (CCDs)?

EDCR TECHNICAL EVALUATION

INITIAL:			
☐ YES	☒ NO	1.	Is the Auxiliary Building Secondary Containment Enclosure (ABSCE), as defined in WBN2-30AB-4001, affected by this change? Is the work adjacent or in the proximity to an ABSCE component, such that the component's Structural Interface Boundary could be affected? Does this change modify any cable, cable tray, conduit, duct, pipe, or instrument tubing penetrating secondary containment? Consult 46W501 drawing series for the location of the ABSCE boundary, and discuss proposed changes with the Mechanical EGS. A justification for the "YES/NO" is required. **EDCR 55385 installs and inspects instruments and local panels 2-L-388 & 2-L-340 in Aux Bldg Room A19 EL 719 for Unit 2 RVLIS. Installation of the capillary sense lines from the Reactor Building to the Auxiliary Building is conducted in EDCR 52601. Electrical work activities are conducted in EDCR 52351. Therefore, this EDCR does not affect any instrument tubing, cable, or conduit penetrating secondary containment (ABSCE).**
☐ YES	☒ NO	2.	Does the modification have the potential to affect the Structural Interface Boundary of a Unit 1/Unit 2 Interface Point? A justification for the "YES/NO" is required. **EDCR 55385 only involves local panel work. The local panels do not have any components identified as U1/U2 Interfaces per 2-47W610-68-7 or 2-47W600-292.**
☒ YES	☐ NO	3.	Is a full Technical Evaluation required for the proposed modification? **A full evaluation will be conducted for EDCR 55385 to ensure all technical areas have been considered in the design.** If "NO," provide a detailed justification explaining why the evaluation is not required for this modification. Things to consider are any Unit Differences, Type of Difference, whether or not the modification was evaluated by some other means (e.g., Unit 1 DCN), etc. The remainder of Attachment I need not be completed or kept as part of the EDCR, page 1 and 2 must be maintained. If "YES," then perform and maintain as a part of the EDCR the remainder of Attachment I, or 0-TI-2 Attachment 1 or 8, as applicable.

EDCR TECHNICAL EVALUATION

GENERAL:

☒ YES ☐ NO 1. Are the nuclear safety functions, protective safety functions, Class 1E requirements, or Seismic Category I or I(L) requirements of a design criteria, system description, FSAR, or Tech Spec affected?

EDCR 55385 replaces safety-related, 1E transmitters and quality-related, non-1E hydraulic indicating switches for the Unit 2 RVLIS at local panels 2-L-388 & 2-L-340. The transmitters are PAM C1 & C2 devices per WB-DC-30-7 and provide Tech Spec compliance. FSAR changes based installation of the Unit 2 RVLIS equipment was captured in EDCR 52601. No changes are required to the system description WB2-68-4001 or any design criteria.

☒ YES ☐ NO 2. Is there an operational/configuration change? Is a component being added to or removed from the plant? Is a component being disabled or abandoned in place? Is the normal or accident position of a valve changing? Is an electrical isolation device being added or deleted? Is a portion of the system being rerouted?

EDCR 55385 installs and inspects the local panel instruments (hydraulic isolator indicating switches, level transmitters, pressure transmitters, fill valve assemblies, isolation valves, & interconnecting panel capillary lines) and local panels (2-L-388 & 2-L-340) to complete the Unit 2 Reactor Vessel Level Indicating System (RVLIS). Local panels are located in the Auxiliary Building Room A19 EL 713. Transmitters are replaced with Barton 763A, Barton 764, and Weed DNT2010 models. Hydraulic indicating switches are replaced with Cameron (Barton) 581A-4 models. Isolation valves and fill valve assemblies at the local panel are replaced with Autoclave models. EDCR 52601 is a co-requisite for installation of the RVLIS in the Reactor Building (capillary lines routing, sensor bellows, tee above seal table, fill valves, etc). EDCR 52351 performs all electrical work associated with RVLIS.

☐ YES ☒ NO 3. Could the change affect the basic function of a structure, system or component that performs or supports the performance of a safety function (deleting or changing logic interlocking, additional pumps, etc.)? Is the most limiting operating condition or design criteria imposed on the change or by the change, evaluated? Include effects by or on Safety Related or Non Safety Related systems in their various possible configurations. Does the change meet or exceed design criteria of other SSCs in similar applications?

The basic functions of the SSCs are not changed in this EDCR. The most limiting operating condition or design criteria imposed is the post accident environment. All components are qualified to meet this requirement. The design meets the applicable design criteria (WB-DC-40-36, WB-DC-30-16, WB-DC-40-31.2, WB-DC-30-7, WB-DC-30-17, WB-DC-40-31.12, WB-DC-40-31.13, and WB-DC-40-54).

☐ YES ☒ NO 4. Could the change affect environmental conditions such as pressure, temperature, humidity, flooding, corrosiveness, site elevation, nuclear radiation (both rate and total integrated dose), and duration of exposure in either harsh or mild areas?

This change has no impact to Unit 1 or 2 environmental conditions.

If "YES", the change shall be coordinated with the Lead Electrical/I&C Engineer, and if applicable, with ME/NE for potential revisions to the EQ/MEQ Binders.

BECHTEL

EDCR TECHNICAL EVALUATION

☒ YES ☐ NO 5. Could the change involve relocating or reorienting a device or system which could impact location-specific dose calculation or shielding analyses or place the device or system in an area with different environmental conditions?

The local panel components are not being relocated and remain in a harsh environment the same as Unit 1 per 2-47E235-56. The transmitters are required to meet EQ per WBNOSG4017.

If YES, coordinate with the Mechanical EGS, MEQ, and EQ Program Engineers to revise the affected location specific dose calculation, environmental drawings, and EQ/ MEQ documentation.

The EQ transmitters (2-LP-68-63 & -64 and 2-LT-68-367, -368, -369, -370, -371, & -372) will be added to EQ binders (WBNEQ-XMTR-001 & -004 and WBNEQ-IPT-001) as part of an Open Item (OI-55385-01, -02, & -07).

☐ YES ☒ NO 6. Are Security Systems modified?

No security systems are affected by this change.

☐ YES ☒ NO 7. Does the modification add quantities of chemicals that may have an impact on control room habitability?

This change does not add any chemicals.

If YES, evaluate impact on control room habitability per NRC Reg. Guide 1.78.

☒ YES ☐ NO 8. Has the component being added or modified been evaluated for proper physical orientation? Components that require consideration are: capacitors, relays, check valves, steam traps, flow and level measuring devices, pressure switches, and solenoid valves. Other components may require consideration based on special applications, unique circumstances or vendor/manufacturer's recommendations.

Transmitters, hydraulic indicating switches, isolation valves, and fill valve assemblies are mounted and oriented according to vendor recommendations and approved seismic mountings. An analysis of the load requirements on panels 2-L-388 and 2-L-340 will be analyzed in a Civil ESQ Calculation WCG-ACQ-1099 (Open Item OI-55385-03).

EDCR TECHNICAL EVALUATION

GENERAL (Continued):			
☒ YES	☐ NO	9.	Have considerations for mounting, connecting, and positioning of components included an evaluation of the required robustness of associated elements? Has the evaluation for robustness considered the need for protection from bumping, jarring, vibration, etc.? **Components on 2-L-388 and 2-L-340 are from standard industry suppliers and mounted above the floor on wall panels. Adequate protection is provided and bumping or jarring of the components is not considered a potential problem.**
☐ YES	☒ NO	10.	Is this modification subject to vibration, thermal movement, and/or leaks on trip sensitive equipment? (i.e., replace carbon steel piping with stainless steel piping, modify routing such that thermal flexibility is reduced, modify support or support locations to resist thermal expansion, process and/or pneumatic leaks.) If YES, create a WITEL action item to incorporate the device into monitoring plans. **Seismic capillary sense line flexibility is addressed by the sense line interface stress calculation as part of EDCR 52601. The RVLIS components are not trip sensitive equipment.**

BECHTEL

EDCR TECHNICAL EVALUATION

CIVIL / PLANT DESIGN:
This section may be considered Not Applicable (N/A), if the Unit 2 modification requires no input from Civil or Plant Design. Civil and/or Plant Design Coversheet signatures will be "N/A" and these five questions need not be answered. If block #14 (Civil Engineer) and block #18 (Plant Design Engineer) of the EDCR Cover Sheet are "N/A," this section does not need to be included in the EDCR package.

☐ YES ☒ NO 1. Does the change potentially impact pipe break considerations, pipe whip, or jet impingement? Consideration should include changes to operating modes, the addition or rerouting of high energy pipe greater than 1 inch nominal diameter, or change or modify pipe rupture protection devices. Does the change relocate or add potential targets such as electrical components, equipment, conduits, instruments or air lines to compartments containing fluid systems? The change may be evaluated generically rather than on a case-by-case basis as described in Civil Design Guide DG-C1.2.10.

Capillary sense lines are 1/4" or 3/16" nominal size at the local panel and are not subject to pipe whip considerations. The pipe break and impingement evaluation program will address all potential target issues independent of this EDCR.

☐ YES ☒ NO 2. Does the change affect piping vibration or testing requirements? Was there a mass change? Were supports added/deleted? Was an orifice, valve, or other flow device added or deleted? Was there an operational or configuration change?

This change does not affect any piping or any type of flow device.

☒ YES ☐ NO 3. Are Seismic Category I or I (L) components added, deleted, or modified? Are components in a Seismic Category I structure added, deleted, or modified? Does the change affect the seismic or dead weight analyses?

For panels 2-L-388 & 2-L-340;

- **Replacement of transmitters 2-PT-68-63 & -64**
- **Replacement of transmitters 2-LT-68-367, -368, -369, -370, -371, & -372**
- **Replacement of hydraulic indicating switches 2-XIS-68-387, -388, -389, -390, -391, & -392**
- **Replacement of panel isolation valves and fill valve assemblies**
- **Replacement of interconnecting capillary sense lines at the panel**

Analysis of the new seismic loads and mountings are evaluated as part of this EDCR. Panels are analyzed in a Civil EQS Calculation WCG-ACQ-1099 (OI-55385-03).

☒ YES ☐ NO 4. Does the change involve an existing attachment on a Seismic Category I structure/civil feature (e.g., new loads generated, revise loads previously approved, physical modification required at interface points) or the addition of an attachment to and/or penetration of a Seismic Category I structure(s)? Does the change affect the attachment or add attachments of engineered features to masonry block walls in a Seismic Category I structure? Does the change impact the fire resistance rating of a fire barrier?

The loads are revised as stated in Civil #3. Sense line interfaces to seismic category 1 or I(L) structures are analyzed in EDCR 52601 for the RVLIS capillary lines. Attachments to the panels are qualified in a Civil ESQ Calculation WCG-ACQ-1099 (OI-55385-03). Attachment to Civil features has been addressed by the SAL process. There are no attachments to masonry brick walls. These

EDCR TECHNICAL EVALUATION

requirements ensure seismic qualification integrity of the process pressure boundary. Plant Design personnel will evaluate support attachment locations and provide the necessary evaluations in EDCR 52601. The change does not impact the fire resistance rating.

☐ YES ☒ NO 5. Could the change affect WBN Probable Maximum Precipitation (PMP) site drainage (i.e. add or obstruct surface to water flow, divert or reroute a flow path, change ground surface contours, change from vegetation to concrete or pavement, etc?).

This change does not affect PMP site drainage.

If YES is the response to any of these questions, consult Civil Engineering.

EDCR TECHNICAL EVALUATION

ELECTRICAL/INSTRUMENTATION & CONTROLS:
This section may be considered Not Applicable (N/A), if the Unit 2 modification requires no input from Electrical or I&C. Electrical and/or I&C Coversheet signatures will be "N/A" and items 1 through 20 need not be answered. If block #15 (I&C Engineer) and block #16 (Electrical Engineer) of the EDCR Cover Sheet are "N/A," this section does not need to be included in the EDCR package.

☐ YES ☒ NO 1. Does the change affect breaker alignment, electrical loads, or electrical separation/isolation?

This EDCR only replaces transmitters and hydraulic indicating switches on local panels 2-L-388 & 2-L-340. All electrical work is conducted in EDCR 52351 for connection to the local panel devices. Refer to the Elect/I&C Checklist included in this EDCR for more information.

☐ YES ☒ NO 2. Is any low or medium voltage (V3, V4 or V5) electrical containment penetration protector(circuit breaker or fuse) involved?

This EDCR does not affect any containment penetration circuits.

☐ YES ☒ NO 3. Has any electrical load classification changed (non-1E to 1E)? Is the Class 1E classification for a fuse on the Fuse Tab changing?

Transmitters remain classified 1E while the hydraulic indicating switches remain classified non-1E.

☒ YES ☐ NO 4. Does the change involve instrument setpoints, instrument/relay settings or other instrument information found in EMPAC? Is the change consistent with N-specs (e.g., instrument line slopes and installation)? Has reset and deadband been evaluated?

A MEL Package is included in this EDCR to update affected fields. Compliance with N3E-934 is required. On Unit 1 DCN 38619, the span of the level transmitters (2-LT-68-367, -368, -369, -370, -371, & -372) for the Barton 764 models was increased by 5% from a span of -315.25" – 0 – 1540" WC (total span 1855.25" WC) to -313.25 – 0 – 1633 (total span of 1948.25" H_2O). This was due to actual DP across the core with all four RCPs running and at the highest density was higher than anticipated. Therefore, on Unit 2 it is desired to have the same span that would have been desired if the 5% re-spanning limit was not the limiting factor. The Barton (Cameron) 764 models on Unit 2 will be supplied with a span of -315.25 – 0 – 1760" WC. Common Q (EDCR 52601) will address the span changes in the SSDs for the level transmitters.

☒ YES ☐ NO 5. Does the change alter, add, or delete Post Accident Monitoring (PAM) equipment or affect the type, category, or operating time of existing equipment? Reference Design Criteria for the list of PAM variables.

Level transmitters 2-LT-68-367, -368, & -369 and pressure transmitter 2-PT-68-63 are PAM Category 1 devices. Level transmitters 2-LT-68-370, -371, & -372 and pressure transmitter 2-PT-68-64 are PAM Category 2 devices. These PAM C1 & C2 devices are replaced in this EDCR and are associated with variable 22 per WB-DC-30-7.

If YES, coordinate with Bechtel Licensing, Electrical, and U2 Operations to ensure continued Reg. Guide 1.97 compliance.

EDCR TECHNICAL EVALUATION

The PAM C1 & C2 devices are only replaced with equivalent models and will still meet the requirements of WB-DC-30-7 variable 22.

☐ YES ☒ NO 6. Does the change involve instrument ratings? (Relay or solenoid coil ratings, contact ratings, duty cycles, etc.)

No instrument ratings are affected.

☐ YES ☒ NO 7. Does the change challenge the capacity of another system (Air conditioning system heat load, control air load, electrical load)?

No heat load changes. Transmitter/hydraulic indicating switch replacement is not considered a heat load issue.

☐ YES ☒ NO 8. Does the change affect the operating or accident environment of instrumentation? Is the electrical equipment or instrumentation required to operate in the affected environment? Have potential operating and accident environments of equipment been considered?

Location of the instruments has not changed and the transmitters are still required to operate in a harsh environment per 2-47E235-56 and calculation WBNOSG4017.

☒ YES ☐ NO 9. Have the effects of EMI/RFI been considered?

Electrical instrument replacements are required to meet EMI/RFI design standard requirement (DS-E18.14.01). The replacement transmitters (Barton 763A, Barton 764, & Weed DNT2010) are procured and tested to proper EMI/RFI considerations. Mounting of the subject instruments does not require any additional considerations.

☐ YES ☒ NO 10. Is the logic of system operation changed? Are new or modified interfaces (physically or electrically) with safety related or important to safety equipment created?

This EDCR does not change any logic or create/modify any interfaces with SR or important to SR equipment.

☒ YES ☐ NO 11. Does the change affect, add, or delete equipment within the scope of 10CFR 50.49 (EQ)? Review appropriate documents such as MEL, Essentially Mild Calculations, Category & Operating Times Calculations, and/or equipment in a harsh environment? Cable must be considered (e.g., mild to harsh environment).

This EDCR replaces EQ transmitters 2-PT-68-63 & -64 and 2-LT-68-367, -368, -369, -370, -371, & -372 on local panels 2-L-388 & 2-L-340. The transmitters are identified as EQ per 2-47E235-56 and WBNOSG4017.

If "YES", the change shall be coordinated with Program Engineers for potential revisions to EQ/MEQ Binders.

The replacement of the EQ transmitters is coordinated with the EQ Program Engineers for EQ Binder changes through an EQCS as Open Items (OI-55385-01, -02, & -07). Additionally, a MEL package is included in this EDCR to update the EQ UNIDs.

EDCR TECHNICAL EVALUATION

ELECTRICAL/INSTRUMENTATION & CONTROLS:(Continued)
This section may be considered Not Applicable (N/A), if the Unit 2 modification requires no input from Electrical or I&C. Electrical and/or I&C Coversheet signatures will be "N/A" and items 1 through 20 need not be answered. If block #15 (I&C Engineer) and block #16 (Electrical Engineer) of the EDCR Cover Sheet are "N/A," this section does not need to be included in the EDCR package.

☐ YES ☒ NO 12. Could the change affect materials such as lubricants, seals and O-rings, which could impact Qualification Maintenance Data Sheet (QMDS) requirements and qualification analyses, and invalidate test data, or could the change affect special maintenance (QMDS) and/or administrative requirements and controls that might impact the qualification of an item?

The transmitters are replaced with similar models and, therefore, the QMDS is not changed.

If YES, coordinate with the responsible discipline on revisions to the QMDS.

☐ YES ☒ NO 13. Does the change involve a power, control, or instrumentation circuit for a 10CFR50.49 component either by direct connection or relay logic or involve a non-10CFR50.49 power control or instrumentation circuit which have a credible circuit interaction failure mode with 10CFR50.49 power control or instrumentation circuit?

This EDCR does not perform any electrical work. All electrical work activities are conducted in EDCR 52351. Any EQ affected circuits will be analyzed as part of that EDCR.

If YES, perform an analysis in accordance with SPP-9.2, Appendix I for any safety-related cables or components located in a harsh environment that are designated as Category C (i.e. not required to be addressed in the EQ program).

☐ YES ☒ NO 14. Does the change upgrade the function of an existing device/cable such that additional QA records and documentation are needed to support 10CFR50.49 Qualification in accordance with 10CFR50, Appendix B manufacturing, procurement, installation, etc.)?

This EDCR does not upgrade the function of any device or cable for 10CFR50.59.

If YES, provided additional documentation as required.

☐ YES ☒ NO 15. Does the modification affect components/equipment that require periodic testing of electrical test points

The Common Q system installed in EDCR 52351 will have test jacks.

If YES, provide appropriate test jacks which are accessible to prevent accidental contact with adjacent electrical terminations during testing.

☐ YES ☒ NO 16 Does the modification change functional logic which has the potential of affecting design characteristics?

This EDCR does not modify any functional logic.

If YES, evaluate PER/NER history on the equipment being modified to determine if problems have previously been identified.

EDCR TECHNICAL EVALUATION

☐ YES ☒ NO 17. Does the modification involve a programmable or digital logic controller?

This EDCR does not involve any PLC or digital controller.

If YES, has the addition of uninterruptible power supplies been considered?

ELECTRICAL/INSTRUMENTATION & CONTROLS: (Continued)
This section may be considered Not Applicable (N/A), if the Unit 2 modification requires no input from Electrical or I&C. Electrical and/or I&C Coversheet signatures will be "N/A" and items 1 through 20 need not be answered. If block #15 (I&C Engineer) and block #16 (Electrical Engineer) of the EDCR Cover Sheet are "N/A," this section does not need to be included in the EDCR package.

☐ YES ☒ NO 18. Does the modification involve fault tolerant non safety-related equipment important to operation such that the need for redundant power sources should be considered (such as CERPI control room devices)?

This EDCR does not involve this type of equipment.

☐ YES ☒ NO 19. Does the design or modification impact an Integrated Computer System (ICS) data point that is also an Emergency Response Data System (ERDS) data point?

This EDCR does not affect any ICS or ERDS data points.

If YES, coordination with Bechtel Licensing is required in accordance with 10CFR50 Appendix E.

☐ YES ☒ NO 20. Does the design or modification impact off site power capability or ability to meet 10CFR50 Appendix A Criterion-17 requirements?

This EDCR does impact off site power capabilities or the ability to meet 10CFR50 App A Criterion-17 requirements.

If YES, coordinate with Electrical Lead Engineer.

EDCR TECHNICAL EVALUATION

MECHANICAL:
This section may be considered Not Applicable (N/A), if the Unit 2 modification requires no input from Mechanical. Mechanical Coversheet signatures will be "N/A" and items 1 through 17 need not be answered. If block #17 (Mechanical Engineer) of the EDCR Cover Sheet is "N/A," this section does not need to be included in the EDCR package.

Ensure EQ requirements addressed for ancillary subcomponents (e.g. Limit Switches on Mechanical only valves). Coordinate with Electrical EQ Engineer as necessary.

☐ YES ☒ NO 1. Does the change affect design conditions or requirements such as process pressure, temperature, chemistry or operating cycles? Is the change affected by operation of other systems, either Safety Related or Non Safety Related in any of their various operating configurations?

This change does not affect any process design condition or operating condition.

If YES, ensure the evaluation encompasses all aspects of the affected system, including impacts on or by interfacing systems. Coordinate with MEQ Program Engineer for potential revisions to affected MEQ documentation.

☐ YES ☒ NO 2. Does the change affect ECCS, decay heat removal systems, or MPC cooling ancillary equipment? Ensure that any changes are consistent with the safety analyses for the plant including WBN SAR Chapter 15 NPSH minimum flow requirements, diesel loading sequencing, and ultimate heat sink limits.

This change does not affect ECCS.

☐ YES ☒ NO 3. Does the change involve potential heating, ventilation, and air conditioning (HVAC) system impacts resulting from adding heat loads, altering air flow or ductwork, etc.?

No heat loads are impacted by this change.

☐ YES ☒ NO 4. Does this change make any alterations or configuration changes to Motor Operated Valves (MOVs) or Air Operated Valves (AOVs)? Does this change impact any MOV or AOV Program documents? Impacts that should be considered include changes to instrumentation or control circuits, power supplies, or change system operating or design conditions such as pressure and flow rate.

This change does not affect any MOV or AOVs.

☒ YES ☐ NO 5. Does this change involve replacement of a complete valve or valve internals which are located in a system that interfaces directly with the Reactor Coolant System (RCS)? Procurement requirements should evaluate valve and valve internals replacements that are located in or interfaces with the Reactor Coolant System (RCS) for hard faced components that are non-cobalt bearing. Hard facing alternatives include NOREM, Nitronic 60 and may include other non-cobalt materials as approved by Engineering. Cobalt bearing hard facing materials is a concern in fluid systems that contain radioactive materials.

This EDCR replaces panel isolation valves and fill valve assemblies at the local panels for the Unit 2 RVLIS. The system measures the level and pressure of the Unit 2 reactor vessel. The valve replacements do not contain any cobalt of cobalt bearing materials according to drawings 2656C12 or 30-9480.

EDCR TECHNICAL EVALUATION

☐ YES ☒ NO 6. Does the modification add a new check valve or impact an existing check valve? Ensure the valve is sized properly, proper type for required service, properly oriented, located suitable distance from upstream components that cause turbulent flow.

This change does not involve any check valves.

MECHANICAL: (Continued)
This section may be considered Not Applicable (N/A), if the Unit 2 modification requires no input from Mechanical. Mechanical Coversheet signatures will be "N/A" and items 1 through 17 need not be answered. If block #17 (Mechanical Engineer) of the EDCR Cover Sheet is "N/A," this section does not need to be included in the EDCR package.

☐ YES ☒ NO 7. Does the modification add, delete, or reroute components in a mechanical piping system? If Yes, will the added components come in contact with borated water or some other harsh environment area?

This EDCR replaces panel isolation valves, fill valve assemblies, transmitters, and hydraulic indicating switches at the local panels for the Unit 2 RVLIS. The system measures the Unit 2 reactor level and pressure. These components do not come in contact with borated water. The sensor bellows installed in EDCR 52601 provides a separation between the reactor medium (borated water) and the capillary line fill liquid (water).

☒ YES ☐ NO 8 Does the modification affect ASME Section III Code (Class 1, 2, and/or 3) boundary?

The capillary sense lines in EDCR 52601 are required to be installed and inspected to ASME Section III Class 2 (TVA Class B) requirements per N3E-934 Section 3.21 & Appendix E. The classification of the components at the local panels is considered TVA Class "Instrument" per WB-DC-40-36. The local panels are not required to have an N-5 Data Report but are required to be installed and inspected to TVA Class B per N3E-934.

If "YES," ensure that the materials and installations meet the applicable ASME code.

Materials for the local panel installation will be either supplied as ASME Section III Class 2 (TVA Class B) parts or supplied to meet the applicable ASTM standard with a CMTR or COC with a TVA approved QA program per N3E-934 Appendix E. The instruments (transmitters, hydraulic indicating switches, fill valve assemblies) are considered outside ASME Section III requirements per NCA-1130(b).

EDCR TECHNICAL EVALUATION

☐ YES ☒ NO 9. Does this modification introduce material into the containment that could become dislodged during LOCA or other events and contribute to Emergency Core Cooling System (ECCS) sump screen or strainer blockage? Does this modification affect protective coatings inside the containment?

This EDCR does not install any components inside containment. Socket welds for capillary sense lines are in accordance with ANSI B16.11. Requirements for installation of instrument capillary sense lines are in accordance with N3E-934. TVA Safety Class designations specify welding requirements.

☐ YES ☒ NO 10. Does the modification increase the possibility of flooding from a Moderate Energy Line Break?
NOTE: Coordinate response with the MELB Program Engineer.

This changes does not increase possible flooding from an MELB.

☐ YES ☒ NO 11. Are there NUREG-0612 impacts? Does the change add, delete, or alter a permanent handling system? Does the change move a heavy load path over safe shutdown equipment or move safe shutdown equipment into a heavy load path?

NUREG-0612 impacts will be evaluated under a separate implementation program. The subject capillary sense lines at the local panel are routed in the same general areas as Unit 1 and no NUREG-0612 impact is expected on Unit 2.

☐ YES ☒ NO 12. Does the change affect barriers such as walls, doors, penetrations, relief panels, and ducts which could affect HVAC flow paths, fire barriers, or environmental conditions in either harsh or mild areas?

This EDCR does not affect any barriers.

If the answer to any of the above questions is "YES", the change shall be coordinated with the Mechanical EGS.

☐ YES ☒ NO 13. Is a new material being added and does the change affect components susceptible to Flow Accelerated Corrosion (FAC) or Microbiologically Induced Corrosion (MIC)?

