UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

December 11, 2018

Mr. Kenneth Watkins
Quality Manager
Transware Enterprises Inc.
1565 Mediterranean Drive, Suite A
Sycamore, IL 60178

SUBJECT: TRANSWARE ENTERPRISES INC. NUCLEAR REGULATORY COMMISSION INSPECTION REPORT NO. 99902067/2018-201

Dear Mr. Watkins:

On October 22-25, 2018, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an inspection at the Transware Enterprises Inc. (hereafter referred to as Transware) facility in Sycamore, Illinois. The purpose of this limited-scope routine inspection was to assess Transware's compliance with provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 21, "Reporting of Defects and Noncompliance," and selected portions of Appendix B, "Quality Assurance Program Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

This technically-focused inspection specifically evaluated Transware's implementation of the quality activities associated with nuclear fluence evaluations for the U.S. nuclear industry. This NRC inspection report does not constitute NRC endorsement of Transware's overall quality assurance (QA) program.

In accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the NRC's "Rules of Practice," the NRC will make available electronically for public inspection a copy of this letter, its enclosure through the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System, which is accessible at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

/RA/ Paul Prescott for

Kerri A. Kavanagh, Chief
Quality Assurance Vendor Inspection Branches 1 and 2
Division of Construction Inspection
and Operational Programs
Office of New Reactors

Docket No.: 99902067

Enclosure:
Inspection Report No. 99902067/2018-201
and Attachment

SUBJECT: TRANSWARE ENTERPRISES INC. NUCLEAR REGULATORY COMMISSION INSPECTION REPORT NO. 99902067/2018-201 Dated: December 11, 2018

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DATE	11/29/2018	11/29/2018	12/11/2018

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NEW REACTORS
DIVISION OF CONSTRUCTION INSPECTION AND OPERATIONAL PROGRAMS
VENDOR INSPECTION REPORT

Docket No.:	99902067
Report No.:	99902067/2018-201
Vendor:	Transware Enterprises Inc. 1565 Mediterranean Drive, Suite A Sycamore, IL 60178
Vendor Contact:	Mr. Kenneth Watkins Quality Manager kenneth.watkins@transware.net
Nuclear Industry Activity:	Transware Enterprises Inc. is an engineering services provider and performs nuclear fluence and radiation physics evaluations for the nuclear industry.
Inspection Dates:	October 22-25, 2018

Inspectors:			
	Jeffrey Jacobson	NRO/DCIP/QVIB-1	Team Leader
	Andrea Keim	NRO/DCIP/QVIB-2	
	James Medoff	NRR/DMLR/MVIB	
	Scott Krepel	NRR/DSS/SNPB	

Approved by: Kerri A. Kavanagh, Chief
Quality Assurance Vendor Inspection Branches 1 and 2
Division of Construction Inspection
and Operational Programs
Office of New Reactors

Enclosure

EXECUTIVE SUMMARY

Transware Enterprises Inc.
99902067/2018-201

The U.S. Nuclear Regulatory Commission (NRC) staff conducted a vendor inspection at the Transware Enterprises Inc. (hereafter referred to as Transware) facility in Sycamore, Illinois to verify that Transware implemented a quality assurance (QA) program that complies with the requirements of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities." In addition, the NRC inspection team (henceforth, team) also verified that Transware implemented a notification program that complies with 10 CFR Part 21, "Reporting of Defects and Noncompliance." This technically-focused, limited scope inspection specifically reviewed Transware's performance of safety-related nuclear fluence evaluations for the U.S. nuclear industry.

Design Control

In the area of design control, the team reviewed Transware's translation of technical requirements into internal documentation and analyses. The team reviewed Transware's translation of the technical requirements described in the purchase orders for four projects: the first two projects concerned fluence evaluations for specified locations for two Boiling Water Reactor (BWR) nuclear power plant operators; and the latter two projects covered work performed for Electric Power Research Institute (EPRI) to perform benchmarking analyses based on capsule surveillance data as part of the BWR Integrated Surveillance Program (ISP), and to produce a complete fluence evaluation for the reactor pressure vessel for two BWR nuclear power plants. The team verified that the requested assessments were performed in a manner consistent with the NRC regulations, guidance, and approved methodologies discussed above.