The change does not add any new material which affects the FAC or MIC.

☐ YES ☒ NO 14. Does the modification increase the susceptibility for cavitation?

N/A

☐ YES ☒ NO 15. Could the change affect location or operation of high energy piping systems, location or operation of radioactive piping systems, operation of environmental control systems, or environmental barriers such as walls, doors, relief panels, piping/other thermal insulation, and ducts which could affect environmental conditions in either harsh or mild areas?

This change will not affect the location or operation of any high energy piping system, radioactive piping systems, environmental systems or barriers.

EDCR TECHNICAL EVALUATION

If YES, coordinate with Mechanical EGS for potential revision to the environmental drawings/design criteria and coordinate with Electrical EGS for potential impact to EQ of equipment.

MECHANICAL: (Continued)
This section may be considered Not Applicable (N/A), if the Unit 2 modification requires no input from Mechanical. Mechanical Coversheet signatures will be "N/A" and items 1 through 17 need not be answered. If block #17 (Mechanical Engineer) of the EDCR Cover Sheet is "N/A," this section does not need to be included in the EDCR package.

☐ YES ☒ NO 16. Does the modification change ventilation, cooling requirements for electronic equipment?

The replacement of transmitters and hydraulic indicating switches at the local panels does not impact the cooling requirements.

If YES, coordinate with Mechanical Engineering for determination of impact on HVAC coolant

☐ YES ☒ NO 17. Does the modification involve strainers for a raw water supply?

This change does not involve any strainers.

If YES, proper strainer selection should be based on industry guidelines (Fluid Controls Institute Std 89-1) and specific site criteria. Major consideration should be given to the following; type of strainer, redundant strainer capability, materials/housing, perforations number and arrangement, mesh size & free area, capacity and pressure loss, fluid type, particle weight & shape, macro fouling and aquatic debris potential, operating parameters, filtration versus separation, blow down line sizing, vendor recommendations, automatic back flushing and the necessity of a bypass line.

NOTE: Contact the appropriate program coordinator in the Mechanical Programs group (or in Plant Design for MOV questions), if any Engineering Design Program(s) are impacted by the proposed modification.

EDCR TECHNICAL EVALUATION

OPERATIONS/HUMAN FACTORS:			
☐ YES	☒ NO	1.	Does the change affect the main control room or the backup control areas (Environment, workspace, controls and displays)? **This EDCR involves replacement of components at local panels 2-L-388 & 2-L-340 and does not affect the MCR or ACR areas. An HFE screen is included in the EDCR.** If YES, human factors must be addressed.
☐ YES	☒ NO	2.	Are OSHA considerations included? Whenever replacement or major repair, renovation, or modification of a machine or equipment is performed, and whenever new machines or equipment are installed, energy isolating devices for such machines or equipment must be designed to accept a lockout device. This applies to mechanical and electrical devices. **OSHA consideration would be evaluated as part of the work order to implement this EDCR.**

EDCR TECHNICAL EVALUATION

OTHER:
Note: This section is not required for Plant Design EDCRs.

☐ YES ☒ NO 1. Does the change affect equipment diversity, failure modes, single failure criteria (DS-E2.0.2, "Single Point Failure For Power Generation Reliability"), equipment redundancy, or equipment reliability?

This EDCR is only replacing transmitters/hydraulic indicating switches at local panels 2-L-388 & 2-L-340. Based on DS-E2.0.2, since the system is designated with redundant train protection sets, it is already single failure tolerant. Additionally, the wide range pressure transmitters for each protection set are different models in order to provide equipment diversity and prevent a common mode failure as done in Unit 1.

☒ YES ☐ NO Does the modification install redundant equipment?

This EDCR is installing redundant transmitters/hydraulic indicating switches at local panels 2-L-388 & 2-L-340.

If YES, utilization of redundant attendant equipment (e.g., power from alternate sources) shall be considered and addressed.

Electrical work activities are conducted in EDCR 52351 which will address the power sources.

☐ YES ☒ NO 2. Does the modification change System 18, 43, 77, or 90, or potentially impact the plant Chemistry Organization (i.e., sampling, procedures, training, spare parts, chemical treatments, etc.)?
N/A

☐ YES ☒ NO 3. Does the change involve environmental impacts? If ANY of the questions below are answered "YES," then question #3 must be answered "YES."
N/A

- ☐ YES ☒ NO Will the modification require new Chemicals (as defined in SPP-5.4) to be used anywhere onsite or result in a change in plant chemical storage or usage?
  N/A
- ☐ YES ☒ NO Will the modification generate any new wastes (Solid, Liquid, Hazardous, Universal, Used Oil, Radioactive etc.) or result in the release of any new or different substances to the land, air, or water?

  <u>**NOTE**</u> This does not include consumables used to facilitate the installation of the modification.
  N/A
- ☐ YES ☒ NO Will the modification change the existing flow path or characteristics of any discharge to the land, air, or water?
  N/A
- ☐ YES ☒ NO Will the modification involve any equipment containing PCBs, Mercury, or Asbestos?
  N/A
- ☐ YES ☒ NO Will the modification involve storage or use of oil or hazardous substance in an amount equal to or greater than 55 gallons?
  N/A

If Question #3 is answered "YES," contact Environmental Staff to ensure that the applicable Environmental Review (in accordance with SPP-5.5

EDCR TECHNICAL EVALUATION

and TVA National Environmental Policy Act (NEPA) Process) or chemical traffic control review are initiated/performed.

If Question #3 is answered "YES," Environmental shall be a Core Review group at the initial and final meeting. If the meetings are waived, then Environmental is required to review the EDCR and sign the Coversheet as an "Other Organization."

OTHER: (continued)
Note: This section is not required for Plant Design EDCRs.

☐ YES ☒ NO 4. Does this modification impact the fire protection system or equipment of an insured building?

This EDCR does not affect the fire protection system.

If YES, coordinate with the 10CFR50 Appendix R Program Engineer to have the EDCR documents reviewed by the insurance carrier.

☐ YES ☒ NO 5. Does the modification change functional logic which has the potential of affecting design characteristics or change/impact an item listed in the Equipment Performance Information Exchange (EPIX) system?

Various searches were performed on EPIX concerning the scope of work. The following was found;

- **Wolf Creek - Failure #359**
  - **One dynamic range transmitter was very different than the other due to a calibration issue**
- **Oconee Unit 3 - Failure #714 - 2005**
  - **Leaking fitting on hydraulic isolator caused entire train to go down**
  - **Will be mitigated by using welded fitting when possible**
- **Vogtle Unit 1 - Failure #340 - 2005**
  - **Barton level transmitter developed a leak due to "aging." Replaced with a Rosemount.**
- **Vogtle Unit 2 - Failure #341 - 2003**
  - **One train Barton transmitter started to drift low and would not re-calibrate**
- **Robinson Unit 2 - Failure #475 - 2007**
  - **Barton LT drifted out of calibration during a depressurization for refueling. Replaced transmitters.**
- **North Anna Unit 1 - Failure #2831**
  - **Barton LT failed due to the stain gage internal to transmitter.**

In conclusion, no action or design change will be taken as a result of the information found in EPIX.

If YES, evaluate PER/NER history and EPIX on the equipment being modified to determine if problems have previously been identified and are appropriately addressed in the EDCR Package. Ensure appropriate coordination with affected organizations is performed such as Operations, Maintenance, Environmental, Chemistry, and Emergency Preparedness.

EDCR TECHNICAL EVALUATION

☐ YES	☒ NO	6.	Does the change substitute, change, add or modify materials, components or chemical treatments not previously evaluated to the system parameters or application? **Material used in this change is standard to nuclear plants and specifically to WBN Unit 1.**

10CFR50 APPENDIX R AND OTHER FIRE PROTECTION IMPACTS: Contact the Program Owner **Note: This section is not required for Plant Design EDCRs.**			
☒ YES	☐ NO	a.	Does the change directly or indirectly impact Mechanical or Electrical Appendix R equipment, or cables, required for safe-shutdown (This includes manual actions required for safe shutdown.)? **Wide range pressure transmitter 2-PT-68-63 is listed on the Unit 2 Appendix R Safe Shutdown Equipment List and is replaced in this EDCR with an equivalent model (Barton 763A). Electrical connections to this transmitter are conducted in EDCR 52351.**
☐ YES	☒ NO	b.	Does the change impact Appendix R component availability in any fire area/zone? **N/A**
☐ YES	☒ NO	c.	Have any Appendix R equipment parameters (e.g., flow rate, pressure, setpoints, load limitations, electrical load, interface with other components) changed? **N/A**
☐ YES	☒ NO	d.	Have Appendix R cable tag/UNID numbers or cable fire area/zone routings changed? **N/A**
☐ YES	☒ NO	e.	Have Appendix R cables been added/deleted or Appendix R control circuit logics been changed? **N/A**
☐ YES	☒ NO	f.	Does the change involve a non-Appendix R circuit which interferes with an Appendix R Circuit (e.g., re-wiring to create associated circuits)? **N/A**
☐ YES	☒ NO	g.	Does the change impact the use of Appendix R equipment in any fire area/zone? **N/A**
☐ YES	☒ NO	h.	Has component been installed or relocated which obstructs the light pattern of an existing Appendix R emergency light? **N/A**
☐ YES	☒ NO	i.	Has an Appendix R component been added, deleted or relocated which would affect Appendix R light placement, including ingress/egress lights? **N/A**
☐ YES	☒ NO	j.	Has an Appendix R component been installed or relocated in the same fire area/zone as its functionally redundant safe shutdown train/system? (This includes instrument sensing lines.) (Note: The functionally redundant train is not necessarily the redundant divisional train.) **N/A**
☐ YES	☒ NO	k.	Does the change affect in-plant communication systems? **N/A**

EDCR TECHNICAL EVALUATION

☐ YES ☒ NO l. Does the change affect fire barriers, fire doors, fire dampers or fire wraps, or affect electrical or mechanical penetrations through fire rated walls, floors, ceilings or cable fire stops?

Capillary sense lines for RVLIS were routed in EDCR 52601. This EDCR is only installing the interconnecting capillary lines at local panels 2-L-388 & 2-L-340 located in the same room and does not require breaching of any fire barriers.

☐ YES ☒ NO m. Does the change affect structural steel, raceway supports or raceway fire-proofing material?

N/A

☐ YES ☒ NO n. Does the change result in the addition or deletion of in-situ combustibles in a fire area/zone (e.g., panels, new cable trays, components with oil sumps, grease, plastics)? (Note: Exclude cables routed entirely in conduits. Also exclude cables routed in existing trays without exceeding the tray fill capacity. Exclude combustibles less than 0.5 gallons oil, 4 lbs plastic, 4 lbs grease or equivalent amount of other combustible materials.) If yes, combustible loading calculation may be affected. Check with the 10CFR50 Appendix R Program Owner.

Transmitters and hydraulic indicating switches are replaced at local panels 2-L-388 & 2-L-340. Although these components do contain a small about of combustibles, the amount is less than 4 lbs plastic. Therefore, this EDCR will not result in an increased amount of combustible loading for the area.

10CFR50 APPENDIX R AND OTHER FIRE PROTECTION IMPACTS: Contact the Program Owner (continued)
Note: This section is not required for Plant Design EDCRs.

☐ YES ☒ NO o. Does the change affect any of the fire protection systems (HPFP, AFFF, Halon, or CO_2) or affect any of the fire detection systems (e.g., smoke or heat)?

N/A

☐ YES ☒ NO p. Does the change impact the Fire Protection Reports?

N/A

If "YES", then a DCN must be issued.

☐ YES ☒ NO q. Does the change impact the property insurance carrier fire protection standards and/or associated commitments?

N/A

☐ YES ☒ NO r. Does the change involve the reactor coolant pump oil collection system?

N/A

☐ YES ☒ NO s. Does the modification introduce or remove combustible material or fire source in the area?

N/A

If ANY of the above questions are answered "YES," contact the 10CFR50 Appendix R Program Engineer.

EDCR TECHNICAL EVALUATION

SINGLE POINT FAILURE/FAILURE MODES AND EFFECTS/RELIABILITY:
Note: This section is not required for Plant Design EDCRs.

Checklist of questions to ask vendors of large scale systems, and our own designer(s) in regards to single point failures and margin to operation/trip/runback. The following questions should be considered when dealing with vendor supplied packaged solutions.

This section may be considered Not Applicable (N/A) if the Unit 2 change for the associated EDCR is the same as the Unit 1 installed design.

☐ If this section is NA, check this box.

☒ YES ☐ NO

a. What are the system failure modes for the entire package (i.e., output fail-as-is, fail high or low, oscillate, trip system/plant, run back system plant, consider loss of motive power such as electric or control air, etc.)?
Mechanical components addressed by EDCR do not include these failure modes.

The following analysis was conducted in EDCR 52601 but addressed here again for components installed in this EDCR.

The most likely cause of failure for RVLIS is a leak in one of the fittings on the filled capillary lines. This will cause a change in pressure which would cause actuation of the hydraulic indicating switch sending a signal to Common Q in the MCR. This will be mitigated by having welded fittings or high quality compression fittings and a trained system. Any failure of the RVLIS system will lead to LCO 3.3.3 of the Tech Specs.

It is logically possible that the bellows within the hydraulic indicating switch could seize and not allow any hydraulic coupling to occur - perhaps as a result of an over-pressurization. In this case, measuring reactor vessel level would be impacted since the level transmitter would not see any change in pressure. This is mitigated by having a trained system so the operators would see the difference between the two trains.

☒ YES ☐ NO

b. What are the failure modes of the individual components, which were considered, and what was their effect on the overall system (i.e., consider failures of the digital control systems related to the hardware and software, loss of CPU, loss of communication connection, loss of an entire I/O board, etc.)?
Mechanical components addressed by EDCR do not include these failure modes.

EDCR TECHNICAL EVALUATION

The following analysis was conducted in EDCR 52601 but addressed here again for components installed in this EDCR.

Hydraulic indicating switches - if either the switch or internal bellows fails, RVLIS will still function properly since the purpose of then hydraulic isolator is to provide a signal if there is a leak in the filled capillary system.

Level transmitters - the likely failure is that no signal would be sent to Common Q. Common Q would pick this up and give a system trouble alarm.

See RVLIS Instrumentation Manual page 2-12 for further failure analysis.

☐ YES ☒ NO c. Will these system and/or component failures directly or indirectly via transient cause a plant trip or runback?

RVLIS is an important system for post accident monitoring but has no ability to trip the plant.

If YES,

1. What is the reliability of the individual components and system?
2. How can testing be performed to detect failure modes, miss configurations, and precursors to imminent failures?
3. What alarms or indications provide timely precursor indication of impending component/system failure?
4. What redundancy is there in the alarms, indications, runback, or trip functions?
5. Which trips and runbacks are absolutely necessary? Which can be changed to alarms and what operator response is needed for the alarms?
6. Are digital systems developed in accordance with SPP-2.6 and SS-E18.15.01 software requirements for real time data acquisition and control computer systems?
7. Are there any reasons why redundancy was not considered in alarm, trip, runback systems, and can redundancy be added?

EDCR TECHNICAL EVALUATION

DIGITAL SYSTEM UPGRADES/MODIFICATIONS:

Note: This section is not required for Plant Design EDCRs.

Does this change involve a digital system, component, or upgrade?

No digital upgrade is involved with this EDCR. The Common Q digital system is installed in EDCR 52351.

☐ YES ☒ NO If "NO," then leave Questions #1 through 6 below blank.

☐ YES ☐ NO 1. Have the requirements of SPP-2.6, SS-E18.15.01, and the guidelines of DG-E18.1.25 been considered?

☐ YES ☐ NO 2. Does the change involve any in-house modification? If so, implement in accordance with SPP-2.6. Doe the change involve a vendor-performed modification? If so, implement in accordance with SS-E18.15.01.

☐ YES ☐ NO 3. Is the digital modification associated with a Safety-Related Protection upgrade? Has the potential for common cause software failure been considered?
NOTE: For digital upgrades, refer to NRC RIS 2002-2 which endorses NEI 01-01, Rev 1.

☐ YES ☐ NO 4. Has the method and level of configuration control needed for the digital application been addressed?
NOTE: The configuration control method should be implemented using approved design control processes such as SPP-2.6 and/or an EDCR (i.e., design output). This may involve the need to maintain configuration control of both the software and hardware revision levels. The level of control needed shall be based upon the application function (i.e., Safety Related, Quality Related, Critical to Plant Operations), capability to modify software such as software versus firmware, software and hardware revision compatibility, etc. Safety Related system configuration control must ensure that V&V qualification remains valid so prescriptive configuration control methods would be required. For Non Safety Related software, the configuration control may be less restrictive with focus on plant reliability and day to day operation. Firmware/Software includes both the Operating/Platform System firmware/software and the application specific firmware/software along with any configuration parameters such as setpoints, constants, scaling, etc.

EDCR TECHNICAL EVALUATION

DIGITAL SYSTEM UPGRADES/MODIFICATIONS: (continued)

Note: This section is not required for Plant Design EDCRs.

Does this change involve a digital system, component, or upgrade?

☐ YES ☒ NO If "NO," then leave Questions #1 through 6 below blank.

☐ YES	☐ NO	5.	Has a Cyber Security Assessment been completed to address NEI 04-04 requirements? Contact the Computer Engineering Group for instructions.
☐ YES	☐ NO	6.	Is there a communication network interface such as an ICS interface? If yes, implement design of this interface per the guidelines addressed in DG-E18.1.25.

Based on the Technical Evaluation Considerations responses listed above, the modifications described within this EDCR are considered safe from a nuclear safety standpoint.

Non Proprietary Description Of The Differences Between The Unit 1 And Unit 2 IIS

Differences between Unit 1 and Unit 2 Core Monitoring

The [1]BEACON™ System monitor power distribution process sequence is as follows:

- Obtain the latest plant data by reading the binary plant.dat file produced by the plant_if (plant interface) process. The plant_if process retrieves plant condition measurements needed to generate a predicted core power distribution.

- Calculate a predicted core power distribution from previous core power distribution measurement and current plant data.

For plants using core exit thermocouples and Power Range excore detector signals (Watts Bar Unit 1):

- Use periodic (minimum of once every 180 Effective Full Power Days (EFPD)) Movable Incore Detector (MID) core power distribution measurements to generate nodal calibration factors for all fuel assembly nodes.

- Apply the nodal calibration factors to the predicted nodal power distribution. Adjust the resulting core radial power shape using a surface spline fit of the ratio of the reference thermocouple-based enthalpy rise values to the current thermocouple-based enthalpy rises. The thermocouple data is used to determine the adjustments made to the reference power distribution for all assemblies.

- Adjust the axial power distribution based on the excore detector signals. A sine term is created to adjust the reference axial power distribution to match the excore detector determined core average axial offset.

For plants using Self Powered Detector (SPD) signals (Watts Bar Unit 2):

- Adjust each node in the reference power distribution using nodal calibration factors determined using the measured SPD signals. The nodal adjustment factors are determined at least once per minute by:

  - calculating the ratio of the measured and predicted SPD signals for all operable SPD locations; and

  - performing a 3-D spline fit of the measured-to-predicted SPD signal ratios to produce nodal calibration factors at all fuel assembly node locations.

For plants using either SPD or thermocouple and excore signals:

- The fluxes and powers are integrated for later use by the updater process. This integration is maintained over the time interval from the initialization of one updater execution to the next.

---

[1] BEACON is a registered trademark of the Westinghouse Electric Company LLC

- Update the xenon and delta-xenon axial distributions using the axially averaged data from updater and the current measured average reactor power.

- Calculate the power distribution uncertainties based on the current average reactor power, number of good thermocouples or SPDs, control rod insertion, and time since the last nodal model calibration.

- Determine the FΔH and FQ margin and the power margin in the core, or

- Determine the DNBR margin and the minimum kW/ft. power margin in the core.

- Perform BEACON operability data checks.

- Write the monitoring information to the file for transfer to any BEACON display in the network.

Attachment 12
TVA Letter Dated June 10, 2011
Responses to Licensee Open Items to be Resolved for SER Approval

EDCR 52351 Excerpts Including Scope, Intent, Unit Difference And Technical Evaluation

BECHTEL

EDCR COVER SHEET

GENERAL INFORMATION		Page No.	1
EDCR TYPE	☐ EDCR #	Rev.	B
(Check One Box Only)	☒ EDCR-2 # 52351	Rev.	B

☐ Check here if this is a Streamlined EDCR.

☐ Check here if this EDCR is for Documentation change only & No construction work is required.

☒ SR ☐ QR Check appropriate box if field material procurement quality requirements included.

System	Building	Elevation	Quality Class	Lead Discipline	Code/Class
068,275,261,94,98, 99	*CB*	*various*	*SR*	*I&C*	*1E/ Cat 1*

WORK SCOPE STATEMENT:

Westinghouse is to provide a system (Common Q) which performs the same function presently in service in Unit 1 for Inadequate Core Cooling Systm (ICCM-86). This EDCR will install the new Common Q system.

PREPARED:			VERIFIED:	
Laura Radcliffe Laura Radcliffe	365-8801	5/24/11 LMR 5/25/11	Rufino Ayala RA	5/24/11 RAA 5/25/11
Design Engineer	Phone	Date	Engineer	Date
APPROVALS:			**INTER DISCIPLINE REVIEWS:**	
Bill Perkins		5-25-11	Robert F Brown	5/25/11
Civil EGS		Date	Civil Engineer	Date
Thomas R Raley THOMAS R RALEY		5/25/11	Rufino Ayala RA	5/24/11 RAA 5/25/11
I&C EGS		Date	I&C Engineer	Date
BC Anil Kumar ANIL C. BANGALORE		5/25/11	Kaarteek Gummi	~~5/26/11~~ 5/25/11 KG
Electrical EGS		Date	Electrical Engineer	Date
K.W. Peterman Kirk Peterman		5/25/11	Chad M. Grennor	5/25/11
for Mechanical EGS		Date	Mechanical Engineer	Date
N/A			N/A	
Plant Design EGS		Date	Plant Design Engineer	Date
R E Smith Roger E. Smith		5/25/11		
Project Engineering Manager		Date	DELETED	Date
ACCEPTANCE:			**OTHER ORGANIZATIONS:**	
N/A			N/A	
Responsible Superintendent (If Constructability Walkdown is waived, this is N/A)		Date	Signature/Org'n.:	Date
N/A			N/A	
Field Engineer (If Constructability Walkdown is waived, this is N/A)		Date	Signature/Org'n.:	Date
S A Hilmes		5/25/11	N/A	
TVA Engineering Manager for EF		Date	Signature/Org'n.:	Date

CAL 5/25/11

Refer to the electronic documents in TVA [...] revision.

LEGIBILITY EVALUATED AND ACCEPTED FOR ISSUE
Initials: LMR Date: 5/25/11
ALL PAGES

EDCR COVER SHEET (continued)

EDCR# 52351 **Rev.** B **Page No.** 2

WORK SCOPE STATEMENT (CONTINUED):

Introduction

This EDCR completes the installation of the Post Accident Monitoring System or Common Q racks, 2-R-179 and 2-R-180, and provides the power feed to these new cabinets. Unit 1 currently has an Inadequate Core Cooling Module (ICCM-86); Unit 2 will have the Common Q system which will perform the same function as the ICCM-86 system.

The Common Q system was procured via Procurement Request (WB2-08-182) to Westinghouse, Contract # 65717. Common Q is a trained system consisting of two racks, 2-R-179 and 2-R-180; two touch screen displays on 2-M-4 and 2-M-6, and their associated PC Node boxes. Rack 2-R-179 and the touch screen display located on 2-M-4 corresponds to Train A and Rack 2-R-180 and the touch screen display located on 2-M-6 corresponds to Train B. Common Q's primary function is to display the following three parameters to aid the operators:

1. reactor vessel level
2. subcooled margin (SMM)
3. core exit temperatures

Other functions include providing input to the annunciator, plant computer, and an analog digital panel meter.

The Common Q system has the following inputs:

- Reactor Vessel Level Indication System (RVLIS) Differential Pressure transmitter and hydraulic isolator (panels 2-L-388 and 2-L-340)
- RVLIS capillary line RTDs (through penetrations 38 and 19)
- Reactor Coolant Pump (RCP) status from the Solid State Protection System (SSPS) (panels 2-R-48 and 2-R-51)
- Core Exit Thermocouples (CET) from the Westinghouse In-Core Information, Surveillance and Engineering (WINCISE) System (through penetrations 33 and 18)
- Wide Range Reactor Coolant System (RCS) pressure from Eagle 21 (panels 2-R-2 and 2-R-6)
- RCS hot leg temperatures from Eagle 21 (panels 2-R-2 and 2-R-6)
- ΔT from Eagle 21 (panels 2-R-2 and 2-R-6)

Panel Installation

New Common Q panels 2-R-179 and 2-R-180 will be located in the Unit 2 Auxiliary Instrument Room (AIR). See DRAs for location and welding detail for the installation of panels. EDCR 53080 is a pre-requisite to the installation of these new panels. EDCR 53080 removes the Unit 2 panel 2-R-148 from the Auxiliary Instrument Room to make room for the installation of the Common Q panels.

The Common Q cabinets are to be welded according to DRA 52351-001, DRA 52351-002 and Westinghouse Dwg No. 10044E60-1. There are precautions that must be taken when welding in the AIR, See DRA 52351-001 (reference EDCR 53310 for more information).

The seismic qualification for the Common Q panels, 2-R-179 and 2-R-180, is included in the Qualification Summery Report for the Common Q System. This summary report is a Westinghouse document, EQ-QR-68-WBT-P, the seismic portion of this final report has been approved.

The racks utilized will be from group G04 (see section 4.2.1 of System Design Specifications - WNA-DS-01667-WBT). They have been specified to be painted color 34410 per federal standard 595c (this matches the other cabinets in the AIR See WBT-D-0846 and WBT-D-1057).

Panel Power

EDCR 54636 pulled the power cables (2PV605D and 2PV604E) for Common Q Panels 2-R-179 and 2-R-180. This EDCR will land power cables for each Common Q panel on its associated power breaker. Breakers 2-BKR-094-7900-A and 2-BKR-094-8000-B are currently installed in the vendor supplied panels 2-R-179 and 2-R-180. Power is supplied from safety related 120 VAC Vital Instrument Power Boards, Board 2-I for Train A and Board 2-II for Train B.

Interface with ICS

The Common Q System will provide input into the ICS from the Maintenance Test Panels (MTP), located in panels 2-R-179 and 2-R-180. The signals to the ICS from the MTPs will go though panel 2-R-23 for Train A and 2-R-20 for Train B. Computing Data Diodes which are installed in Dell R200 servers are to be mounted in 2-R-23 (for Train A) and 2-R-20 (for Train B) to provide cyber security isolation between the Safety Related Common Q System and the ICS. The Dell servers were specifically procured to accept a fiber optic Ethernet interface compatible with the network protocol Common Q is transmitting.

Westinghouse provided fiber optic to CAT5 modems that will be utilized downstream of the data diodes prior to ICS. These modems are manufactured by Transition Networks, model # J/FE-CF-04, and are not Safety Related.

Interface with Annunciator System

Each Train of the Common Q System will provide an input into the Annunciator System. The purpose of these alarms is to alert operators of 'System Trouble' when there is a problem internal to the Common Q System. Panel 2-R-179 (Train A) will annunciate box 2-XA-55-4B window 85F, on panel 2-M-4. Panel 2-R-180 (Train B) will annunciate box 2-XA-55-6C window 124E, on panel 2-M-6.

These new Common Q alarm points create a Unit Difference; see Unit Difference form for further detail.

Digital Panel Meters (DPMs)

Unit 1 Subcooled Margin DPMs, 1-TI-68-105 and 1-TI-68-115, are manufactured by Analogic, these Analogic meters are obsolete and no longer produced. Unit 2 Subcooled Margin DPMs, 2-TI-68-105 and 2-TI-68-115 will be manufactured by Otek. The Otek model has been used in nuclear applications and will be qualified by Nuclear Logistics Inc (NLI) to be both seismically and EMI qualified.

Note:
The Otek DPM has an Application Specific Integrated Circuit (ASIC) that performs the A/D conversion via the sigma-delta method and has an integrated LED driver for the display. The integrated circuit is an analog device that does not contain software. The Otek DPM has potentiometers for GAIN and ZERO, see figure 1 for a functional diagram from Maximum, the ASIC manufacturer.

NUREG/CR-6992, *Instrumentation and Controls in Nuclear Power Plants: An Emerging Technologies Update*, Section 5.3 discusses digital devices used in a safety system that consist of a few elements on an ASIC. These lower end digital devices resemble a function block layout and its implementation is strongly analogous to the wiring of an analog device. This ASIC DPM is considered a lower end device and therefore, as stated in NUREG/CR-6992 "At the lower end of the spectrum, it seems obviously true that the device is more like conventional hardware and can be tested as any other hardware device under IEEE 603." Due to this discussion, this DPM will not go through a V&V or ISG06.

Figure 1. Functional Diagram for ASIC

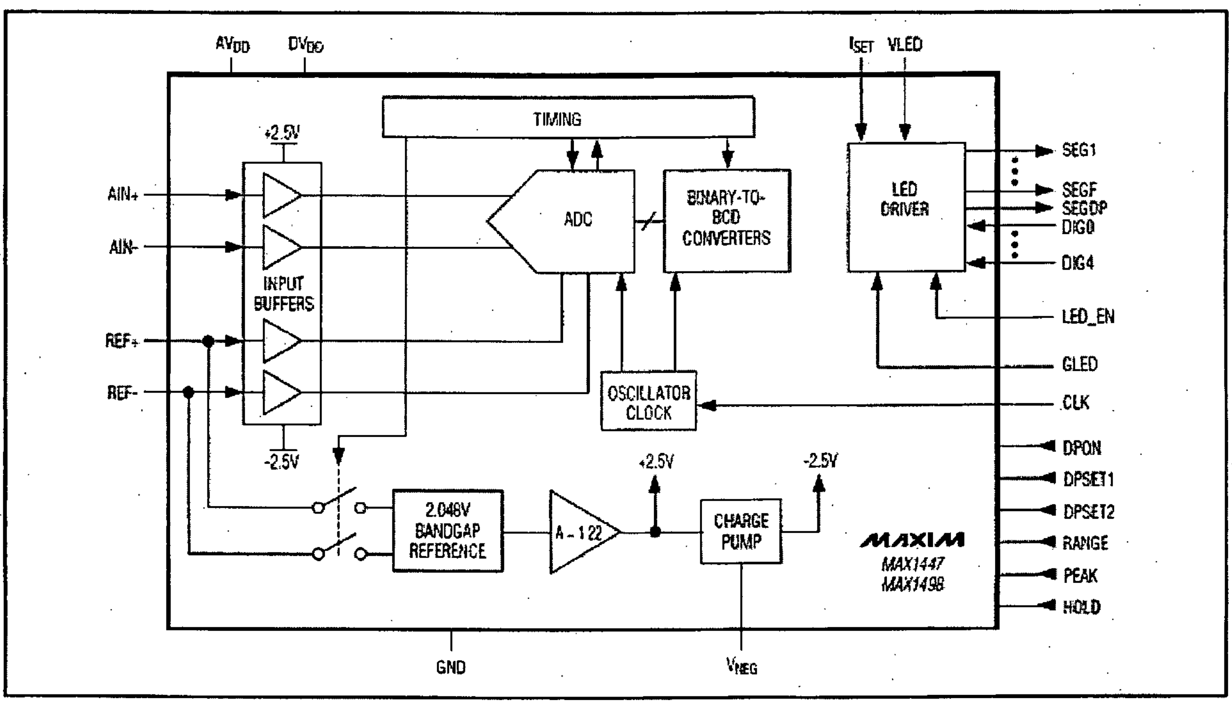


Figure 1. MAX1447/MAX1498 Functional Diagram

PC Node Box and Display

Westinghouse is providing 'next generation' PC Node Boxes, 2-CPU-94-4000 and 2-CPU-94-6000, and QNX operating system.

The Westinghouse provided Flat Panel Display 2-MON-68-100 will be mounted on 2-M-4 (for Train A) and 2-MON-68-110 will be mounted on 2-M-6 (for Train B). The Westinghouse provided Operator

Module (OM) Node Boxes 2-CPU-94-4000 and 2-CPU-94-6000 are to be mounted on the floor of panels 2-M-4 and 2-M-6 respectively. The seismic qualification of the OM equipment is also included in the Westinghouse report, EQ-QR-68-WBT-P.

Note:
The OM Node Box is equipped with a port for the Function Enable keyswitch. Unit 2 has decided to not permanently install this keyswitch. There is a lack of room on the Main Control Room Boards and there will be a Function Enable Keyswitch installed on local panels 2-R-179 and 2-R-180 to be utilized when needed.

Installation/Termination of Safety Related Fiber Optic Cable
Safety Related Fiber Optic Cable is used as the link between panels 2-R-179 and 2-M-4 and between panels 2-R-180 and 2-M-6. This cable was procured as a Safety Related 1E cable (See MRs 25402-011-MRA-EWS0-00002 and 25402-011-MRA-EWS0-00003) and is routed in the same manner as copper 1E cables.

The main concern with the termination of the Safety Related Fiber Optic Cable is the strain relief. In order to accomplish adequate strain relief (in compliance with G38 section 16.4.2) the fiber optic cables terminating at the AF100 modems shall be wrapped and tied down in the vicinity of the termination.

The fiber optic link in between the MTP and ICS will use standard project cable of WOF-12. There will be fiber optic patch panels located in panels 2-R-23 and 2-R-20 in the vicinity of the data diodes.

Reactor Vessel Level Indication System (RVLIS) Inputs

The Common Q system allows a maximum of eight RVLIS RTD inputs, since RTDs must be installed on the vertical sections of the RVLIS system the maximum number of inputs must be taken into consideration.

Train A will have a single RTD and Train B will have two RTDs that will be for compensation of the seal table and the head capillary temperatures (no differential pressure is taken across these two lines). Addressable constants will be used within the Common Q software to assign a single temperature value to both compensation calculations.

In the Common Q PAMS system, each RVLIS RTD will be assigned a code RTD1 through RTD8. See Table 1 for Train A RTDs and Table 2 (next page) for Train B RTDs.

Table 1. Common Q PAMS Train A RTDs

RTD#	UNID	Description
RTD1	NOT USED	
RTD2	2-TE -068-0376 -D	Reactor Level Temp Comp (Guide Tube)
RTD3	2-TE -068-0377 -D	Reactor Level Cap Tube Temp Comp (Seal Table and Head)
RTD4	2-TE -068-0378 -D	Reactor Level Cap Tube Temp Comp (Head)
RTD5	2-TE -068-0379 -D	Reactor Level Cap Tube Temp Comp (Head)
RTD6	NOT USED	
RTD7	NOT USED	
RTD8	NOT USED	

Table 2. Common Q PAMS Train B RTDs

RTD#	UNID	Description
RTD1	NOT USED	
RTD2	2-TE -068-0383 -E	Reactor Level Temp Comp (Guide Tube)
RTD3	2-TE -068-0384 -E	Reactor Level Cap Tube Temp Comp (Seal Table and Head)
RTD4	2-TE -068-0385 -E	Reactor Level Cap Tube Temp Comp (Head)
RTD5	2-TE -068-0393 -E	Reactor Level Cap Tube Temp Comp (Seal Table and Head)
RTD6	2-TE -068-0386 -E	Reactor Level Cap Tube Temp Comp (Head)
RTD7	NOT USED	
RTD8	NOT USED	

In the Common Q PAMS system each RVLIS level transmitter is also assigned a code: DP1, DP2, and DP3, these are defined in Table 3 for both Train A and Train B for consistency.

Table 3. Common Q PAMS Train A & B Level Transmitters

DP#	UNID	Description
TRAIN A		
DP1	2-LT -068-0369 -D	Reactor Vessel Upper Plenum Level
DP2	2-LT -068-0368 -D	Reactor Vessel Narrow Range (Lower) Level
DP3	2-LT -068-0367 -D	Reactor Vessel Wide Range (Dynamic) Level
TRAIN B		
DP1	2-LT -068-0372 -E	Reactor Vessel Upper Plenum Level
DP2	2-LT -068-0371 -E	Reactor Vessel Narrow Range (Lower) Level
DP3	2-LT -068-0370 -E	Reactor Vessel Wide Range (Dynamic) Level

Recorders

Unit 1 has dedicated Safety Related 1E recorders (1-TR-94-101 and 1-TR-94-102) to record various CET parameters. Unit 2 will not have these recorders. RG 1.97 Rev. 2, states that for Category 1 variables "Recording of instrumentation readout information should be provided . . . it may be continuously updated, stored in computer memory, and displayed on demand" the use of the Common Q system flat panel display and the recording of the CET in the ICS will allow this requirement to be fulfilled.

Note:
The CET trend information is not part of the Common Q default flat panel display screen, but is available through the touch screen interface.

Environmental Qualification

Westinghouse has provided the necessary environmental conditions for the Common Q hardware in their Topical Report and associated Safety Evaluation Report. Unit 2 must follow these qualifications in order for the Common Q equipment to operate properly. The Auxiliary Instrument Room (AIR) radiation calculation WBNAPS3126 has been revised to accommodate the Common Q hardware. Calculation WBNAPS4004, *Summary of Mild Environment Conditions for Watts Bar Nuclear Plant*, will be revised based to accommodate the humidity requirements for the new flat panel displays provided by Westinghouse.

Cables

Three new cables are pulled in this EDCR: 2C2158, 2M7712, 2M7711. Cables 2M7711 and 2M7712 are used for power to the data diodes, and cable 2C2158 is used to link panel 2-R-180 and the ICS.

Related EDCRs

53080 – Removal of rack 2-R-148
54636 – Auxiliary building V3 cables (supplies power cables for racks)
53310 – Upgrade and Installation of Anchorage to Seismic Category 1 R-Panels
52601 – RVLIS Phase 1, installation of tubing, RTDs, and unistrut
55385 – RVLIS Phase 2, installation of instruments
52322 – Installation of the Integrated Computer System (ICS)
52319 – Installation of the Eagle 21 System
53301 – External Connections for the Eagle 21 System
52987 – Installation of Hot Leg RTDs
52328 – Installation of the SSPS
52378 – Installation of Foxboro I/A System (there is no interface between Common Q and Foxboro I/A, however Common Q equipment will be installed in Foxboro I/A panel 2-R-20)
52321 – Installation of WINCISE
52718 – CRDR cutout work for panel 2-M-4
53337 – CRDR cutout work for panel 2-M-6
52361 – CRDR label installation on panel 2-M-4
52363 – CRDR label installation on panel 2-M-6

Related DCN

54598 – Addition of interface separation boundaries for associated power breakers

Associated Calculations

- ICCMCALCNOTE - *Inadequate Core Cooling Monitor (ICCM) Calculation Note Supporting ICCM Setpoint and Scaling Documents*
  - This is the supporting calculation for the SSDs. These are being supplied by.
- WBPEVAR8902002 - *Determination of Devices Required for Indicating Safety-Related Trends for WBN PAM.*
  - No action or revision is needed for this calculations
- WBNOSG4076 - *RG 1.97 variables needing trend recording*
  - This calculation establishes which of the Category 1 variables must be provided with a continuously available trend recorder.

- The SMM is one of the variables that needs trend recording, Unit 2 is using the node box as the trend recorder, Common Q PAMS is still in compliance with the calculation and no revision is required.

- WBNEEBIDQ29990901 - *Non-Class 1E Cables Required For Post Accident Monitoring Category 2 Variables*
  - This calculation contains the "block diagrams" from the respective RG 1.97 variables.
  - Unit 2 is using ICS to act as the recorder for the CETs, the data link between the Common Q panels and ICS is a Non-Class 1E cable and is considered a Category 2 Variable.
  - This calculation will need to be revised for Common Q.
- WBNEEBIDQ29990903 - *PAM Instrumentation Evaluation and Verification Methodology, Standards and Guidelines*
  - To be revised with various instrumentation information including applicable UNIDs
- MDQ00299920090342 - *WBN2CCP - Combustible Loading Data (CLD)*
  - To be revised for adding burnable weights to various compartments.
- EPMMCP071689 - *Cooling/Heating Load & Equipment/Component Performance Analysis For The Control Building Electrical Board Room Areas (el. 692.0 & 708.0)*
  - To be revised with new heat loads going into AIR.
- EPMLCP072489 - *Cooling And Heating Load Analysis, Main Control Room HVAC*
- WCGACQ0371- *Seismic Qualification of Weld Anchorage of R Panels*
  - To be revised to add the Westinghouse weld detail of the racks.
- WBNOSG4188 - *EOP Setpoints Verification Document*
  - There are various changes being made due to Common Q. This document is the responsibility Bechtel Engineering with input from Westinghouse.
- WBNOSG4220 - *WB Incore Instrumentation Systems Failure Modes and Effects Analysis (FMEA)*
  - There are various changes being made due to Common Q. This document is the responsibility Bechtel Engineering with input from Westinghouse.
- For Electrical and I&C Calculations see the Electrical and I&C Calculation Checklist.
- WCGACQ1173 - *Development of RRS for WBN Unit 2 Devices*
  - This calculation was revised to document the accelerations of the equipment provided by Westinghouse
- WBNOSG4076 - *Determination of Category 1 RG 1.97 Variables Requiring Trend Indication*
  - This Calculation determines the Category 1 variables that require trending
  - Unit 2 will not have a dedicated recorder for trending Core Exit Temperature, however the use of ICS trending and the trending available on the Common Q touch screen display fulfills the trending requirement.
  - To be revised

Related PERs

144982 – Mineral insulated cables for various cables in system 94 were installed in unistrut with no detailed installation instructions – or it had no supporting design input or output. Thus some of the cables were found to be damaged.

- Applicable Design Criteria:
  WB-DC-30-4 – separation of electrical equipment and wiring
  WB-DC-30-5 – power, control, and signal cables used in CAT I structures
- This is being addressed in the RVLIS EDCR 52601.

145147 – Westinghouse RTD cables were not installed correctly according to the drawings.

- This is being addressed in the RVLIS EDCR 52601.

143833 – This PER found that the welding was inadequate to drawing 47W605-3 and thus all cabinets in the aux instrument room will be welded from the outside.

- This EDCR will include welding information. No additional action required

172694 – Modify NCH cards (function generator) within ICCM-86 which will restore the RVLIS accuracy to plus or minus 6 percent. This modification was implemented by Westinghouse FCN WBTM-10717B.

- This is not applicable to unit 2 because the Common Q hardware is completely different than the unit 1 hardware. Additionally, TVA has no requirement in any design basis or licensing document of what the RVLIS accuracy must be (although Westinghouse does make claims what its accuracy will be).

233598 – Reconcile the fact the design basis of WBN2 is RG 1.97 rev 2 but common Q PAMS is designed to RG 1.97 rev 3 (note at the time of issuing this package, the most up to date RG 1.97 rev 4).

- This analysis was performed and submitted to the NRC. No further action required.

Procurement

- The Common Q system was procured via Procurement Request (WB2-08-182) to Westinghouse.
- Dual diodes from Owl Computing - purchased as NQR
- Digital panel meters from Otek - purchased as safety related
- Field will procure any fiber optic connectors for the interface with ICS as NQR
- Field will procure any fiber optic connectors for the interface between the racks and OM as safety related.

EDCR OPEN ITEM FORM

EDCR# **52351** **Rev. B**

Open Item Type	Check all Applicable
Calculation	X
Vendor Information	X
ICRDS Reports	
Drawing/DRA	X
DELETED	
DELETED	
Environmental Qualification – EQCS Issuance	
Appendix R	
DELETED	
Other: Review ERDS points	X

Open Item Details:

Open Item Number	Open Item Description:
OI-52351-01	Revise Calculation WCGACQ0319, *Seismic Evaluation of Panel 2-M-4 in Control Room*
OI-52351-02	Revise Calculation WBNEEBMSTI090042, *Electrical Heat Generation in the Control Building Main Control Room, El 708.8 (Rms C1 & C4) and El 729.0 (Rm C1)*
OI-52351-03	Revise Calculation EDQ00299920080006, *Unit 2 Class 1E V3 Cable Ampacity*
OI-52351-04	Revise Calculation EPMMCP071689, *Cooling/Heating Load & Equipment/Component Performance Analysis for the Control Building Electrical Board Room Areas (el. 692.0 & 708.0)*
OI-52351-05	Revise Calculation WBNEEBMSTI070018, *120 VAC Protection, Coordination and Short Circuit Study*
OI-52351-06	Revise Calculation WCGACQ0371, *Seismic Qualification of Weld Anchorage of R Panels*
OI-52351-07	Revise Calculation MDQ00299920090342, *WBN2CCP - Combustible Loading Data (CLD)*
OI-52351-08	Approve the qualification summary report for Common Q system, for the EMI/RFI and environmental reports sections.
OI-52351-09	Complete the Cyber Security Assessment for the installation of Common Q PAMS

Refer to the electronic documents in TVA Business Support Library (BSL) for current revision.

EDCR OPEN ITEM FORM

Open Item Number	Open Item Description:
OI-52351-10	Revise Calculation WBNEEBIDQ29990901, *Non-Class 1E Cables Required for Post Accident Monitoring Category 2 Variables*
OI-52351-11	Revise Calculation WBNEEBIDQ29990903, *PAM Instrumentation Evaluation and Verification Methodology, Standards and Guidelines*
OI-52351-12	Revise Calculation WBNAPS4004, *Summary of Mild Environment Conditions For Watts Bar Nuclear Plant*
OI-52351-13	Revise Environmental drawings to incorporate the change in calculation WBNAPS4004
OI-52351-14	Coordinate ICS points that are also ERDS points
OI-52351-15	Receive and approve the "Final Initial" Technical manual from Westinghouse
OI-52351-16	Receive and approve Setpoint and scaling Document (SSD) supporting calculations
OI-52351-17	Revise Calculation WBNOSG4188, *EOP Setpoints Verification Document*
OI-52351-18	Revise Calculation WBNOSG4220, *WB Incore Instrumentation Systems Failure Modes and Effects Analysis (FMEA)*
OI-52351-19	Revise Calculation WBNOSG4076, *Determination of Category 1 RG 1.97 Variables Requiring Trend Indication*
OI-52351-20	Revise Main Control Room Panel drawings (DRAs) for correct wiring of new DPM
OI-52351-21	Receive and approve the seismic report new digital panel meters on 2-M-4
OI-52351-22	Revise Calculation EDN00299920080005, *Load flow, Voltage Drop, Short Circuit, Cable Ampacity in Conduits and Trays and Protection/Coordination for Unit 2 BOP Circuits*

Action Plan for Open Item:

Open Item Number	Open Item Action Plan
OI-52351-01	Issue Revision of Calculation WCGACQ0319, *Seismic Evaluation of Panel 2-M-4 in Control Room,* to include EDCR 52351
OI-52351-02	Issue Revision of Calculation WBNEEBMSTI090042, *Electrical Heat Generation in the Control Building Main Control Room, El 708.8 (Rms C1 & C4) and El 729.0 (Rm C1),* to include EDCR 52351
OI-52351-03	Issue Revision of Calculation EDQ00299920080006, *Unit 2 Class 1E V3 Cable Ampacity,* to include EDCR 52351
OI-52351-04	Issue Revision of Calculation EPMMCP071689, *Cooling/Heating Load & Equipment/Component Performance Analysis for the Control Building Electrical Board Room Areas (el. 692.0 & 708.0),* to include EDCR 52351 (See the Technical Evaluation Mechanical Section, Question #4)
OI-52351-05	Issue Revision of Calculation WBNEEBMSTI070018, *120 VAC Protection, Coordination and Short Circuit Study,* to include EDCR 52351
OI-52351-06	Issue Revision of Calculation WCGACQ0371, *Seismic Qualification of Weld Anchorage of R Panels,* to include EDCR 52351
OI-52351-07	Issue Revision of Calculation MDQ00299920090342, *WBN2CCP - Combustible Loading Data (CLD),* to include EDCR 52351
OI-52351-08	Approve the qualification summary report for Common Q system, for the EMI/RFI and environmental reports sections.
OI-52351-09	Complete the Cyber Security Assessment for the installation of Common Q PAMS
OI-52351-10	Issue Revision of Calculation WBNEEBIDQ29990901, *Non-Class 1E Cables Required for Post Accident Monitoring Category 2 Variables,* to include EDCR 52351

EDCR OPEN ITEM FORM

Open Item Number	Open Item Action Plan
OI-52351-11	Issue Revision of Calculation WBNEEBIDQ29990903, *PAM Instrumentation Evaluation and Verification Methodology, Standards and Guidelines,* to include EDCR 52351
OI-52351-12	Issue Revision of Calculation WBNAPS4004, *Summary of Mild Environment Conditions For Watts Bar Nuclear Plant,* to include EDCR 52351
OI-52351-13	Create DRAs to include that revise the environmental drawings to incorporate the changes made to calculation WBNAPS4004
OI-52351-14	Coordinate ICS points that are also ERDS points (See item #19 in Technical Evaluation, in I&C Section)
OI-52351-15	Receive and approve the "Final Initial" Technical manual from Westinghouse (Under Westinghouse schedule activity WS 312565)
OI-52351-16	Receive and approve the SSD supporting Calculations that are to be supplied by Westinghouse.
OI-52351-17	Issue Revision of Calculation WBNAPS4004, *EOP Setpoints Verification Document*, to include EDCR 52351/Westinghouse
OI-52351-18	Revise Calculation WBNOSG4220, *WB Incore Instrumentation Systems Failure Modes and Effects Analysis (FMEA),* to include EDCR 52351/Westinghouse
OI-52351-19	Revise Calculation WBNOSG4076, *Determination of Category 1 RG 1.97 Variables Requiring Trend Indication,* to include EDCR 52351 modifications
OI-52351-20	Add DRAs to Correct drawings to show correct wiring of new DPMs
OI-52351-21	Receive and approve the seismic report new digital panel meters on 2-M-4
OI-52351-22	Revise Calculation EDN00299920080005, *Load flow, Voltage Drop, Short Circuit, Cable Ampacity in Conduits and Trays and Protection/Coordination for Unit 2 BOP Circuits,* to include EDCR 52351

Action Taken:

Open Item Number	Action Taken for Closure:
OI-52351-01	
OI-52351-02	
OI-52351-03	
OI-52351-04	
OI-52351-05	
OI-52351-06	
OI-52351-07	
OI-52351-08	

EDCR UNIT DIFFERENCE FORM

EDCR# 52351 **Rev.** B

Operations Difference is Identified as follows:

1. Unit 1 has monochrome CRTs to display the Post Accident Monitoring (PAM) variables. Unit 2 will have a touch screen multi-color display; the Unit 2 display is larger and more visible for the operators.

2. The default screen on Unit 1 displays:
   - CET Highest quadrant average
   - CET based subcooled margin
   - RVLIS level
   - RCP status
   - RVLIS mode
   - Logo of pump in dynamic mode and the core in static mode
   - RCS pressure
   - T_{HOT}

   The default screen on Unit 2 displays:
   - The highest CET value in each quadrant (four values total)
   - CET and auctioneered T_{HOT} based subcooled margin
   - RVLIS level along with a much improved graphic of the core depicting the loops.
   - RCP status
   - RVLIS mode
   - RCS pressure
   - Void Fraction

   Unit 2 no longer has the value for T_{HOT} displayed on the default screen, however during events where it is necessary to monitor the hot leg temperature operators are trained to monitor hot leg indicators, not the ICCM screen (or for Unit 2 the Common Q screen).

3. Unit 1 has 1E CET recorders: 1-TR-94-101-J, located on 1-M-4 for Train A, and 1-TR-94-102-K located on 1-M-6 for Train B to record various CET parameters. Unit 2 will not have these recorders. RG 1.97 Rev. 2, states that for Category 1 variables "Recording of instrumentation readout information should be provided . . . it may be continuously updated, stored in computer memory, and displayed on demand" the use of the Common Q flat panel display and the recording of the CET in the ICS will allow this requirement to be fulfilled.

4. Unit 1 annunciator window box XA-55-4B, window 85F, and window box XA-55-6C, window 124E, annunciates on 'RVLIS SYSTEM MALFUNCTION'. The Unit 1 windows will annunciate when they receive a signal from the Unit 1 ICCM panels 1-R-179 and 1-R-180 indicting a 'Diagnostic Error' or a 'Calculation Alarm.' The equivalent Unit 2 window box 2-XA-55-4B, window 85F and window box 2-XA-55-6C, window 124E will annunciate on a signal from the Common Q Panel, 2-R-179 and 2-R-180 respectively, for 'COMMON Q SYSTEM TROUBLE'. For Unit 2 this window will annunciate when there are various internal problems within the system, including a high temperature signal from an RTD located inside the panel.

5. Unit 1 has 'Screen Select' push buttons, Unit 2 will have a touch screen display and operators will use the touch screen to select which screen they want displayed.

6. Unit 1 RCS Subcooling Margin Monitors, 1-TI-68-105 and 1-TI-68-115, are Analogic Digital Panel Meters (DPM). The Analogic DPMs are obsolete and Unit 2 RCS Subcooling Margin Monitors, 2-TI-68-105 and 2-TI-68-115, will use Otek DPMs, the Otek DPMs will have a similar LED displays that are the same color blue.