The team also reviewed Transware's documentation of its software calculations and the final generated reports that were performed and issued as part of the vendor's contractual responsibilities on four projects. For the projects concerning ISP related calculations, the team reviewed the neutron fluence calculations in accordance with the requirements for implementing NRC-approved ISPs. The team also reviewed the vendor's neutron fluence calculations for the surveillance capsule against the NRC's guidance criteria for neutron fluence calculations in Regulatory Guide (RG) 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence."

The team did not identify any findings of significance in regard to Transware's activities for performing the neutron fluence assessments and calculations for the site-specific RPV surveillance capsules, RPVs, and RVI components. Although the team did observe several minor documentation issues, the staff did not find them to be a safety concern because they did not impact the validity of the conclusions as reported in the deliverable reports issued from Transware to their customers. Based on the scope and depth of its review, the team concluded that Transware is performing its fluence calculations for site-specific RPV surveillance capsules, RPVs, and RVI components in accordance with either NRC-established requirements, NRC-established guidelines, or staff-endorsed methodologies.

Software/Firmware Development Lifecycle, Verification, and Validation

The team reviewed calculational files to verify that the software being utilized had been shown to be capable of performing its intended function correctly. For the samples reviewed, Transware was able to provide acceptable validation and verification documents, including for computerized sub-routines that may be utilized as part of the vendor's process for generating component-specific or capsule-specific fluence calculations.

From the records reviewed, the team determined that Transware's records appropriately documented the vendor's basis for updating the software codes from the previous versions of the codes. The team did not identify any findings of significance in regard to Transware's activities or bases for updating specific Transware-developed computer codes used in its fluence assessments. Based on the scope and depth of its review, the team concluded that Transware is implementing appropriate quality activities and taking appropriate steps to record and provide the bases for any company updates of its Quality Level I software codes.

Corrective Action and 10 CFR Part 21

The team reviewed Transware's quality assurance (QA) manual, policies, and procedures that govern the implementation of corrective action, to ensure compliance with the requirements of Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50 and 10 CFR Part 21. No findings of significance were identified. The team concluded that Transware is implementing its policies and procedures that govern corrective actions and Part 21 consistent with the regulatory requirements of Criterion XVI, "Corrective Action" of Appendix B to 10 CFR Part 50, and with 10 CFR Part 21.

REPORT DETAILS

1. Design Control – Translation of Technical Requirements

a. Inspection Scope

The NRC inspection team (henceforth, team) reviewed Transware Enterprises' (Transware or the vendor) translation of purchase order requirements for performing neutron fluence evaluations into calculations, software codes, reports, or records. NRC requirements for implementing fluence-dependent reactor pressure vessel (RPV) material surveillance and capsule withdrawal programs are given in 10 CFR Part 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements." NRC guidelines and criteria for performing neutron fluence calculations are given in Regulatory Guide (RG) 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," and in RG 1.99, "Radiation Embrittlement of Reactor Vessel Materials," for neutron fluence attenuation calculations. The NRC-endorsed methodologies that are used by Transware to perform neutron transport or neutron flux calculations are described in Electric Power Research Institute (EPRI) Technical Report No. 1019050, "BWRVIP-115-A: BWR [Boiling Water Reactor] Vessel and Internals Project, RAMA Fluence Methodology Benchmark Manual – Evaluation of RG 1.190 Benchmark Problems," and EPRI Technical Report No. 1019052, "BWRVIP-121-A: BWR Vessel and Internals Project, RAMA Fluence Methodology Procedures Manual."