7. On Unit 2, the Common Q Maintenance Test Panel (MTP) has a Function Enable (FE) key switch. The FE key switch will allow for enabling print screen function, bypassing any input signal, changing selected alarm setpoints, changing alarm reset points, system functional tests, and parameters through the MTP. The Common Q MTP also has a Software Load Enable (SLE) key switch. The SLE key switch controls which media (software storage devices) and operating system the MTP will use. The SLE key switch will allow the selection between an online mode or maintenance mode.

8. The Unit 1 Core Exit Thermocouples (CETs) are top-mounted and are in direct contact with the core exit fluid. The Unit 2 CETs will be located inside the Incore Instrumentation Thimble Assemblies (IITAs). The IITAs are inserted into the instrumentation thimble tubes and are inserted through the bottom of the reactor, and are provided as part of the WINCISE system (See EDCR 52321). Since the CETs for Unit 2 are located inside the IITAs the CETs are not in direct contact with the core exit fluid and will have a temperature differential from the bulk fluid conditions at the core exit. The temperature differential is primarily driven by a difference in flow velocity between the coolant inside the instrumentation thimble tubes and that of the fuel assemblies. Maximum temperature differences expected between the bulk core exit temperature and the temperature measured by the Unit 2 CETs will be 15°F; this is therefore the difference in the temperature between the Unit 1 CETs and the Unit 2 CETs. The bounding temperature difference is obtained assuming a Steam Line Break (SLB), during this event the fluid temperature within the instrumentation thimble tube 'hangs up'

while the bulk conditions of the core experience a rapid cool down from the SLB accident. In steady state conditions this temperature difference is expected to be less than15°F.

9. In Unit 1 the value of Auctioneered T_{HOT} is 2 to 4°F lower than the value of the highest average quadrant temperature. When the SMM is calculated using the highest average quadrant temperature this creates a scenario where the saturation margin is lower, and therefore more conservative. Unit 1 uses the highest average quadrant temperature in the calculation of the SMM. The Unit 2 SMM value will be calculated using 'T_{CREP}' which is a value based on a sophisticated statistical analysis of the CET values. The Unit 2 SMM value based on the CETs may be different then the Unit 1 value, this is because the Unit 2 value is calculated using T_{CREP} instead of the highest average quadrant temperature and the physical location of the Unit 2 CETs is different than Unit 1. Using the discussion in this section (Operations Difference) #8, during steady state conditions, the Unit 2 CET temperature will be lower than Auctioneered T_{HOT} therefore, using the CET as a basis for the SMM would result in larger margins and would be less conservative. During a bounding event (SLB) when the maximum temperature difference is expected to occur, the fluid temperature within the instrumentation thimble tube 'hangs up' and the value of T_{CREP} will be hotter than the bulk conditions of the core. In this case the bulk conditions of the core and therefore the value of auctioneered T_{HOT} will be cooler than T_{CREP} and for this bounding situation the value for the SMM will result in a smaller margin and therefore, is more conservative. (Note: both CET and T_{HOT} based SMM are displayed on the default Common Q screen)

10. The span of the Unit 1digital panel meters, 1-TI-68-105 and 1-TI-68-115, is -20 to 200°F, the span of the Unit 2 digital panel meters, 2-TI-68-105 and 2-TI-68-115, -800 to 200°F. Although the span is much larger for Unit 2 due to the fact that this is a digital indicator and the span is not shown on it, this difference should not affect the operators.

SA Strickler, SAStrickler for Tom Wallace 5/19/2011

Unit 2 TVA Operations Acceptance (Mgr or Designee): **Date:**

Maintenance Difference is identified as follows:

1. Unit 1 has a separate maintenance test panel box for system maintenance. In Unit 2 all similar maintenance functions can be accomplished internal to the panels.

2. Unit 2 panels 2-R-179 and 2-R-180 have a 'simulator hookup' located at the bottom of the panel for the input of signals to replicate various plant conditions.

3. Unit 1 RCS Subcooling Margin Monitors, 1-TI-68-105 and 1-TI-68-115, are Analogic Digital Panel Meters (DPM), which is a software based meter. The Analogic DPMs are obsolete and Unit 2 RCS Subcooling Margin Monitors, 2-TI-68-105 and 2-TI-68-115, will use Otek DPMs, the Otek DPMs are non-software based devices that have potentiometers for GAIN and ZERO.

4. Unit 2 uses data diodes for isolation between the Common Q panels 2-R-179 and 2-R-180 and the plant computer. Unit 1 does not use data diodes for this purpose.

5. On Unit 2, the Common Q Maintenance Test Panel (MTP) has a Function Enable (FE) key switch. The FE key switch will allow for enabling print screen function, bypassing any input signal, changing selected alarm setpoints, changing alarm reset points, system functional tests, and parameters through the MTP. The Common Q MTP also has a Software Load Enable (SLE) key switch. The SLE key switch controls which media (software storage devices) and operating system the MTP will use. The SLE key switch will allow the operator to select between an online mode or maintenance mode.

6. Unit 2 has a different number of RVLIS RTDs and the RTDs also have a different location then those on Unit 1. This difference is due to the fact that the Unit 2 RVLIS capillary route is different. (Note: This could affect maintenance if an RTD fails)

7. The Unit 2 cables from the CETs go through Westinghouse 'Feedthrough Module Assemblies with Integral Electrical Connectors' which go through penetration 18 and 33. The cable is provided by Westinghouse and is considered part of the instrument, so that it is a Type K thermocouple all the way to the local Common Q racks. The need for reference junction boxes located inside containment is eliminated. The Unit 2 Core Exit Thermocouple Integral Reference Junction RTDs for the Type-K thermocouples are located in the Common Q panels 2-R-179 and 2-R-180.

S Strickler, SStrickler for Brian Briody* 5/19/2011

Unit 2 TVA Maintenance Acceptance (Mgr or Designee): Date:

* Originally signed on copy dated 4/29/11 SStrickler

Design Difference is identified as follows:

1. Unit 1 has 65 CETs and Unit 2 has 58 CETs located in different core locations. Unit 1 has the Movable Incore Detection System (MIDS) with top-mounted Core Exit Thermocouples. The cables connected to the top mounted CETs are removed during outages so that the reactor vessel head can be removed. Unit 2 has the Westinghouse Incore Instrumentation, Surveillance, and Engineering (WINCISE) System with CETs located in new Incore Instrument Thimble Assemblies inserted through the bottom of the reactor. The location of the new CETs eliminates the need to spend time at the reactor vessel head to remove CET cables during an outage. The new design helps Unit 2 achieve ALARA goals.

2. The Unit 2 cables from the CETs go through Westinghouse 'Feedthrough Module Assemblies with Integral Electrical Connectors' which go through penetration 18 and 33. The cable is provided by Westinghouse and is considered part of the instrument, so that it is a Type K thermocouple all the way to the local Common Q racks. The need for reference junction boxes located inside containment is eliminated. The Unit 2 Core Exit Thermocouple Integral Reference Junction RTDs for the Type-K thermocouples are located in the Common Q panels 2-R-179 and 2-R-180. The new design helps Unit 2 achieve ALARA goals.

3. Unit 2 will have a different number and location of RVLIS RTDs, and therefore the number of inputs to the Common Q system will be different. The field routed unistrut was existing in Unit 2 and was used in the design of the RVLIS portion of the system (See EDCR 52601). The Unit 2 configuration differs from Unit 1 but both achieve the same purpose.

4. On Unit 2 a single RTD will be used for compensation of both the head and seal table capillary lines in one location for Train A and in two locations for Train B. In these three specific instances both the head and seal table capillary lines are run together for the vertical section, where compensation is needed, and no differential pressure is taken across the head and the bottom of the core. The Common Q system uses one RTD input for two separate compensation calculations, depending on the plant status, through the use of addressable constants. This configuration is used to save cost and keep the system simpler. While Unit 2 only uses one RTD input for two compensations, the output is the same.

5. The Unit 1 Subcooled Margin Monitors (SMM) digital panel meters (1-TI-68-105 and 1-TI-68-115) have selectable inputs using the portable maintenance test panel. For Unit 1 the SMM can be based on either auctioneered T_{HOT} or quadrant average CET value. The Unit 2 Common Q system calculates the SMM value based on both auctioneered T_{HOT} and

T_{CREP}. The analog output for the SMM values are located on different terminal blocks in the Common Q panels and therefore only one will be displayed and the values are not selectable as in Unit 1. (Note: The Unit 2 SMM value will be different than that of Unit 1, the 'Operations Difference Section' of this Unit Difference Form has an in-depth discussion)

6. The Unit 1 analog output to the digital panel meters, 1-TI-68-105 and 1-TI-68-115, is 0-10 VDC, the Unit 2 analog output to the digital panel meters, 2-TI-68-105 and 2-TI-68-115, from the Common Q system is 4-20 mA. Although the input to the digital panel meters varies from Unit 1 to Unit 2, both display the same information. The span of the digital panel meters for Unit 1 is -20 to 200°F and the span for Unit 2 is -800 to 200°F.

7. There are various UNID difference due to the fact that Unit 2 is installing a completely new Common Q system that has different components than the system used on Unit 1. Attempts were made to keep consistency between the Unit 1 and Unit 2 UNIDs even if the actual component was different between the Units.

8. The Unit 2 link from the Common Q panels to ICS will pass through a data diode device to ensure one way TCP/IP network flow. This configuration is used to ensure cyber security compliance (Regulatory Guide 5.71).

9. Due to the fact that Unit 2 is using a different system than is currently used for Unit 1 there will be a difference in the data points that are sent to ICS. The new Common Q system does not calculate all of the same data points that are calculated by the Unit 1 system. Data points that are not exactly duplicated in Unit 2 are often replace with a similar value. The difference in data points sent to ICS does not affect the function of the system.

10. The new Common Q panels 2-R-179 and 2-R-180 have a different physical set up than the panels in Unit 1. This difference will be reflected on the Unit 2 Common Q connection diagrams series 2-45W2623. These systems perform the same function and the internal configuration difference between the Units does not affect the performance of the system.

11. Unit 2 will use Safety Related fiber optic cable as a link between the local panels and the operator's module. The Westinghouse Common Q design calls for the use of this safety related fiber optic cable and Safety Related 1E fiber optic cabling has been procured.

Carl C. Lyke for — 05/24/11

Unit 2 TVA Engineering Acceptance (Mgr or Designee): **Date:**

Laura Radcliffe — 5/24/11

Prepared By: Laura Radcliffe **Date:**

Streamlined EDCR approved by TVA Oversight________________________________

SESG TO ROUTE A COPY OF THIS COMPLETED FORM TO TVA TRAINING MANAGER AND TO UNIT 2 LICENSING.

This attachment provides topics to be considered when evaluating the technical and safety aspect of changes being implemented in WBN Unit 0 and/or Unit 1 by the EDCR-2 process; see Reference 5.0A. It is not intended to be an all inclusive list of items to be considered. It is to be used as an aid in determining attributes that should be addressed in a technical evaluation. Information is also provided to aid in determining coordination interfaces. These are minimum guidelines which are primarily excerpts from SPP-9.3. It should be recognized that many topics and changes involve multiple disciplines and organizations and technical considerations must be coordinated accordingly. All parts of Attachment 1 must be considered for applicability for the associated EDCR-2.

GENERAL:

☒ YES ☐ NO 1. Are the nuclear safety functions, protective safety functions, Class IE requirements, or Seismic Category I or I(L) requirements of a design criteria, system description, FSAR, Technical Specification (Bases), or Technical Requirements Manual (Bases) affected?

***Design Criteria** – WB-DC-30-7 'Post Accident Monitoring Instrumentation' has three PAM variables that are measured by the Common Q system*
6 – Core Exit Temperature
16 – Subcooling margin monitor
22 – reactor vessel level
There are two other parameters – RCS WR pressure and WR temperature – which are PAM variables that are fed into Common Q. The operator will be able to see these values on the OM, but this is not the primary way these variables are viewed.

The Common Q PAMS was designed to meet the requirements of RG 1.97, Revision 3, the Watts Bar Project licensing basis is for RG 1.97, Revision 2. A new appendix was added to the Design Criteria, WB-DC-30-7, to perform a comparison between Revision 2 and 3 of RG 1.97 as it relates to Common Q PAMS. The comparison concludes that although the Common Q PAMS was designed to meet RG 1.97, revision 3, requirements, it is also compliant with RG 1.97, revision 2. This information was sent to the NRC.

System Description – The Common Q System contains both system 68 and system 94. EDCR 52351 impacts both System Descriptions: N3-94-4003, Incore Instrumentation System, and N3-68-4001, Reactor Coolant System. A system description revision package is included in this EDCR.

FSAR – PP-10's have been completed and included in this EDCR for all impacted sections of the FSAR.

Tech Spec – Common Q impacts the Technical Specifications. See attached PP-10 package.

☒ YES ☐ NO 2. Is there an operational/configuration change? Is a component being added to or removed from the plant? Is a component being disabled or abandoned in place? Is the normal or accident position of a valve changing? Is an electrical isolation device being added or deleted? Is a portion of the system being rerouted?

Operational/Configuration Change – Common Q will have operator differences, the most significant is the installation of two touch screen displays, one on 2-M-4 for Train A and one on 2-M-6 for Train B. See the Unit Difference Form for a detailed write-up.

Components Added – multiple components are being added to the plant. See the MEL package.

Added Electrical Isolation – There are two new 1E to Non-1E interfaces per train added. Isolation is accomplished on the hardware level and is within Westinghouse's cabinet. One transition is from the data link from 2-R-179 and 2-R-180 to ICS, isolation is accomplished by using a fiber optic interface. The other is signal from 2-R-179 and 2-R-180 to the annunciator system; isolation is accomplished by using a 1E relay.

GENERAL:			
☐ YES	☒ NO	3.	Could the change affect the basic function of a structure, system or component that performs or supports the performance of a safety function (deleting or changing logic interlocking, additional pumps, etc.)? Is the most limiting operating condition or design criteria imposed on the change, or by the change, evaluated? Include effects by or on Safety Related or Non-Safety Related systems in their various possible configurations. Does the change meet or exceed design criteria or other SSCs in similar applications? ***The Common Q System is a Safety Related system used for monitoring in a post accident environment. This system is new and different from the ICCM-86 System currently installed on Unit 1; however the basic function of these systems is the same. This EDCR installs the Common Q system in the Main Control Room and the Auxiliary Control Room which are both considered mild environments and all components are mounted using Cat 1 standards. Therefore, the most limiting conditions are being accounted for. The Common Q system is designed to provide isolation from non-safety related systems so that the failure of one of these systems (either ICS or Annunciator) will not have an effect on its safety function.***
☐ YES	☒ NO	4.	Could the change affect environmental conditions such as pressure, temperature, humidity, flooding, corrosiveness, site elevation, nuclear radiation (both rate and total integrated dose), and duration of exposure in either harsh or mild areas? If "YES", the change shall be coordinated with the Lead Electrical/I&C Engineer, and if applicable, with ME/NE for potential revisions to the EQ/MEQ Binders.
☐ YES	☒ NO	5.	Could the change involve relocating or reorienting a device or system which could impact location-specific dose calculation or shielding analyses or place the device or system in an area with different environmental conditions? If YES, coordinate with ME/NE to revise the affected location specific dose calculation, environmental drawings, and EQ/MEQ documentation.
☐ YES	☒ NO	6.	Are Security Systems modified?
☐ YES	☒ NO	7.	Does the modification add quantities of chemicals that may have an impact on control room habitability? If YES, evaluate impact on control room habitability per NRC Reg. Guide 1.78.

GENERAL:

☒ YES ☐ NO 8. Has the component being added or modified been evaluated for proper physical orientation? Components that require consideration are: capacitors, relays, check valves, steam traps, flow and level measuring devices, pressure switches, and solenoid valves. Other components may require consideration based on special applications, unique circumstances or vendor/manufacturer's recommendations.

All components will be installed according to manufacturers' installation instructions.

☒ YES ☐ NO 9. Based on the following considerations does the change create an operating unit difference?

☒ YES ☐ NO The change being made creates operational differences that would affect actions by the Operations staff.

Common Q will have operator differences; the most significant is the installation of two touch screen displays, one on 2-M-4 for Train A and one on 2-M-6 for Train B. See the Unit Difference Form for a detailed write-up.

If YES, coordinate with Operations to ensure impacts on training are considered.

☒ YES ☐ NO The change being made creates operational differences that would affect the simulator.

Common Q will have operator differences; including the installation of two touch screen displays, one on 2-M-4 for Train A and one on 2-M-6 for Train B. See the Unit Difference Form for a detailed write-up.

If YES, coordinate with Operations to ensure simulator is updated.

The simulator will not be updated to include the Unit 2 differences, these changes will be handled with independent operator training or other process separate from this EDCR.

☒ YES ☐ NO The change being made creates unit differences that are economically feasible and would improve the operation or maintenance of the other unit or units.

The ICCM-86 is an outdated system; Unit 1 is aware of this and there are no plans to update the Unit 1 system in the near future.

If YES, initiate the appropriate package for Technical Review Committee.

GENERAL:

☒ YES	☐ NO	10.	Have considerations for mounting, connecting, and positioning of components included an evaluation of the required robustness of associated elements? Has the evaluation for robustness considered the need for protection from bumping, jarring, vibration, etc?" ***All components are being installed per the vendor's installation details.***
☐ YES	☒ NO	11.	Is this modification subject to vibration, thermal movement, and/or leaks on trip sensitive equipment? (i.e., replace carbon steel piping with stainless steel piping, modify routing such that thermal flexibility is reduced, modify support or support locations to resist thermal expansion, process and/or pneumatic leaks.) If yes, develop and incorporate a monitoring plan.

CIVIL:			
☐ YES	☒ NO	1.	Does the change potentially impact pipe break considerations, pipe whip, or jet impingement? Consideration should include changes to operating modes, the addition or rerouting or high energy pipe greater than 1 inch nominal diameter, or change or modify pipe rupture protection devices. Does the change relocate or add potential targets such as electrical components, equipment, conduits, instruments or air lines to compartments containing fluid systems? The change may be evaluated generically rather than on a case-by-case basis as described in Civil Design Guide DG-C1.2.10. ***Equipment Installation is in the Auxiliary Instrument Room and Main Control Room, neither location is in an area of high energy or moderate energy piping***
☐ YES	☒ NO	2.	Does the change affect piping vibration or testing requirements? Was there a mass change? Were supports added/deleted? Was an orifice, valve, or other flow device added or deleted? Was there an operational or configuration change? ***No piping, valves, or components attached to piping are being added, deleted, or modified.***
☒ YES	☐ NO	3.	Are Seismic Category I or I(L) components added, deleted, or modified? Are components in a Seismic Category I structure added, deleted, or modified? Does the change affect the seismic or dead weight analyses? ***Seismic Category I Common Q Panels 2-R-179 and 2-R-180 are replacing existing panel 2-R-148. The seismic qualification and anchorage design are documented in Westinghouse Seismic Report WB-QR-68-WBT-P. DRA 52351-001 and Westinghouse Dwg No. 10044E60-1 provide installation instructions for the new cabinets. TVA Calc No. WCG-ACQ-0371 addresses the qualification of the base plate and concrete structure where the new panels are to be installed.*** ***The seismic qualification of Common Q OM equipment (two flat panel displays, two PC Node Boxes, and four Modems) is also documented in WB-QR-68-WBT-P. Calculation WCGACQ1173 documents the required response spectra for the Flat Panel Displays for comparison to the test response spectra documented in WB-QR-68-WBT-P. One Flat Panel Display and two new Panel Meters are being added to Main Control Room Panel 2-M-4 along with one PC Node Box and two Modems to be added on the floor inside 2-M-4. The seismic qualification of Panel 2-M-4 will be documented in calculation WCGACQ0319. The seismic qualification of the Panel Meters will be provided by the procurement process. One Flat panel Display is being added to Main Control Room Panel 2-M-6 along with one PC Node Box and two Modems to be added on the floor inside 2-M-6. The seismic qualification of Panel 2-M-6 is documented in calculation WCGACQ0412.*** ***Caution: Panel 2-M-6 contains equipment required for Unit 1***

CIVIL:			
☒ YES	☐ NO	4.	Does the change involve an existing attachment on a Seismic Category I structure/civil feature (e.g., new loads generated, revise loads previously approved, physical modification required at interface points) or the addition of an attachment to and/or penetration of a Seismic Category I structure(s)? Does the change affect the attachment or add attachments of engineered features to masonry block walls in a Seismic Category I structure? Does the change impact the fire resistance rating of a fire barrier? ***The Common Q Panels 2-R-179 and 2-R-180 are to be installed on existing steel embedded plates. The qualification of embedments under the new cabinets is addressed in TVA Calc No. WCG-ACQ-0371.*** ***Main Control Room Panels 2-M-4 and 2-M-6 are installed on existing steel embedments. The qualification of the steel embedments and the concrete under these existing cabinets is addressed in calculation WCGACQ0412 for 2-M-6 and will be addressed in calculation WCGACQ0319 for 2-M-4.***
☐ YES	☒ NO	5.	Could the change affect WBN Probable Maximum Precipitation (PMP) site drainage (i.e. add or obstruct surface to water flow, divert or reroute a flow path, change ground surface contours, change from vegetation to concrete or pavement, etc.). ***The equipment installations are inside the plant buildings and cannot affect site drainage.*** If YES is the response to any of these questions, consult Civil Engineering.

ELECTRICAL/INSTRUMENTATION & CONTROLS:

☒ YES ☐ NO

1. Does the change affect breaker alignment, electrical loads, or electrical separation/isolation?

The two new Common Q panels, 2-R-179 and 2-R-180, will be powered from the 120 VAC vital boards, the new flat panel displays will be powered from the 120 VAC vital instrument boards, and the new data diodes will be powered from the Non-1E instrument power panels.

There are two new 1E to Non-1E interfaces per train added. Isolation is accomplished on the hardware level and is within Westinghouse's cabinet. One transition is from the data link from 2-R-179 and 2-R-180 to ICS, isolation is accomplished by using a fiber optic interface. The other is signal from 2-R-179 and 2-R-180 to the annunciator system; isolation is accomplished by using a 1E relay.

☐ YES ☒ NO

2. Is any low or medium voltage (V3, V4, or V5) electrical containment penetration protector (circuit breaker or fuse) involved?

☐ YES ☒ NO

3. Has any electrical load classification changed (non-1E to 1E)? Is the Class 1E classification for a fuse on the Fuse Tab changing?

☐ YES ☒ NO

4. Does the change involve instrument set points, instrument/relay settings or other instrument information found in EMPAC? Is the change consistent with N-specs (e.g., instrument line slopes and installation)? Has reset and deadband been evaluated?

Common Q receives input from various instruments. However these instruments are being installed by other EDCRs.

☒ YES ☐ NO

5. Does the change alter, add, or delete Post Accident Monitoring (PAM) equipment or affect the type, category, or operating time of existing equipment? (See Design Criteria for the list of PAM variables.)

Common Q provides post accident information for Variables:

- ***6 - Core Exit Temperature***
- ***16 - Subcooling Margin***
- ***22 - Reactor Vessel Level***

If YES, coordinate with M/N, EE, Operations and Licensing to ensure continued Reg. Guide 1.97 compliance.

Calculation WBNEEBIDQ29990901 will need to be revised to include the Non-Class 1E Cables associated with the ICS points from the Core Exit Thermocouples. Calculation WBNEEBIDQ29990903, PAM Instrumentation Evaluation and Verification Methodology, Standards and Guidelines, will need to be revised to include the new Common Q System.

ELECTRICAL/INSTRUMENTATION & CONTROLS:			
☐ YES	☒ NO	6.	Does the change involve instrument ratings? (Relay or solenoid coil ratings, contact ratings, duty cycles, etc.)
☒ YES	☐ NO	7.	Does the change challenge the capacity of another system (Air conditioning system heat load, control air load, electrical load)? ***Common Q components require power and will produce heat. The Common Q System consumes 4A in each new Panel (2-R-179 and 2-R-180), each PC Node Box consumes 1.25A, and each fiber/cat5 modems consume 0.5A.*** ***Calculation WBNEEMBSTI090042, Electrical Heat Generation in the control Building Main Control Room, El. 708.0 (Rms C1 & C4) and El 729.0 (Rm C1), will be revised, See Open Item OI-52351-02. Based on the result of Calculation WBNEEMBSTI090042, Calculation EPMMCP071689, Cooling/Heating Load & Equipment/Component Performance Analysis For The Control Building Electrical Board Room Areas, may need to be revised, Open Item OI-52351-04 will track this analysis.***
☒ YES	☐ NO	8.	Does the change affect the operating or accident environment or instrumentation? Is the electrical equipment or instrumentation required to operate in the affected environment? Have potential operating and accident environments of equipment been considered? ***The Common Q PAMS is required to operate in post accident environments. The system is 1E and seismic Cat 1. All of the Common Q components are located in mild environments. (Note: Many of the instruments that are inputs to the Common Q system are located in harsh environments; however these instruments will be evaluated by the EDCRs that install them)***
☒ YES	☐ NO	9.	Have the effects of EMI/RFI been considered? ***The Westinghouse Common Q design does not comply with TVA SS-E18.14.01. The Common Q PAMS has been qualified to the requirements of Regulatory Guide 1.180, Revision 1, Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems. Westinghouse will submit an EQ summary report to be reviewed (See open item OI-52351-08).*** ***During the welding of new panels 2-R-179 and 2-R-180 in the Auxiliary Control Room construction will implement precautionary measures to preclude EMI/RFI interference with Unit 1 components located in the vicinity.***

ELECTRICAL/INSTRUMENTATION & CONTROLS:			
☒ YES	☐ NO	10.	Is the logic of system operation changed? Are new or modified interfaces (physically or electrically) with safety related or important to safety equipment created? ***There is no logic associated with the Common Q. The Common Q system does not make any decisions or take any action it only uses inputs to calculate and display plant conditions for the operators.*** ***There are two new 1E to Non-1E interfaces per train added. Isolation is accomplished on the hardware level and is within Westinghouse's cabinet. One transition is from the data link from 2-R-179 and 2-R-180 to ICS, isolation is accomplished by using a fiber optic interface. The other is signal from 2-R-179 and 2-R-180 to the annunciator system; isolation is accomplished by using a 1E relay.***
☐ YES	☒ NO	11.	Does the change affect, add, or delete equipment within the scope of 10CFR 50.49 (EQ)? Review appropriate documents such as MEL, Essentially Mild Calculations, Category & Operating Times Calculations, and/or equipment in a harsh environment? Cable must be considered (e.g., mild to harsh environment). ***The Common Q System is installed in mild environments; the instruments that feed Common Q and are located in harsh environments are evaluated by the EDCR that installed them.*** If "YES", the change shall be coordinated with the EQ and MEQ Program Engineers for potential revisions to EQ/MEQ Binders.
☐ YES	☒ NO	12.	Could the change affect materials such as lubricants, seals and O-rings, which could impact Qualification Maintenance Data Sheet (QMDS) requirements and qualification analyses, and invalidate test data, or could the change affect special maintenance (QMDS) and/or administrative requirements and controls that might impact the qualification of an item? If YES, coordinate with the responsible discipline on revisions to the QMDS.

ELECTRICAL/INSTRUMENTATION & CONTROLS:

☒ YES ☐ NO

13. Does the change involve a power, control, or instrumentation circuit for a 10CFR50.49 component either by direct connection or relay logic or involve a non-10CFR50.49 power control or instrumentation circuit which have a credible circuit interaction failure mode with 10CFR50.49 power control or instrumentation circuit?

The Common Q System is installed in mild environments; the instruments that feed Common Q and are located in harsh environments are evaluated by the EDCR that installed them.

If YES, perform an analysis in accordance with SPP-9.2, Appendix I for any safety-related cables or components located in a harsh environment that are designated as Category C (i.e. not required to be addressed in the EQ program).

The inputs to the Common Q system are:

- ***RVLIS TEs - CAT A for all events***
- ***RVLIS LTs - CAT A for all events***
- ***WINCISE CETs - CAT A for all events***
- ***WR RTDs - CAT A for all events (input to Common Q is through Eagle 21)***
- ***WR PT - CAT A for all events (input to Common Q is through Eagle 21)***
- ***RVLIS XIS - located in mild environment (auxiliary building)***

The Common Q system does not have interactions with any Category C components.

☐ YES ☒ NO

14. Does the change upgrade the function of an existing device/cable such that additional QA records and documentation are needed to support 10CFR50.49 Qualification in accordance with 10CFR50, Appendix B manufacturing, procurement, installation, etc.)?

If YES, provided additional documentation as required.

☐ YES ☒ NO

15. Does the modification affect components/equipment that require periodic testing of electrical test points.

If YES, provide appropriate test jacks which are accessible to prevent accidental contact with adjacent electrical terminations during testing.

☐ YES ☒ NO

16. Does the modification change functional logic which has the potential of affecting design characteristics?

If YES, evaluate PER/NER history on the equipment being modified to determine if problems have previously been identified.

ELECTRICAL/INSTRUMENTATION & CONTROLS:

☒ YES ☐ NO 17. Does the modification involve a programmatic or digital logic controller?

Common Q has multiple PLCs located in panels 2-R-179 and 2-R-180 for the processing and analyzing of inputs and outputs.

If YES, has the addition of uninterruptible power supplies been considered?

The PLCs are powered from a redundant power supply located in each panel and provided by Westinghouse. The cabinets are powered from the 120 VAC vital boards; these boards are backed by the 125 VDC battery boards in the event of a loss of AC power. Uninterruptible power supplies are not needed with this design.

☐ YES ☒ NO 18. Does the modification involve fault tolerant non-safety-related equipment important to operation such that the need for redundant power sources should be considered (such as CERPI control room devices)?

☒ YES ☐ NO 19. Does the design or modification impact an Integrated Computer System (ICS) data point that is also an Emergency Response Data System (ERDS) data point?

It is expected that some of the ICS points from the Common Q PAMS will be sent to ERDS. The final list of ICS points from the Common Q PAMS, supplied by Westinghouse, will be reviewed and the ERDS points will be added or revised as necessary.

If YES, coordination with Site Licensing is required in accordance with 10CFR50 Appendix E.

See Open Item OI-52351-14

☐ YES ☒ NO 20. Does the design or modification impact off site power capability or ability to meet 10CFR50 Appendix A Criterion-17 requirements?

If YES, coordinate with Electrical Lead Engineer.

MECHANICAL:			
Ensure EQ requirements addressed for ancillary subcomponents (e.g., Limit Switches on Mechanical only valves). Coordinate with Electrical EQ Engineer as necessary.			
☒ YES	☐ NO	1.	Does the change affect design conditions or requirements such as process pressure, temperature, chemistry or operating cycles? Is the change affected by operation of other systems, either Safety Related or Non-Safety Related in any of their various operating configurations? ***The Common Q System is affected by operations of other systems. If any of the inputs into Common Q fail, then Common Q will not perform its safety function. These inputs are installed in other EDCRs, see scope statement for details.*** If YES, ensure the evaluation encompasses all aspects of the affected system, including impacts on interfacing systems. Coordinate with MEQ Program Engineer for potential revisions to affected MEQ documentation.
☐ YES	☒ NO	2.	Does the change affect ECCS, decay heat removal systems, or MPC cooling ancillary equipment? Ensure that any changes are consistent with the safety analyses for the plant including WBN SAR Chapter 15 NPSH minimum flow requirements, diesel loading sequencing, and ultimate heat sink limits.
☐ YES	☒ NO	3.	Is the Auxiliary Building Secondary Containment Enclosures (ABSCE) as defined in WBN2-30AB-4001, affected by this change? Does this change modify any cable, cable tray, conduit, duct, pipe, or instrument tubing penetrating secondary containment? Consult 46W501 drawing series for the locations of the ABSCE Boundary, and discuss proposed changes with the NSSS EGS. A justification for the "Yes/No" is required. ***Cables that penetrate ABSCE are pulled in Bulk Cable Pull EDCRs (See Scope Statement), EDCR 52351 only lands these Cables as needed for their Common Q application.***
☒ YES	☐ NO	4.	Does the change involve potential heating, ventilation, and air-conditioning (HVAC) system impacts resulting from adding heat loads, altering air flow or ductwork etc.? ***Common Q components require power and will produce heat. The Common Q System consumes 4A in each new Panel (2-R-179 and 2-R-180), each PC Node Box consumes 1.25A, and each fiber/cat5 modems consume 0.5A.*** ***Calculation WBNEEMBSTI090042, Electrical Heat Generation in the control Building Main Control Room, El. 708.0 (Rms C1 & C4) and El 729.0 (Rm C1), will be revised, See Open Item OI-52351-02. Based on the result of Calculation WBNEEMBSTI090042, Calculation EPMMCP071689, Cooling/Heating Load & Equipment/Component Performance Analysis For The Control Building Electrical Board Room Areas, may need to be revised, Open Item OI-52351-04 will track this analysis.***

MECHANICAL:			
☐ YES	☒ NO	5.	Does this change make any alterations or configuration changes to Motor Operated Valves (MOVs) or Air Operated Valves (AOVs)? Does this change impact any MOV or AOV Program documents? Impacts that should be considered include changes to instrumentation or control circuits, power supplies, or change system operating or design conditions such as pressure and flow rate.
☐ YES	☒ NO	6.	Does this change involve replacement of a complete valve or valve internals which are located in a system that interfaces directly with the Reactor Coolant System (RCS)? Procurement requirements should evaluate valve and valve internals replacements that are located in or interfaces with the Reactor Coolant System (RCS) for hard faced components that are non-cobalt bearing. Hard facing alternatives include NOREM Nitronic 60 and may include other non-cobalt materials as approved by Engineering. Cobalt bearing hand materials is a concern in fluid systems that contain radioactive materials.
☐ YES	☒ NO	7.	Does the modification add a new check valve or impact an existing check valve? Ensure the valve is sized properly, proper type for required service, properly oriented, located suitable distance from upstream components that cause turbulent flow.
☐ YES	☒ NO	8.	Does the modification add, delete, or reroute components in a mechanical piping system? If Yes, will the added components come in contact with borated water or some other harsh environmental area?
☐ YES	☒ NO	8a.	Does the modification affect the ASME Section III Code (Class 1, 2, and 3) boundary. If "YES", ensure that the materials and installations meet the applicable ASME Code.
☐ YES	☒ NO	9.	Does this modification introduce material into the containment that could become dislodged during LOCA or other events and contribute to Emergency Core Cooling system (ECCS) sump screen or strainer blockage? Does this modification affect protective coatings inside the containment?
☐ YES	☒ NO	10.	Does the modification increase the possibility of flooding from a Moderate Energy Line Break?
☐ YES	☒ NO	11.	Does the modification affect the power uprate?
☐ YES	☒ NO	12.	Are there NUREG-0612 impacts? Does the change add, delete, or alter a permanent handling system? Does the change move a heavy load path over safe shutdown equipment or move safe shutdown equipment into a heavy load path?
☐ YES	☒ NO	13.	Does the change affect barriers such as walls, doors, penetrations, relief panels, and ducts which could affect HVAC flow paths, fire barriers, or environmental conditions in either harsh or mild areas?
			If the answer to any of the above questions is "YES", the change shall be coordinated with the Mechanical EGS.

MECHANICAL:			
☐ YES	☒ NO	14.	Is a new material being added and does the change affect components susceptible to Flow Accelerated Corrosion (FAC) or Microbiologically Induced Corrosion (MIC)?
☐ YES	☒ NO	15.	Does the modification increase the susceptibility for cavitation?
☐ YES	☒ NO	16.	Could the change affect location or operation of high energy piping systems, location or operation of radioactive piping systems, operation of environmental control systems, or environmental barriers such as walls, doors, relief panels, piping/other thermal insulation, and ducts which could affect environmental conditions in either harsh or mild areas? If YES, coordinate with ME for potential revision to the environmental drawings/design criteria and coordinate with EE for potential impact to EQ of equipment.
☐ YES	☒ NO	17.	Does the change involve any valve tabulation information? If YES, include the completed MEL Data Entry Sheet in the EDCR-2 Package.
☐ YES	☒ NO	18.	Does this change affect the Seismic Category I boundary? If YES, the applicable Seismic Category I Boundary calculations must be revised. <u>NOTE</u> Issuing a design calculation in accordance with NEDP-2 is the means of assuring that the applicable Seismic Category I Boundary calculation is revised.
☐ YES	☒ NO	19.	Does the modification change ventilation, cooling requirements for electronic equipment? If YES, coordinate with Mechanical Engineering for determination of impact on HVAC coolant.
☐ YES	☒ NO	20.	Does the modification involve strainers for a raw water supply? If YES, proper strainer selection should be based on industry guidelines (Fluid Controls Institute Std 89-1) and specific site criteria. Major consideration should be given to the following: type of strainer, redundant strainer capability, materials/housing, perforations number and arrangement, mesh size & free area, capacity and pressure loss, fluid type, particle weight & shape, macro fouling and aquatic debris potential, operating parameters, filtration versus separation, blow down line sizing, vendor recommendations, automatic back flushing and the necessity of a bypass line. **NOTE:** Contact the appropriate program coordinator in the Mechanical Programs group (or in Plant Design for MOV questions) if any Engineering Design Program(s) are impacted by the proposed modification.

MECHANICAL:

☒ YES ☐ NO

21. Does the change directly or indirectly impact Mechanical or Electrical Appendix R equipment, or cables, required for safe-shutdown per 10CFR50 Appendix R (TI-277 at WBN)? (If the answer to any of the following questions is "YES", then the answer to Question 22 is "YES".)

☐ YES ☒ NO Does the modification involve a system, component or structure required for Appendix R safe shutdown capability?

☐ YES ☒ NO Does the modification involve a fire rated barrier (includes fire door, fire damper, fire wrap, walls, floors, ceilings, penetration seals, etc.)?

☐ YES ☒ NO Does the modification affect a suppression system, the detection system, or Appendix R required lighting, including the illumination path?

☒ YES ☐ NO Does the modification introduce or remove combustible material or fire source in the area?

In the Auxiliary Control Room, Two new panel, 2-R-179 and 2-R-180, are being added each fully loaded panel has an approximate weight of 1000 lbs also two data diodes are being added. Two PC Node boxes, two digital panel meters, and Two flat panel displays are being added to the Main Control Room. The addition of this material will require the Combustible Loading Calculation, MDQ00299920090342, to be revised (see Open Item OI-52351-07)

If YES, contact the 10CFR 50 Appendix R Program Engineer.

OPERATIONS/HUMAN FACTORS:			
☐ YES	☒ NO	1.	Does the change involve compensatory measures or require an increase in operator staffing to complete newly required actions?
☒ YES	☐ NO	2.	Does the change affect the main control room or the backup control areas (Environment, workspace, controls and displays)? ***A Complete Human Factors Evaluation has been done for this EDCR.*** If YES, human factors must be addressed.
☒ YES	☐ NO	3.	Are OSHA considerations included? Whenever replacement or major repair, renovation, or modification of a machine or equipment is performed, and whenever new machines or equipment are installed, energy isolating devices for such machines or equipment must be designed to accept a lockout device. This applies to mechanical and electrical devices. ***The installation of the Common Q system will take OSHA regulations into consideration.***
☐ YES	☒ NO	4.	Does the modification affect valves listed in the locked valve checklist maintained by Operations and the locked position shown on design output? If YES, ensure that design output (DRAs/drawings) agree with the locked position of applicable valves or coordinate a revision to the locked valve checklist, if necessary.

OTHER:

☒ YES ☐ NO 1. Does the change affect equipment diversity, failure modes, single failure criteria (DS-E2.0.2, "Single Point Failure For Power Generation Reliability"), equipment redundancy, or equipment reliability?

The Common Q system is a redundant system and includes isolated equipment for both Train A and Train B

☒ YES ☐ NO Does the modification install redundant equipment?

The Common Q system has redundant independent equipment for each train.

If YES, utilization of redundant attendant equipment (e.g., power from alternate sources) shall be considered and addressed.

☐ YES ☒ NO 2. Does the modification change System 18, 43, 66, 77, or 90, or potentially impact the plant Chemistry Organization (i.e., sampling, procedures, training, spare parts, chemical treatments, etc.)?

☐ YES ☒ NO 3. Does the change involve environmental impacts? (If ANY of the Below questions are answered "YES", then question 3 must be answered "YES".)

☐ YES ☒ NO Will the modification require new Chemicals (as defined in SPP-5.4) to be used anywhere onsite or result in a change in plant chemical storage or usage?

☐ YES ☒ NO Will the modification generate any new wastes? (Solid, Liquid, Hazardous, Universal, Used Oil, Radioactive, etc.) or result in the release of any new or different substances to the land, air, or water?

NOTE This does not include consumables used to facilitate the installation of the modification.

☐ YES ☒ NO Will the modification change the existing flow path or characteristics of any discharge to the land, air, or water?

☐ YES ☒ NO Will the modification involve any equipment containing PCBs, Mercury, or Asbestos?

☐ YES ☒ NO Will the modification result in all upgrade or alteration to any pollution control equipment?

☐ YES ☒ NO Will the modification affect the waters of the U.S. (e.g., dredging or discharging to the river)?

☐ YES ☒ NO Will the modification involve storage or use of oil or hazardous substance in an amount equal to or greater than 55 gallons?

If Question 3 is answered "YES", contact Environmental Staff to ensure that the applicable Environmental Review (in accordance with SPP-5.5 and TVA National Environmental Policy Act (NEPA) Process or chemical traffic control review are initiated/performed.

OTHER:

If Question 3 is answered "YES", Environmental shall be a Core Review group at the initial and final meetings. If the meetings are waived, then Environmental is required to review the EDCR-2 and sign the coversheet as an "Other Organization".

☐ YES ☒ NO

4. Does the modification affect the Radiological Emergency Plan (for example, radiation monitors, meteorological instrumentation, onsite emergency sirens, or onsite telephone system) or does the modification affect any equipment, boundaries, or plant structures in a manner that will affect any of the Emergency Action levels (EALs) in EPIP-1 or the REP Appendix A, B, or C?

If either question is YES, contact Radiological Emergency Plan Staff to ensure that a Plan Effectiveness Determination is initiated/performed (in accordance with 10CFR50.54 and EPIL-1, Emergency Preparedness Instruction Letter, "Procedures, Maps, and Drawings") to determine if NRC prior approval is required prior to any REP revision.

If NRC approval is required prior to any REP revision (i.e., EPIP changes), then document this in the Work Scope Statement on the "EDCR Cover Sheet."

☐ YES ☒ NO

5. Does this modification impact the fire protection system or equipment of an insured building?

If YES, coordinate with the 10CFR50 Appendix R Program Engineer to have the EDCR-2 documents reviewed by the insurance carrier.

☒ YES ☐ NO

6. Does the change affect information in the Q-List? (If the answer to any of the following questions is "YES", then the answer to Question 6 is "YES".)

☐ YES ☒ NO Are any attributes as defined in Limited QA appendix of NEDP-4 added, deleted, or modified?

☒ YES ☐ NO Is the UNID for a component in MEL altered?

See MEL packages included in this EDCR

☒ YES ☐ NO Is the MEL evaluation for the proposed modification adequate and complete?

See MEL packages included in this EDCR

☒ YES ☐ NO Is a UNID being added or modified in the MEL?

See MEL packages included in this EDCR

OTHER:			
☒ YES	☐ NO	7.	Does the modification change functional logic which has the potential of affecting design characteristics or change/impact an item listed in the Equipment Performance Information Exchange (EPIX) system? If YES, evaluate PER/NER history and EPIX on the equipment being modified to determine if problems have previously been identified and are appropriately addressed in the EDCR-2 Package. Ensure appropriate coordination with affected organizations is performed such as Operations, Maintenance, Environmental, Chemistry, and Emergency Preparedness. ***The Common Q group of components has various different functions. The plants that currently use a version of the Westinghouse Common Q system are: Calvert Cliffs Units 1 and 2, Palo Verde Units 1, 2, and 3, Vogtle Units 1 and 2, and Watts Bar Unit 1. Various EPIX searches were done for these plants, the results are:*** • ***Calvert Cliffs, Failure #1068 (2005) - There was a blown fuse for one of the heated thermocouples. Watts Bar Unit 2 does not use this portion of the Common Q system so this is not applicable.*** • ***Calvert Cliffs, Failure #1114 (2006) - During routine calibration of the analog input card AI685, the as left value was OOS high. This card could not be calibrated and had to be replaced. Watts Bar Unit 2 uses this card in their system.*** • ***Watts Bar Unit 1, Failure #380 (2004) - Multiple rods dropped. The cause was found to be a bad transistor on the rod control side of the system and this was not related to the Common Q CERPI system.***
☐ YES	☒ NO	8.	Does the change substitute, change, add or modify materials, components or chemical treatments not previously evaluated to the system parameters or application? If YES, an evaluation for material compatibility shall be performed.

			10CFR50 APPENDIX R AND OTHER FIRE PROTECTION IMPACTS: (Contact the Program Owner)
☒ YES	☐ NO	a.	Does the change directly or indirectly impact Mechanical or Electrical Appendix R equipment, or cables, required for safe-shutdown (This includes manual actions required for safe shutdown.)? ***The installation of the Common Q system indirectly impacts Appendix R equipment. The Wide Range (WR) pressure Transmitter 2-PT-68-63 and WR RTDs is an input to Common Q and are on the Appendix R list (Fire Protection Report Section III, table 3-2).***
☐ YES	☒ NO	b.	Does the change impact Appendix R component availability in any fire area/zone?
☐ YES	☒ NO	c.	Have any Appendix R equipment parameters (e.g., flow rate, pressure, setpoints, load limitations, electrical load, interface with other components) changed?
☐ YES	☒ NO	d.	Have Appendix R cable tag/UNID numbers or cable fire area/zone routings changed?
☐ YES	☒ NO	e.	Have Appendix R cables been added/deleted or Appendix R control circuit logics been changed? ***Cables for Common Q were installed in the Bulk Cable Pull EDCRs (See Scope for a list of applicable EDCRs)***
☐ YES	☒ NO	f.	Does the change involve a non-Appendix R circuit which interferes with an Appendix R Circuit (e.g., re-wiring to create associated circuits)?
☐ YES	☒ NO	g.	Does the change impact the use of Appendix R equipment in any fire area/zone?
☐ YES	☒ NO	h.	Has component been installed or relocated which obstructs the light pattern of an existing Appendix R emergency light?
☐ YES	☒ NO	i.	Has an Appendix R component been added, deleted, or relocated which would affect Appendix R light placement, including ingress/egress lights?
☐ YES	☒ NO	j.	Has an Appendix R component been installed or relocated in the same fire area/zone as its functionally redundant safe shutdown train/system? (This includes instrument sensing lines.) Note: The functionally redundant train is not necessarily the redundant divisional train.)
☐ YES	☒ NO	k.	Does the change affect in-plant communication systems?
☐ YES	☒ NO	l.	Does the change affect fire barriers, fire doors, fire dampers or fire wraps, or affect electrical or mechanical penetrations through fire rated walls, floors, ceilings or cable fire stops?
☐ YES	☒ NO	m.	Does the change affect structural steel, raceway supports or raceway fire-proofing material?

10CFR50			APPENDIX R AND OTHER FIRE PROTECTION IMPACTS: (Contact the Program Owner)
☒ YES	☐ NO	n.	Does the change result in the addition or deletion of in-situ combustibles in a fire area/zone (e.g., panels, new cable trays, components with oil sumps, grease plastics)? (Note: Exclude cables routed entirely in conduits. Also exclude cables routed in existing trays without exceeding the tray fill capacity. Exclude combustibles less than 0.5 gallons oil, 4 lbs. plastic, 4 lbs. grease or equivalent amount of other combustible materials.) If yes, combustible loading calculation may be affected. Check with the 10CFR50 Appendix R Program Owner. ***In the Auxiliary Control Room, Two new panel, 2-R-179 and 2-R-180, are being added each fully loaded panel has an approximate weight of 1000 lbs also two data diodes are being added. Two PC Node boxes, two digital panel meters, and Two flat panel displays are being added to the Main Control Room. The addition of this material will require the Combustible Loading Calculation, MDQ00299920090342, to be revised (see Open Item OI-52351-07)***
☐ YES	☒ NO	o.	Does the change affect any of the fire protection systems (HPFP, SFFF, Halon, or CO_2) or affect any of the fire detection systems (e.g., smoke or heat)?
☐ YES	☒ NO	p.	Does the change impact the Fire Protection Reports? If "YES", then a DCN must be issued.
☐ YES	☒ NO	q.	Does the change impact the property insurance carrier fire protection standards and/or associated commitments?
☐ YES	☒ NO	r.	Does the change involve the reactor coolant pump oil collection system?
☒ YES	☐ NO	s.	Does the modification introduce or remove combustible material or fire source in the area? ***In the Auxiliary Control Room, Two new panel, 2-R-179 and 2-R-180, are being added each fully loaded panel has an approximate weight of 1000 lbs also two data diodes are being added. Two PC Node boxes, two digital panel meters, and Two flat panel displays are being added to the Main Control Room. The addition of this material will require the Combustible Loading Calculation, MDQ00299920090342, to be revised (see Open Item OI-52351-07)***
			If ANY of the above questions are answered "YES", contact the 10CFR50 Appendix R Program Engineer.

SINGLE POINT		FAILURE/FAILURE MODES AND EFFECTS/RELIABILITY:
		Checklist of questions to ask vendors of large scale systems, and our own designer(s) in regards to single point failures and margin to operation/trip/runback. The following questions should be considered when dealing with vendor supplied packaged solutions. This section may be considered Not Applicable (N/A) if the Unit 2 change for this EDCR-2 is the same as the Unit 1 installed design. ☐ If this section is N/A, check this box.
☒ YES	☐ NO	a. What are the system failure modes for the entire package (i.e., output fail-as-is, fail high or low, oscillate, trip system/plant, run back system plant, consider loss of motive power such as electric or control air, etc.)? **Mechanical components addressed by EDCR-2 do not include these failure modes.** ***New calculation WBNOSG4420 is being created to include the Failure Mode Effects and Analysis of the Common Q PAMS (OI-52351-18)*** ***The two major failure modes associated with the Common Q system are a failure within the cabinet or a failure within the node box. The most significant result of one of these failures is the loss of one of the three primary functions of the system: RV Level Indication, Submargin Monitoring, or CET Temperatures.*** ***In previous uses of the Common Q there has been a 'data freeze' problem which would cause the Operator Module (OM) to freeze. The system being installed in this EDCR is a newer version of the software and will not experience this problem (Note: the newer version is not the same as the software patch). See 25402-011-GAKS-00257-000 for explanation.***

SINGLE POINT FAILURE/FAILURE MODES AND EFFECTS/RELIABILITY:

☒ YES ☐ NO

b. What are the failure modes of the individual components which were considered, and what was their effect on the overall system (i.e., consider failures of the digital control systems related to the hardware and softloss of CPU, loss of communication connection, loss of an entire I/O board, etc.)?

Mechanical components addressed by EDCR-2 do not include these failure modes.

Submargin Calculation

Failure of a CET input impacts the calculation of T_{CREP} only. T_{CREP} requires two CETs per quadrant to be valid. Therefore one CET failure would not result in SMM value failing. However the SMM would be labeled as "suspect". See 00000-ICE-30156 section 2.5.3.4.26 and System Req Spec R2.5.3.2-12.

Failure of WR temperatures from Eagle 21 would not affect the SMM calculation. Normally these two are auctioneered in that the highest is selected. If one fails then the other will be used. See System Req Spec R2.5.3.2-6. The SMM value will not be labeled as "suspect" or "failed".

Failure of WR pressure from Eagle 21 would cause the SMM calculation to be labeled as "failed". This is mitigated by Common Q being trained along with the two pressure transmitters that feed Common Q (2-068-PT-063/064) are separate brands (Barton and Weed). The purpose of these different brands is to support an RCS/RHR interlock, but this can still be used to mitigate the failure of a single WR pressure transmitter.

SINGLE POINT FAILURE/FAILURE MODES AND EFFECTS/RELIABILITY:

Reactor Vessel Calculation

Failure of D/P transmitter

- ***with no pumps running this will cause the water level to be labeled as "failed". See R2.5.3.4.6-2***

Failure of hydraulic isolator (XIS) will cause the water level quality with that range to be labeled as "failed". See R2.5.3.4.8-3

Failure of SSPS RCP status will result is the associated level being labeled as "suspect". See section 2.5.3.4.9 of the System Req Spec.

Failure of RVLIS RTD – open or short
The failure of a RVLS RTD is unique. There will be a user adjustable substitute for each RTD input when they are bypassed. So if an RTD fails either open or short, then the technicians will bypass that value and be able to adjust to another value at their discretion.

Failure of ΔT or core thermal power will result in RV level being "failed".

Failure of a single WR temperature from Eagle 21 would not affect the RVLIS calculation. Normally these two are auctioneered in that the highest is selected. If one fails then the auctioneered T_{hot} value will be "suspect" (see section 2.5.3.4.5):

- ***The auctioneered T_{hot} is used to calculate the temperature fluid density $\rho_f(T)$ which is compared to the pressure based fluid density $\rho_f(P)$ and then the highest density ρ_l is selected. If the auctioneered T_{hot} value is suspect then $\rho_f(T)$ will be "suspect". This will cause the overall ρ_l be "suspect". See System Req Spec 2.5.3.4.3.***
  - ***If both temperatures fail, then the calculated $\rho_f(T)$ be labeled as "failed", the overall density ρ_l will be "suspect".***
- ***The same argument applies to vapor based density ρ_g. Section 2.5.3.4.4.***
- ***Will cause Upper Range and Lower Range Levels to be "suspect". See 2.5.3.4.6. The normal EUDH will be used***
- ***Will cause the expected uncompensated dynamic head, EUDH(T) to be "suspect", see R2.5.3.4.10-4. The normal EUDH value will be used.***
- ***End result is if one WR temperature fails, the final RV level will be "suspect"***

SINGLE POINT FAILURE/FAILURE MODES AND EFFECTS/RELIABILITY:

WR pressure is used to calculate different aspects is the vessel level algorithm.