The team reviewed Transware's translation of the technical requirements described in the purchase orders for four projects: SNC-HA1-004, EXL-JAF-001, EPR-DR3-001, and EPR-CPR-001. The first two projects concern fluence evaluations for specified locations for two BWR nuclear power plant operators. The latter two projects cover work performed for EPRI to perform benchmarking analyses based on capsule surveillance data as part of the BWR Integrated Surveillance Program (ISP), and to produce a complete fluence evaluation for the reactor pressure vessel for two BWR nuclear power plants. For each project, the technical requirements were translated into a series of calculational files supporting final reports delivered to the customers. The team verified that the requested assessments were performed in a manner consistent with the NRC regulations, guidance, and approved methodologies discussed above.

b. Observations and Findings

The team did not identify any findings of significance with regard to Transware's translation of the technical requirements from the purchase orders into the calculations performed to support the final reports.

c. Conclusions

The team verified that the technical requirements contained within the licensee and EPRI purchase orders were being properly translated into supporting calculations for the final reports delivered to the customers.

2. Design Control – Project Activities and Documentation

a. Inspection Scope

The Transware Quality Assurance Procedures (QAPs) define the controls implemented to ensure compliance with the regulatory requirements in Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50. In particular, QAP 3.2 establishes a standard method for the specification, selection, and qualification of quality-affected items and services; QAP 3.3 describes the processes used by Transware to ensure that any software used to support the design or operation of nuclear power plants; and QAP 6.2 provides instructions for controlling the initiation, review, approval, issuance, distribution, and revision of technical and activity control documents. A full listing of the QAPs reviewed by the team is included near the end of this inspection report.

The team reviewed Transware's documentation of its software calculations and the final generated reports that were performed and issued as part of the vendor's contractual responsibilities on four projects: SNC-HA1-004, EXL-JAF-001, EPR-DR3-001, and EPR-CPR-001. For the projects concerning ISP related calculations, the team reviewed the neutron fluence calculations in accordance with the requirements for implementing NRC-approved ISP's in Paragraph III.C of 10 CFR Part 50, Appendix H, and the NRC's basis for approving the EPRI BWR ISP, as given in the NRC safety evaluation for ERPI Report BWRVIP-86, Revision 1-A. The team also reviewed the vendor's neutron fluence calculations for the surveillance capsule against the NRC's guidance criteria for neutron fluence calculations in RG 1.190. The team reviewed the vendor's records against the quality assurance requirements specified in Criterion III, "Design Control," Criterion V, "Procurement Document Control"; Criterion VI, "Document Control"; and Criterion VII, "Control of Purchased Equipment, Material, and Services," of Appendix B to 10 CFR Part 50, as implemented by the vendor through their QAPs.

Further project-specific discussion and observations are provided in the below subsections for each project.

(1) SNC-HA1-004

This project was performed at the request of the operator for Edwin I. Hatch Nuclear Power Plant, with the specific requests for a fluence evaluation of the core shroud and tie rods, along with a fluence trend analysis. The team reviewed whether the vendor's methodology for performing the neutron fluence calculation of the capsule was performed in a manner consistent with the NRC staff-approved RAMA methodology and the NRC's guidelines and criteria defined in RG 1.190. The team also assessed whether the methods and software for performing the neutron fluence calculation of the capsule included applicable quality verifications of any software code routines used to perform the calculations and any plant-specific design and operational data that would need to be factored into the calculations.

(2) EXL-JAF-001

This project was performed for the operator for James A. Fitzpatrick Nuclear Power Station, with the specific request for a fluence projection for the N16 nozzle. The team reviewed whether the vendor's methodology for performing the neutron fluence calculation of the

capsule was performed in a manner consistent with the NRC staff-approved RAMA methodology and the staff's guidelines and criteria defined in NRC RG 1.190. The team also assessed whether the methods and software for performing the neutron fluence calculation of the capsule included applicable quality verifications of any software code routines used to perform the calculations and any plant-specific design and operational data that would need to be factored into the calculations.