- ***pressure based fluid density $\rho_f(P)$. This is compared to $\rho_f(T)$ and the highest of the densities is utilized. If the pressure signal fails then $\rho_f(P)$ will be labeled "failed", and ρ_l will be "suspect". See section R2.5.3.4.3-3.***
- ***The same argument applies to vapor based density ρ_g in that it will be "suspect". Section 2.5.3.4.4***
- ***Will cause Upper Range and Lower Range Levels to be "suspect". See 2.5.3.4.6.***
- ***Will cause expected uncompensated dynamic head, EUDH(P) to be "failed", see R2.5.3.4.10-5. The normal EUDH value will be used.***
- ***End result is if the WR pressure fails, RV level will still be calculated and be labeled as "failed" with no pumps running and "suspect" with pumps running.***

Other Failures

Failure ICS/printer/annunciator – Common Q is specifically designed so any of these external failures will not affect the safety function

Failure of AC160 data link to the OM – there is a heartbeat that the operator can see along with an alarm.

Failure of PC Node box would result in failure of the entire train. This would put the plant in a 30 day LCO until a report is required to the NRC. Long term operation is acceptable.

Failure of fiber to cat 5 modems will affect the printing capability only. No safety related function will be lost.

Failure of AF100 modem will have no effect. There is a redundant data link that each end has an AF100 modem. If one fails the other link will still function.

Failure of OWL Dual Data Diode will result in the data link ceasing to function. This does not serve any safety function and its failure is acceptable. There will be no other impacts.

New calculation WBNOSG4420 is being created to include the Failure Mode Effects and Analysis of the Common Q PAMS (OI-52351-18)

Failure of Components Within the Rack

There are numerous components within the rack that would cause a diversity of failures. It is assessed that these failures will result in either a failure similar to the one mentioned above, or a complete system failure resulting in the loss of a whole train.

Technical Evaluation Considerations of 0-TI-2

SINGLE POINT		FAILURE/FAILURE MODES AND EFFECTS/RELIABILITY:
☐ YES	☒ NO	c. Will these system and/or component failures directly or indirectly via transient cause a plant trip or runback? If YES, 1. What is the reliability of the individual components and system? 2. How can testing be performed to detect failure modes, miss configurations, and precursors to imminent failures? 3. What alarms or indications provide timely precursor indication of impending component/system failure? 4. What are bases for alarm, runback, trip, and operator action points. 5. What are the margins between normal operation and these alarm, runback, trip, and operator action points? 6. What redundancy is there in the alarms, indications, runback, or trip functions? 7. Which trips and runbacks are absolutely necessary? Which can be changed to alarms and what operator response is needed for the alarms? 8. Are digital systems developed in accordance with SPP-2.6 and SS-E18.15.01 software requirements for real time data acquisition and control computer systems? 9. Are there any reasons why redundancy was not considered in alarm, trip, runback systems, and can redundancy be added?

		DIGITAL SYSTEM UPGRADES/MODIFICATIONS:
☒ YES	☐ NO	Does the change involve a digital system, component or upgrade? (If "NO", then leave Questions 1-7 below blank.)

Common Q is a safety related digital computer system and is required to follow the following regulations:

- ***Regulatory Guide 1.152, Criteria for Use of Computers in Safety Systems of Nuclear Power Plants***
  - ***RG 1.152 endorses: IEEE 7-4.3.2, Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations (however, RG 1.152 does not endorse Annexes B through F of this criteria)***

The TVA requirements for digital systems are:

- ***SPP-2.6, Computer Software Control***
- ***SS-E18.15.01, Software Requirements For Real-Time Data Acquisition And Control Computer Systems (This implements SPP-2.6)***
- ***DG-E18.1.25, Digital System Development, Procurement, and Implementation***

The contract between Westinghouse and TVA states: "the Codes, Standards, and/or licensing requirements and regulations shall be those applicable to the standard Westinghouse product(s) or service(s) and/or product licensing basis for the identified product(s) or service(s)." Therefore, the Westinghouse Common Q system was not designed to the specifications of the requirements listed in the following question.

Westinghouse created this software via the Westinghouse Software Program Manual which has been reviewed by the NRC and complies with accepted industry standards and regulatory guides. This process guarantees the software was developed by the applicable life cycle processes.

☐ YES	☒ NO	1. Have the requirements of SPP-2.6, SS-E18.15.01, and the guidelines of DG-E18.1.25 been considered? ***This was not completed, see above discussion.***
☐ YES	☒ NO	2. Does the change involve and in-house modification? If so, implement in accordance with SPP-2.6. ***This is a new system, not a modification.***
☐ YES	☒ NO	3. Does the change involve a vendor performed modification? If so, implement in accordance with SS-E18.15.01. ***This was not completed, see above discussion.***

DIGITAL SYSTEM UPGRADES/MODIFICATIONS:

☒ YES ☐ NO 4. Is the digital modification associated with a Safety Related Protection System upgrade? Has the potential for common cause software failure been considered?

IF "YES", use DG-E18.1.25 and SS-E18.15.01 for guidance and requirements.

NOTE: For digital upgrades, refer to NRC RIS 2002-2 which endorses NEI 01-01, Rev. 1.

Common Cause failure due to a common software issue has been addressed in the Licensing Technical Report (WNA-LI-00058-WBT) section 8, Diversity and In Depth Analysis.

☒ YES ☐ NO 5. Has the method and level of configuration control needed for the digital application been addressed?

NOTE: The configuration control method should be implemented using approved design control processes such as SPP-2.6 and/or an EDCR-2 (i.e., design output). This may involve the need to maintain configuration control of both the software and hardware revision levels. The level of control needed shall be based upon the application function (i.e., Safety Related, Quality Related, Critical to Plant Operations), capability to modify software such as software versus firmware, software and hardware revision compatibility, etc. Safety Related system configuration control must ensure that V&V qualification remains valid so prescriptive configuration control methods would be required. For Non Safety Related software, the configuration control may be less restrictive with focus on plant reliability and day to day operation. Firmware/Software includes both the Operating/Platform System firmware/software and the application specific firmware/software along with any configuration parameters such as setpoints, constants, scaling, etc.

☐ YES ☒ NO 6. Has a Cyber Security Assessment been completed to address NEI 04-04 requirements? Contact the Computer Engineering Group for instructions.

Preliminary cyber security assessment completed on February 24th 2010. Action items consisted of updating the UNIDs for the data diodes to have system 068 on the Common Q side and ICS's 261 on the ICS side.

The initial data collection assessment for the post-issuance of Regulatory Guide 5.71 occurred in February 2011. The final assessment that would assign action items has not occurred (See Open Item OI-52351-09).

DIGITAL SYSTEM UPGRADES/MODIFICATIONS:			
☒ YES	☐ NO	7.	Is there a communication network interfaces such as an ICS interface? If "YES", implement design of this interface per the guidelines addressed in DG-E18.1.25. ***The Common Q system has an interface with the ICS. There is a data link that transmits computer points from the Maintenance Test Panel to the ICS. The network interface is TCP/IP and will be done optically. There will also be a Dual Diode that the signal passes through to ensure a one way network flow from Common Q to ICS.*** ***See the Software Service Requests included in this package.***

EOCR 52351 ~~-A~~ B page ~~127~~ 5/19/11

NPG System Description Document	TITLE INCORE INSTRUMENTATION SYSTEM	WBN2-94-4003 Rev. ~~0000~~ XXXX Page 1 of 41 Quality Related ☑ Yes ☐ No Effective Date ~~8-26-08~~

System Description Markups

EDCR 52351 Common Q PAMS

Markups

prepared Mat Merten 6/2/10

Reviewed Algene Germany 6/9/10

page 1 of 21

Prepared by:	Rao Pachigolla		8-19-08
Reviewed by:	Paul Harless		8-19-08 Date
Approved by:	R. Considine		8/20/08 Date

EDCR No. 52351-~~A~~ B
Page ~~128~~ 194 JMK 5/19/11
JMK 5/19/11

Revision Log

Revision or Change Number	Effective Date	Affected Page Numbers	Description of Revision/Change
0	8/26/08		This interim was issued by WB2CCP to address the Incore Instrumentation System (IIS) applicability to Unit 2 in Section 1.0 (Summary) of this SDD. An outstanding WITEL Punchlist item applicable to Unit 2 is listed as follows: • PL-08-1148, see Section 1.0 New and upgraded Incore Instrumentation System (IIS) is being supplied by Westinghouse thru WB2CCP purchase contract number 65717, Contract Work Authorization (CWA) WEST-WBT-2008-005. Section 1.0 (Summary) and Section 2.0 (Design Criteria) have been reviewed and are approved for applicability to WBNU2 Construction Completion Project. Remaining sections 3.0 through 8.0, have been included for information only. The information only sections have been marked accordingly in the Table of Contents and in the text of the SDD.
XXXX			Various changes were made to support the instalation of Common Q PAMS (EDCR 52351). This is replacing ICCM-86.

EDCR No. 52351-A B
Page ~~129~~ 195 5/19/11
5/19/11

1.0 SUMMARY

1.1 Incore Instrumentation System

The Incore Instrumentation System (IIS) consists of instrumentation which is provided to monitor neutron flux distribution and fuel assembly coolant outlet temperatures at selected locations within the reactor core. This information is obtained to confirm reactor core design parameters. When the system is used in conjunction with previously determined analytical information, fission power distribution at any time during core life can be ascertained. This is of interest because the combination of fission power distribution and the thermal and hydraulic limitations determines the maximum core capacity. The IIS provides information which can be used to calculate the enthalpy distribution (Reference 7.1.1). The IIS is composed of two subsystems; the Incore Thermocouple Subsystem (ITS) and the Incore Flux Mapping Subsystem (IFMS).

Incore Instrumentations System (IIS) is being upgraded by Westinghouse to support the Watts Bar Unit 2 Construction Completion (WB2CCP) Project. Supporting vender and engineering analyses shall be completed and incorporated into this System (IIS) being declared operational [PL-08-1148].

1.2 Incore Thermocouple Subsystem

See last page

~~The Incore Thermocouple Subsystem consists of sixty-five (65) thermocouples which are provided and positioned to measure fuel assembly coolant outlet temperature. (See Figure 8.1 for thermocouple locations within the reactor core). Thirty-three (33) of the thermocouples are grouped and wired under Train A and thirty-two (32) under Train B. Three (3) resistance temperature detectors (RTDs), per train, are also provided to monitor the temperature of a cold reference at the integral reference junctions which are part of the containment cable assemblies, one (1) RTD per cable assembly. A total of five (5) RTDs per train are available, three (3) are connected and two (2) are spares. (See Figure 8.5 for arrangement of incore thermocouple cables inside containment.) The RTD signals along with their associated incore thermocouple signals are inputted into a microprocessor unit [one (1) per train] located in the Inadequate Core Cooling Monitoring (ICCM) cabinet which provides separate inputs to a Westinghouse Plasma Display, two 3-pen recorders and plant computer for incore thermocouple system temperature readout at the MCR. Incore thermocouple temperature readout is provided by the plant computer.~~

The ~~ICCM~~ Common Q PAMS is part of the Reactor Coolant System. Refer to ~~N3-68-4001~~ WBN2-68-4001 (Reference 7.2.23) for detailed description.

EDCR No. 52351-~~A~~ B
Page ~~130~~ 196
JMR 5/19/11 JMR 5/19/11

1.3 Incore Flux Mapping Subsystem

The Incore Flux Mapping Subsystem consists of 58 incore flux thimbles which permit measurement of the axial neutron flux distribution within the reactor core. Six movable miniature neutron detectors are available to scan the length of 58 selected fuel assemblies to provide remote reading of the axial flux distribution. (See Figure 8.1 for location of selected fuel assemblies within the reactor core). The thimbles are inserted into the reactor through thimble guide tubes mounted on the bottom of the reactor vessel. The thimble guide tubes are essentially extensions of the reactor vessel, with the thimbles allowing the insertions of the incore instrumentation movable miniature detectors. The drive system for the insertion of the miniature detectors consists basically of six drive units, 13 limit switch assemblies, six 5-path rotary transfer devices, six 10-path rotary transfer devices, and 58 isolation valves. (See Figures 8.2 and 8.3 for IFMS configuration.)

2.0 DESIGN CRITERIA

2.1 Function

2.1.1 Safety Function

Common QPAMS

Common Q

The Incore Thermocouple Subsystem (ITS) performs a (primary) safety function during normal and post-accident operating modes by providing fuel assembly coolant temperature signals to ~~the Inadequate Core Cooling Monitor (ICCM).~~ ~~This includes the thermocouples, integral reference junction RTDs and all associated cabling and connectors. The Incore Thermocouple recorders located on the MCR boards M-4 and M-6 and associated cabling from the ICCM also performs a (primary) safety-related function.~~ (The ~~ICCM~~ cabinets and ~~Plasma~~ Display are considered a portion of the Reactor Coolant System.) The ~~Incore~~ Core exit Thermocouple temperature signals sent to the Plant Computer from ~~the ICCM~~ perform a quality related function (secondary safety function).

touch screen

Common Q PAMS

The Incore Flux Mapping Subsystem performs a quality related function except for the RCS pressure retaining portion identified below. The quality related portion includes the neutron flux detectors, drive units and controls, and the signal processing equipment.

The Bottom Mount Instrumentation Thimble Guide Tubing performs a (primary) safety function. This tubing is an extension of the RCS pressure boundary and is used to provide a path for the neutron flux detectors. This tubing extends from the Reactor Pressure Vessel to the seal table.

2.1.2 Normal Operating Function

The Incore Instrumentation System shall be designed to allow correlating of movable neutron detector information with fixed thermocouple information to provide radial, axial, and azimuthal core characteristics. Thermocouples shall provide a backup to the flux monitoring instrumentation for monitoring power distribution. Thermocouple readings shall be used by the operator to detect reduced Reactor Coolant System flow. The ITS may be used to verify a dropped rod, rod out of alignment and flux tilts.

The movable incore neutron detectors shall be used for more detailed mapping if the ITS indicates an abnormality. The Incore Instrumentation System shall be designed to detect misloaded fuel after initial fuel load and each subsequent fuel load before operating at power.

EDCR No. 52351-~~A~~B
Page ~~121~~ 197
JMR 5/19/11

2.2.5 Environmental Qualifications

The Incore Instrumentation System shall be designed to withstand the environmental effects associated with normal operations, maintenance and testing as defined in WB-DC-40-42, (Reference 7.2.18). The portions of the Incore Thermocouple Subsystem which perform a safety related function shall be designed to meet environmental qualification requirements as defined in WB-DC-40-54 (Reference 7.2.19).

2.2.6 Separation, Fire Protection, and Intrazonal Protection Requirements

The safety-related portion of the Incore Thermocouple Subsystem (see Section 2.1.1) shall be designed using two independent electrical channels and maintain separation in accordance with WB-DC-30-4 (Reference 7.2.5).

The Incore Instrumentation System does not require a separation evaluation from the effects of a plant fire as defined in 10CFR50 Appendix R.

2.2.7 Electrical Power Requirements

Electrical power supplied to the IIS shall be in accordance with WB-DC-30-27 (Reference 7.2.9) and WB-DC-30-28 (Reference 7.2.10).

A. Incore Thermocouple Temperature Recorders

~~The recorders shall be supplied 120 V AC, 60 Hz, from the Vital Instrument Supply Power.~~ Not installed in unit 2.

B. Incore Flux Mapping - Drive Unit Motors

Each drive motor shall be supplied 3-Phase, 460 V, 60 Hz power.

C. Incore Flux Mapping - Control Cabinets

The control cabinets shall be supplied with 120 V AC, 60 Hz power supply. These cabinets supply control power to external equipment such as rotary transfer drive motors. See reference 7.1.2 for Incore Flux Mapping Subsystem schematics.

2.2.8 Instrumentation and Control Requirements

Control panels shall be designed in accordance with WB-DC-30-20 (Reference 7.2.7). Controls and instrumentation shall be designed to human factor principles specified in WB-DC-30-23 (Reference 7.2.8).

A. Incore Thermocouple Subsystem

Fifty eight (58)

1. ~~Sixty-five (65)~~ thermocouples [Chromel/Alumel] shall be located within the reactor core to monitor fuel assembly coolant temperature. The minimum range of the thermocouples shall be ~~100°F~~ 32°F to 2300°F (Reference 7.1.3)

2. ~~Three~~ Four RTDs [platinum] per each train shall provide reference junction temperature. ~~The minimum range shall be 50°F to 450°F (Reference 7.1.3).~~

Those RTDs are within the common Q racks.

2.2.8 Instrumentation and Control Requirements (continued)

Delete

~~3. Two 3-pen strip chart recorder (1 train A, 1 train B) shall record each of the following parameters: 1) High Quadrant Average Temperature, 2) Hottest Thermocouple, and 3) Selectable (Thermocouple Temperature, Saturation Margin, RVLIS, or Hot Leg Temperature).~~

B. Incore Flux Mapping Subsystem

1. Functional Control Requirements

   a. Interlocks shall be provided to prevent the simultaneous insertion of two detectors into the same path during automatic (multiple Drive unit) operation.

   b. Interlocks shall be provided to prevent operation of the rotary transfer devices unless the associated detector is in the withdrawn position.

   c. Interlocks shall be provided to stop automatic withdrawal prior to the detector reaching the drive wheel.

   d. Manual position switches shall be furnished to provide a stop signal to the Drive Unit at a preset distance from the top of the core and from the bottom of the core for each selected path.

   e. A pressure switch shall be provided to monitor the 10-path rotary transfer drainage header and initiate automatic drainage.

2. Main Control Room Controls

   The following controls shall be provided for each of the six Drive Units:

   - Six-position selector switch with status lights to control the 5-path rotary transfer device. The five modes of operation shall include OFF, NORMAL, CALIBRATE, EMERGENCY, COMMON GROUP, and STORAGE.

   - Ten-position selector switch with status lights to control the 10-path rotary transfer device. Each switch positions corresponds to each one of the ten paths.

   - Two sets of ten patchboard-type matrix selector switches to provide a preset "top of core" and "bottom of core" stop signals during NORMAL operational mode.

   - Four sets of thumbwheel switches shall be supplied to provide stop signals from the following operational modes: COMMON GROUP, EMERGENCY, STORAGE, and CALIBRATE.

   - Rotary knob shall be supplied to provide continuous adjustment of the detector voltage.

   The following controls shall be provided for the Drive units. These controls are common to all Drive Units.

2.2.8 Instrumentation and Control Requirements (continued)

- Picoammeter to indicate low current level measurements. Range shall be 0-5 µA.

D. Local Mounted Controls

A portable control unit shall be supplied to allow local-manual operation of the Drive units. This control unit provides "Low" and "High" Drive speed signals and "Insert/Withdraw" direction signals.

2.2.9 Interface Requirements

The Incore Instrumentation System shall interface with the following plant systems.

A. Reactor Coolant System

The Incore Thermocouples are installed into guide tubes which penetrate the reactor pressure vessel head.

The detector guide tubing connects to the reactor pressure vessel flux thimbles located on the bottom of the vessel.

core exit Common Q PAMS

The ~~Incore~~ Thermocouples provide an input signal to ~~the Inadequate Core Cooling Monitor (ICCM).~~ ~~The Incore Thermocouple temperature recorders receive input signals from the ICCM.~~

touchscreen

The Westinghouse ~~Plasma~~ Display in the MCR provides the means to monitor the output of each of the ~~sixty five~~ ~~Incore~~ Thermocouples in order to analyze the reactor core performance and help determine hot channel factors. ~~backed by Plant Computer printout.~~

fifty eight core exit

B. Electric Power Systems

Electric power shall be supplied to the following equipment:

- Drive Unit Motors
- Incore Flux Mapping Subsystem Cabinets
- ~~Incore Thermocouple Temperature Recorders~~

C. Plant Computer Systems

The Plant Computer monitor Incore Instrumentation System process signals.

2.2.10 Quality Assurance Requirements

The Incore Instrumentation System shall comply with the quality assurance specified in TVA Nuclear Quality Assurance Plan (NQAP) (Reference 7.2.1). Portions of the IIS which perform a (primary) safety function (see Section 2.1.1) shall meet the quality assurance requirements specified in TVA Nuclear Power Standard, STD-3.1 (Reference 7.2.2). Additionally, reactor coolant pressure boundary retaining components shall meet the requirements specified in TVA ASME III Quality Assurance Manual (ASME III QAM) (Reference 7.2.4). The remaining portions of the IIS perform a quality related function (seismic category I(L)) and shall conform to the augmented quality assurance requirements specified in TVA Nuclear Power Standard, STD-3.2 (Reference 7.2.3).

2.2.11 Process and Operational Requirements

A. Operational Requirements

1. The drive cable should be capable of operating at a low speed of 12 feet per minute and at a high speed of 72 feet per minute. (Reference 7.1.1)

2. The 10-path rotary transfer should be capable of the transfer of a selected path from any other path position within 15 seconds. (Reference 7.1.1)

3. The accuracy of the ~~Incore~~ Core exit Thermocouples ~~and Integral Reference Junction RTD's~~ and response times are based on CCM Common Q operational requirements. (References 7.1.3, 7.1.4 and 7.2.23)

B. Process Requirements

The detector thimble guide tubing shall meet reactor coolant process conditions. The design conditions are 650°F and 2485 psig. The guide tubing are an extension of the reactor pressure vessel. This tubing is designated as Class I components designed to meet the requirements of Section III of the ASME Boiler and Pressure Vessel Code. (References 7.1.5 and 7.2.17).

2.2.12 Codes, Standards, and Regulatory Requirements

The referenced standards shall be applicable to the Incore Instrumentation System (IIS). In addition, the portions of the IIS that are used to mitigate Design Basis Events (DBEs) shall be designed in accordance with the design classification as defined in WB-DC-40-64 (Reference 7.2.21)

A. NRC Regulatory Guides

1. Reg. Guide 1.97 Rev. 2 (Reference 7.3.5)

2. NUREG 0737, Item II.F.2 (Reference 7.3.6)

B. Code of Federal Regulations

1. 10 CFR 50 Appendix A (Reference 7.3.3)

2. 10 CFR 50 Appendix B (Reference 7.3.7)

2.2.13 Other Requirements

Wincise EDCR ~~52319~~ JM 6/8/10 52321 to change

A. Cable Routing to Reactor Head

The Incore Thermocouple Subsystem extension cables from the thermocouple leads to the junction boxes located in the Incore Instrument Room shall be designed to allow for the reactor head removal process.

B. Thimble Design Requirements for the Incore Flux Mapping Subsystem

The thimbles shall be distributed nearly uniformly over the core with approximately the same number of thimbles in each quadrant. The number and location of these thimbles shall be chosen to permit measurement of local to average peaking factors to an accuracy of ±5% (95% confidence). Measured nuclear peaking factors will be increased by 5% to allow for this accuracy. If measured power peaking is larger than acceptable, reduced power capability will be indicated.

The movable detector thimbles shall be closed at the leading (reactor) ends, and thus normally dry inside. The thimbles shall serve as the pressure barrier between the reactor water pressure and the atmosphere. Mechanical seals between the retractable thimbles and the thimble guide tubes shall be provided at the seal table. The thimble guide tubes are essentially extensions of the reactor vessel, with the thimbles allowing the insertion of the incore instrumentation movable miniature detectors.

During normal operation, the retractable thimbles shall be stationary and shall only be retracted under depressurized conditions during refueling or for maintenance to avoid interference within the core. A manually operated isolation valve shall be provided on each thimble on the outboard side of the mechanical seal. This valve shall be designed to isolate the thimble if thimble leakage is detected. The valve need not be designed to isolate a thimble while the detector/drive cable is inserted in the thimble.

C. Storage Requirements

Upon use, the IFMS neutron detectors and portions of the detector device cables which are driven into the reactor vessel will become irradiated. Provisions shall be made to provide adequate storage facilities for the irradiated neutron detectors and portions of the detector drive cables when they are not in use.

3.0 DESIGN DESCRIPTION - FOR INFORMATION ONLY

The following describes engineering bases for functional requirements of the Incore Instrumentation System.

EDCR No. 52351-~~A~~B
Page ~~136~~ 202 ymcr 5/19/11
ymcr 5/19/11

3.1 System Description and Performance Characteristics

3.1.1 Incore Thermocouple Subsystem

The ~~65~~ 58 Chromel-Alumel type K thermocouples are threaded into guide tubes that penetrate the reactor vessel head through seal assemblies, and terminate at the exit flow end of the fuel assemblies. The thermocouples are provided with two primary seals, a Core Exit Thermocouple Nozzle Assembly (CETNA), see Reference 7.1.8, and swage type seal from conduit to head. The thermocouples are supported in guide tubes in the upper core support assembly.

See last page

~~Thermocouple extension wires (Chromel/Alumel) are terminated at the integral reference junctions contained on each of ten (10) containment cable assemblies, five (5) per train, and located in junction boxes in the Incore Instrument Room. Each integral reference junction provides a platinum resistance temperature detector (RTD). Only three (3) RTDs per train are connected; the other two (2) are installed spares. These detectors, along with their associated incore thermocouple signals are input to the Inadequate Core Cooling Monitor (ICCM) system. A microprocessor in the ICCM cabinet processes the input information and provides for a Plasma Display incore thermocouple temperature readout at the MCR. Information is available on the multipage screen of the Plasma Display using key switches. Thermocouple readings are also monitored by two (2) 3-pen recorders (one for each train) and backed by plant computer printout, input for which is provided from the ICCM system.~~

3.1.2 Incore Flux Mapping Subsystem

The control and readout system provides means for inserting the miniature neutron detectors into the reactor core and withdrawing the detectors while plotting neutron flux versus detector position. The thimbles are distributed nearly uniformly over the core with about the same number of thimbles in each quadrant. The control system consists of two sections, one physically mounted with the drive units, and the other contained in the control room. Limit switches in each transfer device provide feedback of path selection operation. Each gear box drives an encoder for position feedback. One 5-path operation selector is provided for each drive unit to insert the detector in one of five functional modes of operation. A 10-path rotary transfer assembly is a transfer device that is used to route a detector into any one of up to ten selectable paths. A common path is provided to permit cross calibration of the detectors.

The control room contains the necessary equipment for control, position indication, and flux recording for each detector. Additional panels are provided for such features as drive motor controls, core path selector switches, plotting, and gain controls.

A "flux-mapping" consists, briefly, of selecting (by panel switches) flux thimbles in given fuel assemblies at various core quadrant locations. The detectors are driven to the top of the core and stopped automatically. An x-y plot (position versus flux level) is initiated with the slow withdrawal of the detectors through the core from top to a point below the bottom. In a similar manner other core locations are selected and plotted. Each detector provides axial flux distribution data along the center of a fuel assembly.

The detectors are designated A, B, C, D, E, and F. Each detector will normally be used to measure the flux in thimbles connected to the correspondingly lettered 10 path rotary transfer device (normal mode). However, by means of the operation selector controls, each detector can also be routed through several other paths (see Figure 8.4 for diagram of detector paths). Each detector can thus be sent into each path of the next sequentially lettered 10-path transfer device (emergency mode) to serve as an operational spare detector for that device. For calibration purposes, each detector can be routed separately into a common calibration path (calibrate mode), thus providing correlation of the six detectors. Each detector can also be sent into any path of the 10-path transfer (common group mode) or to a shielded area for storage (storage mode). Various radial positions of detectors are then compared to obtain a flux map for a region of the core.

The thimbles are inserted into the reactor through thimble guide tubes extending from the bottom of the reactor vessel through the concrete shield area and then up to a thimble seal table. Because the movable detector thimbles are closed at the leading (reactor ends, they will normally be dry inside. They will thus serve as the pressure barrier between the reactor water pressure (2485 lb/in^{2}g design) and the atmosphere. High pressure mechanical seals between the retractable thimbles and the thimble guide tubes are provided at the seal table.

The thimbles are distributed nearly uniformly over the core with approximately the same number of thimbles in each quadrant. The number and location of these thimbles have been chosen to permit measurement of local to average peaking factors to an accuracy of ±5% (95% confidence). Measured nuclear peaking factors will be increased by 5% to allow for this accuracy. If the measured power peaking is larger than acceptable, reduced power capability will be indicated.

Operating plant experience has demonstrated the adequacy of the Incore Instrumentation System in meeting the design bases stated.

3.2 Equipment Description

3.2.1 Incore Thermocouple Subsystem

A. core exit ~~Incore~~ Thermocouples (CET)

fifty eight ~~Sixty-five~~ chromel-alumel core exit ~~incore~~ Thermocouples are provided. Each thermocouple is 1/8" (nominal) diameter, stainless steel sheathed, aluminum oxide insulated, with the trailing end terminated in a male thermocouple connector. The thermoelectric characteristics conform to the K calibration curve.

Each thermocouple is supplied to the specific length required for its assigned location. They are located at the core exit for each quadrant and provide indication of radial distribution of the coolant enthalpy rise across representative sections of the core.

EDCR No. 52351-~~A~~B
Page ~~138~~ 204

B. Integral Reference Junction RTDs

See last page

~~There are~~ five (5) Integral Reference Junction RTDs per train, ten (10) ~~total, and each~~ utilizes an ~~integral~~ reference junction platinum RTD. The ~~reference~~ RTDs are provided to permit transition from ~~chromel~~-alumel thermocouple extension wiring to copper field wiring. Six (6), three (3) per ~~channel, of the~~ RTDs are connected directly to Inadequate Core Cooling Monitoring ~~(ICCM)~~ cabinets for ~~cold~~ reference junction temperature compensation. ~~The~~ remaining four (4) RTDs, two (2) per ~~channel~~, are not connected but ~~are~~ retained as spares for connection should one of the ~~connected RTDs~~ fail.

~~Means are provided by cross checking between channels to verify the operational availability of each of the RTD monitoring channels during reactor operation.~~

C. Incore Thermocouple Recorders

For unit 1 only ~~These are not installed in unit 2~~

Two 3-pen strip chart recorders are supplied to record Incore Thermocouple temperature data. The ICCM supplies each recorder with an input signal for each of the following parameters: 1) High Quadrant Average Temperature, 2) Hottest Thermocouple Temperature, and 3) Selectable (Thermocouple Temperature, Saturation Margin, RVLIS, or Hot Leg Temperature).

The recorders are designated as PAM 1 and PAM 2 and are located on MCR Boards M-4 and M-6, respectively.

D. ~~Incore Thermocouple (ICTC) Plasma~~ Common Q touch screen Display

See last page

~~The ICTC temperature indication is provided through a Plasma Display screen (one for each train) at the MCR. Input for the Display unit is provided from a microprocessor in the ICCM cabinet (one for each train). The Plasma Display consists of graphic and alphanumeric display on a screen in various pages accessible to the operator through four pushbuttons located on a keyboard near the screen. Under normal plant condition information on reactor vessel level, incore thermocouples and subcool parameters and pump status are displayed on the screen termed the first page. In the event that conditions deviate from normal, the operator can use the four pushbuttons to bring up data on sensor status, trending or individual sensor readouts on reactor vessel level, incore thermocouples and subcooling margin. Pushing the relevant pushbutton for incore thermocouples displays the following pages of information:~~

1. ~~The first page on the screen will display a spatially oriented core map giving temperature values at each thermocouple coordinate.~~

2. ~~The second page on the screen will display maximum, average, and minimum temperature for each quadrant of the core, the high auctioneered average temperature appearing toward the center in that quadrant.~~

3. ~~Page three on the screen will display tabulated values of thermocouples temperature by quadrants.~~

4. ~~Thermocouple average and auctioneered high temperature trend over a 30 minute range will be displayed on pages 4 and 5 respectively.~~

touchscreen 5/19/11 the

The above ~~Plasma~~ Display information is backed by ~~readout from two (2) 3-pen recorders (one for each train) at MCR and also by computer printout from~~ Plant Computer System. ~~ICTC temperature high alarm is also annunciated at MCR~~. The range of the display will be ~~200°F~~ to 2300°F. This ~~ICTC~~ Display will constitute compliance to TVA's NUREG 0737, Item II.F.2 commitment.
32°F CET

Refer to N3-68-4001 (Reference 7.2.23) for detailed description of the ~~Plasma~~ Display.
touchscreen

3.2.2 Incore Flux Mapping Subsystem

A. Movable Miniature Neutron Flux Detector

Six fission chamber detectors (employing U_3O_8 enriched to more than 90% in U-235) are provided to be remotely positioned in the retractable guide thimbles. Approximate chamber dimensions are 0.188" in diameter and 2.1" in length. The stainless steel detector shell is welded to the leading end of the 0.188" diameter, helical wrap drive cable and to the stainless steel or Inconel-sheathed coaxial cable. Each detector is designed to have a minimum thermal neutron sensitivity of 1.0×10^{-17} amp/nv and a maximum gamma sensitivity of 3×10^{-14} amp/R/hr. (Reference 7.1.1)

B. Drive Unit Assemblies

The six drive units are mounted permanently on a platform approximately 11' from the seal table. The drive units will push hollow helical-wrap drive cables into the core with the miniature detectors attached to the leading ends of the cables with small-diameter sheathed coaxial cables threaded through the hollow centers back to the trailing ends of the drive cables.

Six drive unit assemblies are supplied as described in the following subsections. (see Reference 7.1.1) Refer to Figure 8.4 for the diagrammatic representation of the Drive System.

1. Gearmotor and Slip Clutch

One 2-speed, 2-winding, reversible, constant torque drive motor (Reuland model A103-F-3) is provided. The drive motor is 3 ph, 460 V, 60 Hz, 3600/600 r/min, with a 60:1 gear reducer. It incorporates an adjustable type magnetic brake. Two lever arms at the top of the motor housing permit manual release of the motor brake. This motor provides sufficient power to push a drive cable and detector through any path. Low speed for the drive cable is 12 ft/min and the high speed is 72 ft/min. The slip clutch is the ball detent type with a maximum torque rating of 17.6 ft-lb.

NOTE: Once the slip clutch setting has been exceeded during operation and the clutch has slipped, it is necessary to slightly withdraw the cable to reset the clutch. Insertion may then be attempted.

2. Drive Box

PS1 (Logic)	Dressen-Barnes, 51-5S	+5 V dc
PS2 (Encoder)	Powertec, 2C5-6	+5 V dc
T1 (Lights & Relays)	Thordarson, Transformer	24 V ac

10. Path Display Panel

A common display panel is located in the MCR to indicate detector position. This display consists of 58 status lights arranged in a grid to represent the relative location of each thimble in the reactor core. Status information is provided by energizing the status light(s) to indicate the detector has reached the selected thimble (microswitches are positioned at the outlet of the 10-path rotary devices).

11. Leak Detection System

The leak detection system consists of a drain header connecting the 10-path transfers, a Mercoid model AP-7021-153 pressure switch and drainage solenoid valve installed in the drain header, and an alarm and reset pushbutton mounted on the distribution panel in the control console. Liquid collecting in a 10-path transfer due to a leak will cause the water level to rise in the drain header, thus actuating the pressure switch. A contact from the pressure switch will energize the leak alarm and drainage solenoid, dumping the water to the plant drain. The alarm may be acknowledged by pressing the lighted reset pushbutton which silences the audible alarm and seals in the alarm light. When the water level in the drain header decreases below the pressure switch trip-point the alarm light will go out and the leak detection system will return to its normal condition.

3.3 System Interfaces

The following system interfaces are provided for the Incore Instrumentation System:

3.3.1 Reactor Coolant System

The thimble and thimble guide tubing connect to the reactor pressure vessel and extend the pressure boundary to the seal table.

Core exit
Common Q Post Accident Monitoring System

The ~~Incore~~ Thermocouples connect ~~to~~ guide tubes which penetrate the reactor vessel head. The guide tubes are an integral part of the reactor vessel. The thermocouple signals are monitored by the ~~Inadequate Core Cooling Monitor (ICCM)~~ which is part of the Reactor Coolant System. Also, ~~the ICCM~~ supplies thermocouple temperature information to the ~~Incore Thermocouple Temperature Recorders and to the~~ Plant Computer System.

Common Q
Add new paragraph, See last page

3.3.2 Electric Power Systems

The Drive Unit Motors are supplied 3-ph 460V AC, 60 Hz power from the 480 V Reactor Vent Boards.

The Incore Flux Mapping Subsystem Control Cabinets (M-18) are supplied 120V AC, 60 Hz power from the MCR (M-7) 120 V AC Instrument Control Power.

YMR 5/19/11

~~The Incore Thermocouple Temperature Recorders are supplied power from the 120V AC Vital Instrument Supply.~~

3.3.3 Equipment and Floor Drainage System

The IFMS leak detection system (Section 3.2.2F.11) will release drainage from the thimble guide tubing to the plant Equipment and Floor Drainage System (Reference 7.2.20).

4.0 SPECIAL OPERATIONS - FOR INFORMATION ONLY

4.1 Procedures at Refueling

At refueling time, the first step will be to remove the movable frame assembly from above the seal table to provide the necessary space for the in-core thimble retraction operations. The detectors and leading ends of the drive cables will be at a high radiation level at this time. They should, therefore, be routed to the shielded storage thimbles. Proceed as follows:

A. Disconnect the tubing runs between the 5-path and 10-path transfers and remove them to a storage area, taking precautions not to cause damage and to keep the insides of the tubes clean and dry. (Note that if these tubing runs are not already clearly identified with individual numbers, identification should be added to facilitate reinstallation.)

B. Disconnect the leakage drain connection from the movable frame assembly.

C. Loosen the unions connecting the tubing runs to the seal table and raise the isolation valve mounting angles by adjusting the two jackscrews until the tubing runs clear the thimbles.

D. Remove the two bolts attaching the movable frame assembly to the anchor angles on the support structure. The movable frame assembly may now be carefully rolled along the rails to the storage area to provide space for thimble retraction.

E. Bolt the movable frame anchor plates to the two storage position anchor angles. To prevent damage, care should be taken to check that the assembly is vertically clear of the seal table unions before permitting lateral movement.

F. After refueling is completed, reinstall the movable assembly and reconnect the tubing runs in accordance with the identification numbers.

Advantage should be taken at refueling downtimes to perform any required maintenance on the drive units, drive cables, or transfer devices.

There are no manual actions which have been credited for any accident scenario; nor, are there any administrative controls or system operational constraints or limitations for which design credit has been taken with respect to the Incore Instrumentation System.

C. Use the INSERT WITHDRAW toggle switch to run the detectors one at a time through the normal scan and record operations. Top-of-core stopping position can be estimated by observations of drop-off of the signals to the values expected near the top.

D. After completing the scan and record operations, return MODE switch to AUTO and withdraw the detectors.

6.0 MAINTENANCE AND TESTING COMMITMENTS - FOR INFORMATION ONLY

WBN in response to IE Bulletin 88-09 committed to eddy current testing for thimble wear during refueling outages.

7.0 REFERENCES - FOR INFORMATION ONLY

7.1 Westinghouse Documents

Inadequate Core Cooling Monitoring System

7.1.1 Technical Manual for In-Core Instrumentation - Volumes 1 and 2

7.1.2 Drawing 27641-Series (12 sheets), Teleflex Incorporated, latest revision

7.1.3 WAT/WBT 300/21 - "Functional Requirements ~~- Reactor Vessel Level Instrumentation System~~" ~~Revision 4~~

7.1.4 Westinghouse ~~Technical Description - "Inadequate Core Cooling Monitoring System - 86 in Response to the TVA Functional Requirements Document Dated 12-1-87," dated June 1988~~

7.1.5 Westinghouse Equipment Specification 953302, Revision 2, dated 6-20-78

7.1.6 Drawing 1096E91-Series (4 sheets), "WAT-WBT Instrumentation Bottom Mounted," latest revision

7.1.7 Westinghouse Equipment Specification 953262, Revision 0, dated 8-19-76

7.1.8 Westinghouse drawing 10002E84, Flanged CETNA Assembly and Details.

7.2 TVA Documents

7.2.1 Nuclear Quality Assurance Plan TVA-NQA-PLN89A

7.2.2 Nuclear Power Standard - Quality Assurance Program STD 3.1

7.2.3 Nuclear Power Standard - Augmented QA Program STD 3.2

7.2.4 ASME III Quality Assurance Manual (ASME III QAM)

page 16 of 21

7.2.5 WB-DC-30-4, "Separation/Isolation"

PAM System Requirement Specifications WNA-DS-0617-WBT

7.3.5 Regulatory Guide 1.97, Revision 2, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident"

7.3.6 NUREG 0737, "Clarification of TMI Action Plan Requirements"

7.3.7 10CFR50 Appendix B - "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"

7.3.8 IEEE 323-1974 - "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations"

7.3.9 2-47W610-94 series, Common Q Block diagram (control diagrams)

7.4 Calculations

7.4.1 FSAR TMI (NUREG-0737) Instrumentation Device Identification - WBPEVAR8603010, Rev. 2 (RIMS No. B18 910604 259)

~~7.4.2 ICCM Incore Thermocouple System Uncertainty Report - ICCM URI, Rev. 4~~

7.4.3 Incore Temperature Monitoring System (94) NUREG 0588 Category and Operating Times - WBN-OSG4-028 ~~Rev. 6~~

7.4.4 Environmental Qualification for NUREG-0737 - WBN-OSG4-069 ~~Rev. 3 (RIMS No. B18 930208 253)~~

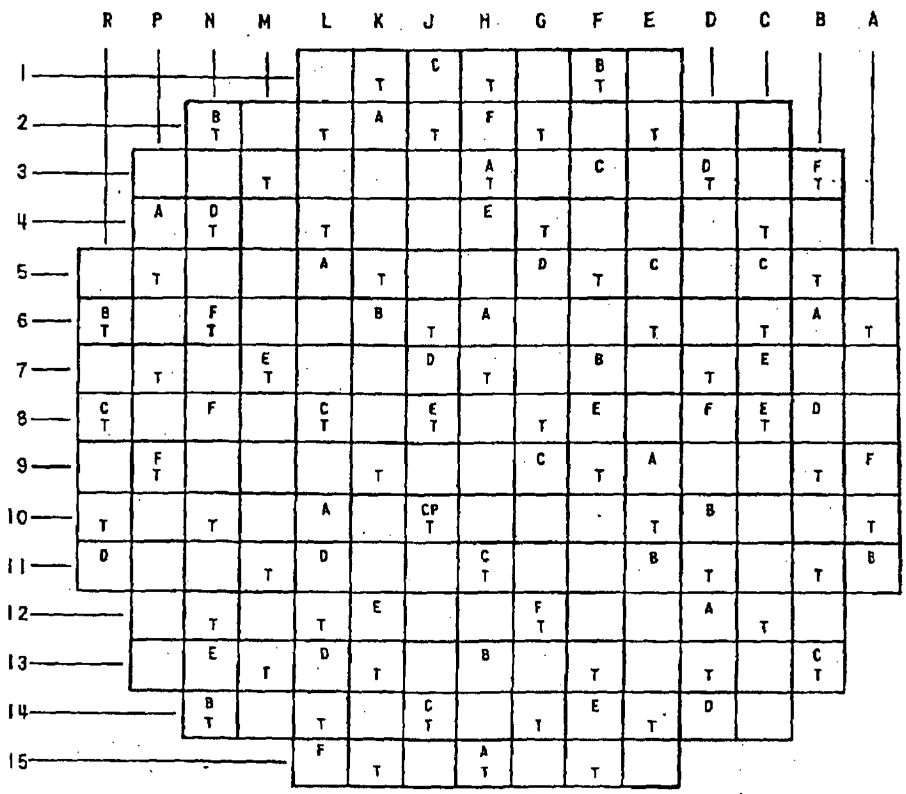
7.5 Other

7.5.1 Letter from J. A. Domer to Ms. E. Adensam, dated September 19, 1985 (RIMS No. L44 850919806)

smr 5/19/11
EDCR No. ~~52351-A~~ B
Page ~~144~~ 210
smr 5/19/11

8.0 FIGURES - FOR INFORMATION ONLY

8.1 Distribution of Flux Thimbles and Thermocouples



A - FLUX THIMBLE, DETECTOR A
B - FLUX THIMBLE, DETECTOR B
C - FLUX THIMBLE, DETECTOR C
D - FLUX THIMBLE, DETECTOR D
E - FLUX THIMBLE, DETECTOR E
F - FLUX THIMBLE, DETECTOR F
CP - CALIBRATION FLUX THIMBLE (COMMON PATH)
T - THERMOCOUPLE

Figure 8.1
Distribution of Flux Thimbles and Thermocouples

Windie EDCR 52321 to change

Page 18 of 21

EDCR No. 52351-~~A~~B
Page ~~145~~ 211 JMR 5/19/11
JMR 5/19/11

Attachment 1
(Page 1 of 1)

ABBREVIATIONS AND ACRONYMS

ASME	American Society of Mechanical Engineers
dc	Direct Current
ERFDS	Emergency Response Facility Data System
°F	Degrees Fahrenheit
ft-lb	Foot-pounds (Torque)
ft/min	Feet Per Minute (Speed)
Hz	Hertz
ICCM	Inadequate Core Cooling Monitor
ICTC	Incore Thermocouple
IFMS	Incore Flux Mapping Subsystem
IIS	Incore Instrumentation System
ITS	Incore Thermocouple Subsystem
lb/in^2g	Pounds Per Square Inch-Gage
MCR	Main Control Room
mA	Milli-Ampere (10^{-3})
µA	Micro-Ampere (10^{-6})
PAM	Post Accident Monitoring
ph	Phase
r/min	Revolutions Per Minute
RPV	Reactor Pressure Vessel
RTDs	Resistance Temperature Detectors
RVLIS	Reactor Vessel Level Instrumentation System
V	Voltage

Common Q   Common Qualified group of components

CET   core exit thermocouple

1.2 - 1st paragraph

The Incore Thermocouple Subsystem consists of fifty-eight (58) core exit thermocouples (CET) which are provided and positioned to measure fuel assembly coolant outlet temperature. (See Figure 8.1 for thermocouple locations within the reactor core). Twenty nine (29) of the thermocouples are grouped and wired under each train. Four (4) resistance temperature detectors (RTDs) per train are provided to monitor the temperature of a cold reference junction located within the racks. The reference junction RTD signals along with their associated incore thermocouple signals are inputted into a microprocessor module [one (1) per train] located in the Common Q PAMS cabinet. This then provides input to a Westinghouse touch screen display in the MCR and a data link to the plant computer. This data link includes all CETs and other associated CET related computed variables.

3.1.1 - 2nd paragraph

Thermocouple extension wires (Chromel/Alumel - type K) - are terminated at the reference junction contained within each rack. This is accomplished by having four cold reference junction platinum RTDs in each rack. The thermocouples and reference junction RTDs are input into Common Q PAMS. A microprocessor in the Common Q cabinet processes the input information and provides for a touch screen displaying CET values in the MCR. Information is available on the multipage screen of the touch screen display. A data link is sent from Common Q to ICS which includes all CETs.

3.2.1 - B

There are four Cold Reference Junction RTDs per train installed in each rack. This design allows the type K thermocouple cable to go all the way to the rack vice having a thermocouple to copper transition in the plant.

3.2.1 - D

Core exit thermocouple temperature indication is provided through the Common Q touch screen display (one for each train) in the MCR. Input for the Display is provided from the Common Q cabinets. The Display consists of graphic and alphanumeric displays on the screen and includes various other pages. Under normal plant conditions information on reactor vessel level, incore thermocouples, subcool parameters, and pump status are displayed on the screen termed the "default page".

In the event that conditions deviate from normal, the operator can use the various menus to bring up data on sensor status, trending, or individual sensor readouts on reactor vessel level, incore thermocouples, and subcooling margin. Applicable pages are...

1. ICC Summary (default page) - will display highest CET temperatures per quadrant, RCS subcooling, a RVLIS display widget, and RCP status
2. Core map - display a spatially oriented core map giving temperature values at each thermocouple coordinate.
3. Core Exit Thermocouple Display - shows representative CET temperature T_{CREP}, highest CET value in each quadrant, and second highest CET temperature in each quadrant.
4. Trend display - can display any parameter with Common Q.

3.3.1 - New paragraph

The data link to ICS goes through a DualDiode from Owl Computing. This is a cyber security device that ensures one-way network flow on the hardware level. The DualDiode for each train consists of two specialized network cards each installed within its own server - for a total of four servers.

System 68 System Description Markups

WBN2-68-4001

EDCR 52351 - Common Q PAMS

Prepared - Mat Merten 6/8/10

Reviewed - Algene Germany 6/9/10

EDCR No. 52351-~~A~~B ymr 5/19/11
Page ~~43~~ 215 ymr 5/19/11

N
E

TENNESSEE VALLEY AUTHORITY

Engineering and Support

QA RECORD

WB2CCP

WATTS BAR NUCLEAR PLANT

No. WBN2-68-4001

TITLE: SYSTEM DESCRIPTION FOR REACTOR COOLANT SYSTEM

ISSUE DATE: ~~7-23-08~~

REVISION	0000			XXXX		
DATE:						
PREPARED	M. A. Egap	[signature]	7-21-08			
CHECKED	K. M. O-Gara	K. O'Gara	7/21/08			
REVIEWED	K. M. O-Gara	K. O'Gara	7/21/08			
APPROVED	K. O. Larssen	K O Larssen	7/21/08			

Title: REACTOR COOLANT SYSTEM JMR 5/19/11		REVISION LOG WBN2-68-4001
REVISION NO.	DESCRIPTION OF REVISION	DATE APPROVED
0000	**Interim issue to support WBN2CCP** Outstanding WITEL punchlist items are listed below: • PL-08-0891, Section 2.1.2 and 7.3.2 • PL-08-0892, Section 2.2.7 and 7.4.5 • PL-08-0893, Section 2.2.7 and 7.4.22 • PL-08-0443, Section 2.2.12.5 and 7.4.3 • PL-08-0894, Section 2.2.10 and 7.1.3 • PL-08-0895, Section 2.2.12 and 7.4.1 • PL-08-0896, Section 2.2.12.5 and 7.4.2 • PL-08-0449, Section 2.2.20 and 7.4.8 **Add the following editorial changes:** • In Section 2.2.7 change Ref. 7.4.3 to 7.4.22 • In Section 7.4, under Ref. 7.4.22 add: "WBN-OSG4-098, Mechanical Equipment Qualification List for 10CFR50.49 Events" • In Section 2.2.16 change Ref. 7.8.80 to 7.5.80 • In Section 2.2.10 change Ref. 7.5.62 to 7.1.3	7-23-08
XXXX	Various changes were made to support the installation of Common Q PAMS (EDCR 52351). Common Q is replacing unit 1's ICCM-86.	6/2/10

EDCR No. 52351-~~A~~ B
Page ~~115~~ 217 Amr 5/19/11 5/19/11

Acronyms and Abbreviations

RT_{NDT}	-	Reference Nil-Ductility Temperature
RTD	-	Resistance Temperature Detector
RVHVS	-	Reactor Vessel Head Vent System
RVLIS	-	Reactor Vessel Level Instrumentation System
SFPCS	-	Spent Fuel Pool Cooling System
SG	-	Steam Generator
SI	-	Safety Injection
SIS	-	Safety Injection System
sp gr	-	Specific Gravity
T-avg	-	Average Temperature
T-cold	-	Temperature of Cold Leg Fluid
TE	-	Temperature Element
T-hot	-	Temperature of Hot Leg Fluid
TR	-	Topical Report
TW	-	Thermometer Well
V	-	Volt
VLV	-	Valve
W	-	Watt
WB-DC	-	Watts Bar-Design Criteria
WDS	-	Waste Disposal System
Common Q	-	Common Qualified group of components
CET	-	core exit thermocouples
T_{CREP}	-	representative thermocouple temperature

page 4 of 15

3.3.1 RVLIS

The RVLIS uses differential pressure (DP) measuring devices to measure vessel level or relative void content of the circulating RCS fluid. The system is redundant and includes automatic compensation for temperature variations of the impulse lines. Essential information is displayed in the MCR ~~in a form called Plasma~~ Display ~~which is a display of information on a screen via a dot matrix plasma.~~ on the Common Q touch screen. This display ~~may be either~~ is alphanumerical and graphical, ~~or both~~ and is directly usable by the operator.

The functions performed by the RVLIS are as follow:

a. Assist in detecting the presence of a gas bubble or void in the reactor vessel.

b. Assist in detecting the approach to inadequate core cooling (ICC).

c. Indicate the formation of a void in the RCS during forced flow conditions.

A. RVLIS System Description

The RVLIS (Figure 4) utilizes two sets of three DP cells. These cells measure pressure drop from the bottom of the reactor vessel to the hot legs and from the hot legs to the top of the vessel.

This DP measuring system utilizes cells of differing ranges to cover different flow behaviors with and without pump operation as follows:

Reactor Vessel - Upper Range (ΔP_a): The DP cell, ΔP_a shown in Figure 4 provides a measurement of reactor vessel level above the hot legs when the RCP in the loop with the hot leg connection is not operating.