(3) EPR-DR3-001

This project had two main deliverables: benchmarking for designated EPRI BWR ISP capsules (including the associated fluence calculations), and fluence projections for the reactor pressure vessel (RPV) and specified reactor vessel internal (RVI) components that are included in the reactor design of the Dresden Generating Station. The first deliverable had been completed, and the second deliverable was not complete at the time that the inspection was conducted. The documents reviewed by the team covered work performed to develop a model capable of performing the required fluence calculations, the fluence calculations themselves (specified fluence projections for capsule locations as well as more general fluence projections for the RPV and RVIs), and the reports generated to summarize the relevant results for the customers.

The team assessed whether the vendor's methodology for performing the neutron fluence calculation of the capsule was performed in a manner consistent with the NRC staff-approved RAMA methodology and the staff's guidelines and criteria defined in NRC RG 1.190. The team also assessed whether the methods and software for performing the neutron fluence calculation of the capsule included applicable quality verifications of any software code routines used to perform the calculations and any plant-specific design and operational data that would need to be factored into the calculations. The team also assessed whether the neutron fluence value calculated and reported for the specified BWR ISP capsule was within the range of fluences typically established for these types of capsule assessments and the range of uncertainties established for these types of assessments.

The team observed three minor issues where the project documentation appeared to contain some information inconsistencies or gaps. In the first case, several of the calculational files documenting generation of data supporting the model used in the fluence evaluations were not signed off yet, even though the first deliverable report had been issued. Based on discussion with the Transware staff, the calculations performed to obtain the desired fluence predictions did not require all of the details of the full model used to perform the RPV and RVI projections. Therefore, some of the specific inputs that do not have a significant impact on the fluence at the capsule locations were not fully documented and verified prior to issuance of the capsule evaluation report. The team agreed that this did not impact the technical acceptability of the reported results.

In the second case, one of the calculational files, related to statepoint selection, was the subject of a difference in professional opinion between the preparer and QA reviewer. This issue was still going through the process of resolution at the time that the first deliverable report was issued, so a separate calculational file was generated (TWE-FLU-001-FA-022-001, as opposed to TWE-FLU-001-F-022-001) to document the information needed to support the first deliverable report. However, this calculational file did not provide any discussion of the difference in professional opinion or how it was resolved

for the purpose of generating the first deliverable report. During discussions with the team, Transware management was able to verbally explain why this file was not necessary to issue the first report.

In the last case, at least one calculational file was identified that did not have a signature of the preparer as normally required. The team determined that this was an inadvertent omission as the same person responsible for signing off as preparer was found to have signed off on several subsequent calculational files that referenced the file in question. The team verbally confirmed with the person in question that the work as performed was acceptable. The calculational files had been signed off by others, including QA reviewers.

(4) EPR-CPR-001

This project had two main deliverables: benchmarking for designated EPRI BWR ISP capsules (including the associated fluence calculations), and fluence projections for the reactor pressure vessel (RPV) and specified reactor vessel internal (RVI) components that are included in the reactor design of the Cooper Nuclear Station. The first deliverable had been completed, and the second deliverable was in the final approval process at the time that the inspection was conducted. The documents reviewed by the team covered work performed to develop a model capable of performing the required fluence calculations, the fluence calculations themselves (specified fluence projections for capsule locations as well as more general fluence projections for the RPV and RVIs), and the reports generated to summarize the relevant results for the customers.

The team reviewed whether the vendor's methodology for performing the neutron fluence calculation of the capsule was performed in a manner consistent with the NRC staff-approved RAMA methodology and the staff's guidelines and criteria defined in NRC RG 1.190. The team also assessed whether the methods and software for performing the neutron fluence calculation of the capsule included applicable quality verifications of any software code routines used to perform the calculations and any plant-specific design and operational data that would need to be factored into the calculations. The team also reviewed whether the neutron fluence values calculated and reported for the specified BWR ISP capsule was within the range of fluences typically established for these types of capsule assessments and the range of uncertainties established for these types of assessments.