Reactor Vessel - Lower Range (ΔP_b): This measurement provides an indication of reactor vessel level from the bottom of the reactor vessel to the hot legs during natural circulation conditions.

Reactor Vessel - Dynamic Head (ΔP_c): This instrument provides an indication of reactor core and internals pressure drop for any combination of operating RCPs. Comparison of the measured pressure drop with the normal, single-phase pressure drop provides an approximate indication of the relative void content or density of the circulating fluid. This instrument monitors coolant conditions on a continuing basis during forced flow conditions.

To provide the required accuracy for level measurement, temperature measurements of the impulse lines are provided. These measurements, together with the existing RC temperature measurements and wide range RCS pressure, are employed to compensate the DP transmitter outputs for differences in system density and reference leg density, particularly during the change in the environment inside the containment structure following an accident.

EDCR No. 52351-AB
Page ~~77~~ 219 SMR 5/19/11
SMR 5/19/11

3.3.1 RVLIS (continued)

The DP cells are located outside the containment to eliminate the large reduction (approximately 15%) of measurement accuracy associated with the change in the containment environment (temperature, pressure, radiation) during an accident. The cells are also located outside the containment so that system operation including calibration, cell replacement, reference leg checks, and filling are made easier.

B. RVLIS System Layout

There are four RCS penetrations for the cell reference lines: one reactor head connection at a spare penetration, one connection to an incore instrument conduit at the seal table and connections into the side of two RCS hot legs 1 and 3.

The pressure sensing lines extending from the RCS penetrations are a combination of 1/2" and 3/4" manual isolation valves. These lines connect to six sealed capillary impulse lines (two at the reactor head, two at the seal table, and one at each hot leg) which transmit the pressure measurements to the DP transmitters. The capillary impulse lines are sealed at the RCS end with a sensor bellows which serves as a hydraulic coupling for the pressure measurement. The impulse lines extend from the sensor bellows through the containment wall to hydraulic isolators, which also provide hydraulic coupling as well as a seal and isolation of the lines. The capillary tubing extends from the hydraulic isolators to the DP transmitters, where instrument valves are provided for isolation and bypass.

Common sense lines serve the two redundant sensor bellows at the reactor head and the seal table. This design is acceptable since the sense lines are located in a protected area to avoid the potential for damage due to an external source (i.e., HELB, NUREG 0612). Plugging of the sense line is not postulated since 1) stainless steel is used which preclude corrosion products, and 2) the absence of mechanisms such as flow of boric acid. Also a random single failure of the sense line is not postulated as described in Ref. 7.5.64.

The impulse lines from the vessel head are routed upward out of the refueling canal to the operating deck, then radially toward the seal table and then to the containment penetration. The connection to the bottom of the reactor vessel is made through an incore detector conduit which is also utilized by the In-Core Flux Detector System. The connection at the incore detector conduit is above the seal table and below the Swagelok Seal, which serves as the pressure boundary, at a tee connection. The impulse line from this connection is routed axially and radially to join with the head connection line in routing to the penetrations. Similarly, the hot leg connection impulse lines are routed toward the seal table/penetration routing of the other two connections.

The impulse lines inside containment are exposed to temperature increase during a LOCA or HELB. Since the vertical runs of impulse lines form the reference leg for the DP measurement, the change in density due to the accident temperature change must be taken into account in the vessel level determination. Therefore, a strap-on RTD is located on each vertical run of separately routed impulse lines to determine the impulse line temperature and to correct the reference leg density contribution to the DP measurement. Temperature measurements are not required where all three impulse lines of an instrument train are routed together. Table 26 contains the RVLIS instrumentation.

EDCR No. 52351-~~A~~B
Page ~~48~~ 220 YMR 5/19/11
YMR 5/19/11

3.4 **RCS Instrumentation and Controls (continued)**

(4) Steam dump control, using T_{avg}, will accommodate sudden loss of generator load, and

(5) Information is furnished to the MCR operator and at local stations for monitoring.

3.4.1 Reactor Vessel Instrumentation and Control

A. Reactor Vessel Flange Leak-Off Temperature Detection

The temperature in the reactor vessel flange leak-off line connections is indicated in the MCR (TI-68-21). An increase in temperature above ambient is an indication of O-ring seal leakage. High temperature actuates an alarm in the MCR (TA-68-21).

B. Reactor Vessel Water Level Indication System (RVLIS)

~~Common Q-PAM~~

~~the Common Q Cabinet~~

See last page

~~The Reactor Vessel upper range, lower range and dynamic head differential pressure transmitter signals are input into the Inadequate Core Cooling Monitor (ICCM) cabinet. A microprocessor in ICCM cabinet (one for each train) processes this information along with signals from strap on RTDs on capillary lines for density compensation, hot leg RTDs and RCS wide range pressure transmitter, core exit thermocouples and provides input to a plasma display at MCR (one for each train).~~

~~The plasma display consists of graphic and alphanumeric display on a screen in various pages accessible to the operator through four pushbuttons located on a keyboard near the screen. Under normal plant condition information on reactor vessel level, core exit thermocouples and subcool parameters and pump status are displayed on the screen termed the first page. In the event that conditions deviate from normal, the operator can use the four pushbuttons to bring up data on the sensor status, trending or individual sensor read-outs on reactor vessel level, core exit thermocouples and subcooling margin. Pushing the relevant pushbutton for RVLIS displays the following pages of information (Ref. 7.2.45):~~

~~Page 1 - Displays reactor vessel water level from 0-100% range for static mode when no RCPs are running or dynamic mode for any combination of RCPs running.~~

~~Pages 2 & 3 - Displays static and dynamic mode trend over 0-30 minute period(s) of reactor vessel water level 0-100% range.~~

~~Page 4 - Displays strap on RTDs temperature, upper, lower and dynamic range differential pressure.~~

~~Page 5 - Displays diagnostic information.~~

~~In addition to the input for plasma display the microprocessor in the ICCM cabinet provides input to a recorder (one for each train) at the main control board and to the plant computer which provides a backup means of obtaining compensated RVLIS level information.~~

page 7 of 15

EDCR No. 52351-4B
Page ~~119~~ 221 5/19/11 5/19/11

3.4.2 RCS Loop Instrumentation and Control (continued)

(TAS) becomes part of the Thermal Overpower and Overtemperature Protection System (T/TAVG Protection). The THAVE signal is used in the calculation of reactor coolant loop differential temperature ΔT and TAVG. The parameters relative to the ΔT and TAVG adjustments necessary during power ascension are contained in Westinghouse Procedure WAT/WBT-SU-2.9.6 (Ref. 7.5.68).

Two fast response, narrow range, RTDs will be located in each cold leg at the discharge of the RCP. The RTDs are spaced 30 degrees and 90 degrees from horizontal. These average cold leg temperatures will be used for determining the reactor coolant loop ΔT and T_{avg} The T_{avg} for each loop is indicated on the main control board. Indications of Reactor Coolant ΔT, overpower ΔT setpoint, and overtemperature ΔT setpoint are also available to the MCR operator.

RCS ΔT and TAVG are used to initiate overtemperature and overpower ΔT reactor trips to protect the reactor from low DNBR and excessive power (Ref. 7.2.44).

3. Incore Thermocouples

The fifty eight (twenty nine per train) incore thermocouples are located at the core exit for each quadrant and, in conjunction with core inlet RTD data, are sufficient to provide indication of radial distribution of coolant enthalpy rise across representative sections of the core. Average, instantaneous, and maximum values of thermocouple temperatures are available to the operator. ~~Auctioneered high core quadrant average or T_{Hot}~~ Representative CET temperature (T_{CREP}) ~~of~~ and auctioneered T_{HOT} also are used for monitoring subcooling.

A qualified ~~plasma~~ touch screen display device to provide post-accident monitoring indication on core exit thermocouple temperature readout is installed in the MCR. ~~Each display device has the capability for selectively reading a minimum of sixteen operable thermocouples, four from each quadrant~~. The range extends from ~~200°F~~ 32°F to 2300°F.

This display provides an indication of RCS subcooling margin. The ~~plasma~~ touch screen display provides direct and continuous recording of core exit thermocouple temperature and ~~on demand~~ subcooling margin information. ~~Core exit temperature is also continuously recorded on the main control board~~. The core exit thermocouples also provide a backup capability to the flux monitoring instrumentation for monitoring power distribution.

The ~~primary and backup displays will be separated to meet the intent of Ref. 7.5.39~~ touch screen displays from both trains will meet train seperation criteria. See Ref. 7.2.7 for details on how the core exit thermocouples are to meet the requirements for Post Accident Monitoring Instrumentation.

D. RCS Subcooling Margin Monitor (Ref. 7.2.45)

See last page

~~The microprocessor in the ICCM cabinet as described in Section 3.4.1B provides output to display subcool margin on various pages of the plasma display screen. The subcool margin is calculated using RCS wide range pressure and auctioneered high core quadrant average temperature with the option to select calculation based on hot leg temperature.~~

EDCR No. 52351-AB
Page ~~120~~ 222 JMR 5/19/11
JMR 5/19/11

3.4.2 RCS Loop Instrumentation and Control (continued)

See last page

~~The ICCM microprocessor also provides input to a digital saturation meter (one for each train) at the main control board which provides a backup means to assess saturation temperature corresponding to RCS pressure from 0-3000 psig.~~

~~The plant process computer is also utilized to continuously monitor pressure and temperature margins to saturation of the RCS.~~

E. RCS Hot Leg Level Indication (Ref. 7.4.6)

The Westinghouse Ultrasonic Level Measurement System (ULMS) is designed to provide a highly accurate indication of water level in the RCS piping during plant shutdown. Various maintenance and inspection activities performed during plant shutdown require that RCS water level be lowered into the loop piping, often referred to as "mid-loop" operation. Operation above a minimum water level in the hot leg is always necessary to prevent air ingestion by the RHP Pumps, with the potential for a resulting loss of decay heat removal capability. The ULMS was specifically developed to provide the accurate indication of water level necessary during mid-loop operations, due to the narrow operating window and the potential severity of loss of decay heat removal events.

In addition to the ULMS, a differential pressure level transmitter and a liquid level gauge are provided as permanent backup instruments to monitor the reactor vessel water level during mid-loop operations. A second D/P level transmitter provides wide range indication from the bottom of the hot leg to an elevation above the pressurizer lower level instrument tap.

3.4.3 Steam Generator Instrumentation and Control

See the Main Steam and Main FeedWater System description (Ref. 7.2.1 and 7.2.46).

3.4.4 RCPs Instrumentation and Control

A. RCP Power Supply

The four RCPs are connected to separate buses of the 6.9KV boards which normally receive power from the main generator. These boards receive emergency power from the 6.9KV start buses. The power supply to each RCP consists of a normally closed breaker and a normally open breaker which are electrically interlocked. If the normally closed breaker should sense a loss of power on its bus, it will open and the normally open breaker will close providing power from another bus. During plant startup and shutdown operations the four RCP buses receive power from an offsite source.

Complete loss of normal ac power results in reactor trip on RCP bus undervoltage or underfrequency and turbine trip (Ref. 7.2.44). The flywheel inertia of each RCP sustains RC flow for a period of time (1-1/2 minutes) after the trip sufficient to assure the minimum heat removal needed to prevent core damage after the trip. Natural circulation of the coolant provides sufficient flow for reactor core residual heat removal until power can be restored to the pumps.

EDCR No. ~~53351-A~~ B
Page ~~121~~ 223

3.5.5 PZR Precautions and Limitations (continued)

F. Maintain a maximum temperature differential of 320°F between the PZR and the loop. See Reference for exact number of heatup and cooldown cycles allowable at different temperature differential (Ref. 7.5.69).

G. If upstream MOV block valve is used to isolate the PORV in the event of leakage, then the MOV block valve shall be stroked open/closed at pressurizer temperatures of 550°F and 450°F during reactor cooldown to Mode 4. These actions are required to assure that the upstream block valve remains operable for COMS, if necessary, and thermal binding does not occur.[17] This precaution is not applicable if the PORV failed in the open position.

3.5.6 PRT Precautions and Limitations

A. Prior to each plant startup, a verification that the PRT rupture disc is in place should be made.

B. If the PRT water temperature alarm is activated, the contents of the tank should be cooled by spraying with reactor makeup water. The alarm could indicate leakage or lifting of PZR safety valve or PORV and the cause of the alarm should be determined.

C. PRT level should be maintained in the normal operating range between the high and low alarm set points.

D. A nitrogen gas blanket should be maintained in the PRT to exclude air and prevent the formation of an explosive hydrogen-oxygen mixture.

E. PRT gases must be sampled routinely. Oxygen must be maintained ≤ 2% by volume when hydrogen ≥ 4% by volume.

F. If the PRT pressure exceeds 10 psig, do not vent the PRT to the WDS vent header.

G. When maintenance inside the PRT is required, it must first be purged with air. The gas in the tank must then be sampled to ensure personnel safety.

3.5.7 RCS Setpoints

Refer to the instrument tabulation (Ref. 7.1.7) for a tabulation of RCS component setpoints and their functions. Many of these values were taken from the WBN PLS (Ref. 7.5.31). See the current revision of the PLS document for an updated listing of setpoints.

EOP Setpoints

Common Q

EOP setpoints for ~~the ICCM~~ (i.e., RVLIS, Incore T/Cs and subcooling) are provided in the W setpoint document ~~EOP-SP~~-1 (RIMS T33 920210 807).

3.5.8 RVLIS Precautions and Limitations

A. The root valves must be closed at each of the RVLIS taps (Head, Hot Leg, and Seal Table) if the RCS is brought up to pressure prior to vacuum fill of the RVLIS.

6.2.4 **Power Ascension (continued)**

B. RVLIS Dynamic Head Scaling Factor Adjustment

which is an input into Common Q PAMS

The Reactor Vessel Instrumentation System (RVLIS), ~~which is part of the Inadequate Core Cooling Monitor (ICCM),~~ requires adjustment of dynamic head (pumps running) parameters during power ascension testing because certain scaling factors depend on the differential pressures experienced with the core loaded and operating at power. Based on the RVLIS functional requirements, the following derives the acceptance criteria to be used during power ascension testing to verify that RVLIS is operational. These acceptance criteria are acceptable as found values and are not acceptable as left values. Dynamic range RVLIS adjustments are made in accordance with SSDS **1-x-68-100 and 1-x-68-110. [PL-09-2825]** 2 2

RVLIS is operational when it performs within the functional requirements. The uncertainties calculated in Reference 7.5.84 have been shown to be within the Watts Bar functional requirements at 600°F by Reference 7.5.83. Since the uncertainties increase with increasing temperature, readings at assumed 100% liquid or 100% level, if within uncertainties calculated at 570°F table values, will be within the functional requirements.

Combining by the square root of the sum of the squares method, the random (non-harsh environmental) errors determined in Reference 7.5.84, Tables 1 and 7 at 570°F, and translating the Table 1 values into percent of vessel by using the relationship identified in Section 4.8 of Reference 7.5.84, the following are the acceptance criteria for RVLIS at all RCS temperatures during power ascension testing **(Reference 7.5.85) [PL-09-2862]:**

Static Level RVLIS (no pumps running and sufficient coastdown time allowed for stabilization): 96.8% to 103.2% as read on the diagnostic page for all temperature plateaus.

Dynamic Level RVLIS (any combination of pumps running): 95.2% to 104.8% liquid as read on the diagnostic page for all temperature plateaus.

Verification of RVLIS performance within these acceptance criteria must be made at or above 557°F average RCS wide range temperature for the test results to be valid.

6.2.5 **RVHVS**

The Reactor Vessel Head Vent System shall be tested at 2235 psig and 557°F. This ensures operability during required conditions per Westinghouse letter WAT-D-9618. (Ref. 7.5.77)

6.2.6 **Thermal Expansion**

For thermal expansion testing, a tolerance of ±10% or ±1/4", whichever is greater, is allowable for temperature plateau gap measurement data.

EDCR No. 52351-~~A~~B
Page ~~123~~ 225 JMR 5/19/11 JMR 5/19/11

7.0 REFERENCES

7.1 TVA Drawings

7.1.1 **1-47W610-68-Series, RCS Electrical Control Diagrams [PL-09-2827]**

7.1.2 **1-47W611-68-Series, RCS Electrical Logic Diagrams [PL-09-2828]**

7.1.3 **1-47W813-Series, RCS Flow Diagram [PL-08-0894]**

7.1.4 **45N600-68-Series, RCS Schematic Diagrams [PL-09-2829]**

7.1.5 **45W751-Series, RCS Single Line Wiring Diagrams [PL-09-2830]**

7.1.6 **45W760-68-Series, RCS Wiring Schematic Diagrams [PL-09-2831]**

7.1.7 SPP-9.6, "Master Equipment List"

7.1.8 **47W576-Series, Table of MOV Requirements [PL-09-2832]**

7.1.9 2-47W600-314, RVLIS

7.1.10 2-47W610-94, Common & Control Drawings

7.2 TVA Documents

7.2.1 WBN2-01-4002, Main Steam System Description

7.2.2 WBN2-74-4001, Residual Heat Removal System Description

7.2.3 WB-DC-40-54, Environmental Qualification to 10CFR50.49

7.2.4 Deleted

7.2.5 Deleted

7.2.6 WB-DC-30-4, Separation/Isolation

7.2.7 WB-DC-30-7, Post Accident Monitoring Instrumentation

7.2.8 WB-DC-40-5, Insulation

7.2.9 WB-DC-40-29, Flood Protection Provisions

7.2.10 Deleted

7.2.11 WB-DC-40-31.2, Seismic Qualification of Category I Fluid System Components and Electrical or Mechanical Equipment

7.2.12 WB-DC-40-31.7, Analysis of Category I and I(L) Piping Systems

7.2.13 WB-DC-40-31.9, Location and Design of Piping Supports and Supplemental Steel in Category I Structures

7.2.14 WB-DC-40-31.10, Seismically Qualifying Conduit Supports

EDCR No. ~~52351-A~~ B
Page ~~124~~ 226 JMR 5/19/11 JMR 5/19/11

7.5 Other References (continued)

7.5.104 AREVA NP, Inc. Document No. 51-9035014-000, "Watts Bar Nuclear Station 10CFR50.59 Safety Evaluation Support to Implement Zinc Chemistry." [PL-09-2866]

7.5.105 Westinghouse Letter WTV-RSG-06-047, May 31, 2006, LOCA Mass and Energy Releases and Containment Integrity Analysis, TVA Watts Bar Unit 1 Replacement Steam Generators, Contract No. 16346 with enclosed Westinghouse Letter LTR-CRA-06-96*, May 31,2006, LOCA Mass and Energy Releases and Containment Integrity Analysis *(EDMS T71 060606 800) [PL-09-2854]

7.5.106 WAT-D-11609, letter from Westinghouse to TVA, dated October 18, 2007, Calculation CN-SEE-III-07-19, "Watts Bar Unit 1 (WAT) Revised Net Heat Input Factor for Increased Letdown Flow Rate."

7.5.107 FCN # WBTM - 10769, Westinghouse Moisture Carryover Modification [Unit 2]

7.5.108 Westinghouse Letter LTR-AMLRS-09-11, December 8, 2009, Watts Bar Unit 2 Completion Project - PTLR, FSAR, and Technical Specifications Markups.

7.5.109 Westinghouse PAM System requirement Specifications WNA-DS-0617-WBT.

EDCR No. 52351-~~A~~B
Page ~~125~~ 227
YMR 5/19/11

Table 26
(Page 1 of 1)
RVLIS Instrumentation

TVA No. (W No.)	Material Type	Wall Thickness (in)	Design Pressure (psig)	Design Temperature °F
LT 369 (LT 1310)	316SS	0.06	3000	N/A
LT 368 (LT 1311)	316SS	0.06	3000	N/A
LT 367 (LT 1312)	316SS	0.06	3000	N/A
LT 372 (LT 1320)	316SS	0.06	3000	N/A
LT 371 (LT 1321)	316SS	0.06	3000	N/A
LT 370 (LT 1322)	316SS	0.06	3000	N/A

N/A: Not applicable (Instrument exceeds 420°F)

Note: The following RTDs and their cables and splices associated with RVLIS were determined to require qualification for submergence resulting from a LOCA.

~~1-TE-68-373~~
1-TE-68-376
1-TE-68-377
~~1-TE-68-380~~
2

1-TE-68-383
1-TE-68-384
1-TE-68-393
[PL-09-2858]
2

3.4.1.B - entire section

The reactor vessel upper range, lower range and dynamic head differential pressure transmitter signals are input into the Common Q PAMS cabinets. A microprocessor in each Common Q cabinet (one for each train) processes this information along with signals from strap on density compensating RTDs, wider range T_{HOT} RTDs, RCS wide range pressure transmitters, RCPs, and CETs. Common Q then calculates various values and provides data to a touch screen display in the MCR, a subcooled margin digital panel meter in the MCR, and a data link to the plant computer.

The touch screen display consists of graphic and alphanumeric displays on the screen and includes various other pages. Under normal plant conditions the "default page" is displayed.

In the event that conditions deviate from normal, the operator can use the various menus to bring up data on sensor status, trending, or individual sensor readouts on reactor vessel level, incore thermocouples, and subcooling margin. Each page has an alarm indication, directory, and print screen buttons. Applicable pages are...

1. ICC Summary (default page) - will display highest CET temperatures per quadrant, RCS subcooling, RCP status, RVLIS mode, and have a RVLIS display widget.
2. Core map - display a spatially oriented core map giving temperature values at each thermocouple coordinate.
3. Core Exit Thermocouple display - shows representative CET temperature T_{CREP}, highest CET value in each quadrant, and second highest CET temperature in each quadrant.
4. Trend display - can display any parameter with Common Q.

In addition, Common Q provides a comprehensive data link to the plant computer containing various parameters within Common Q, including reactor vessel level. There is a print screen function from the operator's touch screen display, but no printer will normally be connected.

3.4.2.D - entire section

The microprocessor in the Common Q cabinet as described in section 3.4.1.B provides output to display subcool margin on various pages of the touch screen display. Common Q constantly calculates two separately derived subooled margin values. The first is based on auctioneered T_{HOT} and the second is based on T_{CREP}. Both calculations use wide range pressure.

Common Q also provides input to a fully qualified digital panel meter (one for each train) on the main control board which provides an alternate means to assess subcooled margin.

In addition, Common Q provides a comprehensive data link to the plant computer containing various parameters within Common Q, including subcooled margin.

Westinghouse Document CAW-11-3141, Dated April 15, 2011,

"Application For Withholding Information From Public Disclosure For NO-WBT-002, Rev. 0, 'Westinghouse Incore Information Surveillance & Engineering (Wincise™) System' (Proprietary)"

Westinghouse

Westinghouse Electric Company
Nuclear Services
1000 Westinghouse Drive
Cranberry Township, Pennsylvania 16066
USA

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

Direct tel: (412) 374-4643
Direct fax: (724) 720-0754
e-mail: greshaja@westinghouse.com
Proj letter: WBT-D-3098

CAW-11-3141

April 15, 2011

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

Subject: NO-WBT-002, Rev. 0, "Westinghouse Incore Information Surveillance & Engineering (WINCISE™) System" (Proprietary)

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-11-3141 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.

The subject document was prepared and classified as Westinghouse Proprietary Class 2. Westinghouse requests that the document be considered proprietary in its entirety. As such, a non-proprietary version will not be issued.

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-11-3141, 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,

BAMaurer /for

J. A. Gresham, Manager
Regulatory Compliance

Enclosures

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

Before me, the undersigned authority, personally appeared B. F. Maurer, 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:

B F Maurer

B. F. Maurer, Manager
ABWR Licensing

Sworn to and subscribed before me
this 15th day of April 2011

Cynthia Olesky
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, ABWR Licensing, 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) 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.

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 contained in NO-WBT-002, Rev. 0, "Westinghouse Incore Information Surveillance & Engineering (WINCISE^{TM}) System" (Proprietary), dated October 2010, 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 Westinghouse Incore Information Surveillance and Engineering System and may be used only for that purpose.

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

(a) Maintain a competitive advantage in the workplace.

(b) Continue to provide technically sound services to the nuclear industry.

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 providing technical expertise.

(b) Westinghouse can sell support and defense of plant 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 products 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 is the proprietary version of a document furnished to the NRC in connection with requests for generic and/or plant-specific review and approval. The document is to be considered proprietary in its entirety.

COPYRIGHT NOTICE

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 NO-WBT-002, Rev. 0, "Westinghouse Incore Information Surveillance & Engineering (WINCISE™) System" (Proprietary)

Also enclosed is the Westinghouse Application for Withholding Proprietary Information from Public Disclosure CAW-11-3141, 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-11-3141 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company LLC, Suite 428, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.

Enclosure 3
TVA Letter Dated June 10, 2011
Responses to Licensee Open Items to be Resolved for SER Approval

List of References

1. WEC letter to TVA, WBT-D-3201, dated May 23, 2011, "NRC Access to WINCISE Documents at the Westinghouse Rockville Office" [Letter Item #5 (NRC Request #378)]

2. TVA letter to NRC, dated May 20, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 - Instrumentation and Controls (I&C) Staff Information Requests - Presentation Package for Public Meeting Held On May 12, 2011" [Letter Item #6 (NRC Request #379)]

3. WEC letter to TVA, WBT-D-3154, dated May 4, 2011, "Non-Proprietary Responses to April 27, 2011 NRC Audit Report of Common Q PAMS (TAC No ME2731)" [Letter Item #15]

4. TVA letter to NRC, dated December 10, 2010, "Watts Bar Nuclear Plant (WBN) Unit 2 - Final Safety Analysis Report (FSAR) - Response to Requests for Additional Information," (T02 101210 001), [Letter Item #17]

5. WEC letter to TVA, WBT-D-3149, dated May 2, 2011, "Non-proprietary Response to TVA Request for Information on PAMS Datastorm Test" [Letter Item #18]

6. WEC letter to TVA, WBT-D-3212, dated May 26, 2011, "NRC Common Q PAMS Audit Report - Comments" [Letter Item #1 (NRC Request #362)]

7. TVA letter to NRC, dated October 29, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 - Instrumentation and Controls (I&C) Staff Information Requests," [Letter Item #19]

8. WEC letter to TVA, WBT-D-3072, dated April 6, 2011, "WINCISE Vibration Induced Wear Calculation Conclusion," [Letter Item #4 (NRC Request #376)]

9. TVA letter to NRC, dated May 6, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 - Instrumentation and Controls (I&C) Staff Information Requests" [Letter Item #1 (NRC Request #362)]

10. TVA letter to NRC, dated April 15, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 - Instrumentation and Controls (I&C) Staff Information Requests" [Letter Item #21]