The team observed one minor issue where the project documentation appeared to contain some information inconsistencies or gaps. In this case, one of the calculational files documenting generation of data supporting the model used in the fluence evaluations was not signed off until after the first deliverable report was issued. This issue was similar to the issue in EPR-DR3-001, where the calculations performed to obtain the desired fluence predictions did not require all of the details of the full model used to perform the RPV and RVI projections. Therefore, some of the specific inputs that do not have a significant impact on the fluence at the capsule locations were not fully documented and verified prior to issuance of the capsule evaluation report. The team agreed that this did not impact the technical acceptability of the reported results.

b. Observations and Findings

The team did not identify any findings of significance in regard to Transware's activities for performing the neutron fluence assessments and calculations for the site-specific RPV surveillance capsules, RPVs, and RVI components, as performed by Transware in accordance the contractual agreement between them and their customers. Although the team did observe several minor documentation issues, the staff did not find them to be a safety concern because they did not impact the validity of the conclusions as reported in the deliverable reports issued from Transware to their customers. The team considered these examples of incomplete verification signatures to be a minor issue which Transware entered into their corrective action program as CAR-2018-001.

c. Conclusions

Based on the scope and depth of its review, the team concludes that Transware is performing its fluence calculations for site-specific RPV surveillance capsules, RPVs, and RVI components in accordance with either NRC-established requirements, NRC-established guidelines, or staff-endorsed methodologies.

3. Software/Firmware Development Lifecycle, Verification, and Validation

a. Inspection Scope

Transware utilizes many different computer software packages to perform different aspects of their calculations. Most commonly, an individual software package will be used to perform data processing or calculations to support a specific step in the overall Transware model generation and analysis process. These software packages may generally be sorted into three groups based on their quality controls:

I. NRC approved, controlled software packages. These are software packages which capture the implementation of an analysis methodology described in a topical report that was reviewed and approved by the NRC. As such, the types of changes that can be made to the software without prior NRC approval and review are limited if the topical report is being referenced by licensees to demonstrate regulatory compliance (e.g., via the UFSAR or other NRC approved program. The software must also be properly controlled and documented in every application. RAMA is one example of such a software package.

II. Controlled software packages that have not been reviewed by the NRC. These are generally software packages developed by Transware to automate specific steps in their process. For example, a computer program may be written to extract information from files provided by customers and convert it into the appropriate format for generation of a model input deck. These software packages are controlled, verified, and validated in accordance with Transware's Appendix B program. In some cases, there may be third party software packages that are controlled to ensure that the software being used is consistent with the validation performed by the third party vendor.

III. Uncontrolled software packages. Many "helper" scripts and processing codes are used to provide further assistance in automating data processing and input generation tasks. Many of these software products do work that is little more sophisticated than

what an Excel spreadsheet can achieve. Due to the uncontrolled nature of these software products, adequate documentation must be provided within the calculational files to demonstrate that the software is appropriately performing its intended function.

The team's understanding of the Transware QAPs indicates that in general, if a software package is used to produce results that are subsequently used for safety related purposes, then the software package must be validated and verified to appropriately perform its function. This is done for controlled software by completing and documenting the software verification and validation for a specified version of the software, prior to use of any results produced by that version of the software. This can be verified by noting that the software verification and validation documentation was signed prior to any calculational files utilizing that software. However, if the software package is not NRC approved, the verification and validation of the software does not necessarily need to be completed prior to use, but would have to be completed prior to the issuance of any evaluations that relied upon the subject software.

The team looked through the calculational files to verify that, based on appropriate documentation, the software had been shown to be capable of performing its intended function correctly and had been sufficiently verified prior to any reports being delivered to Transware customers. A few sample validation and verification document packages were requested for controlled codes, namely the MB2SMBGEN, SIM2SMBGEN, and SMBGEN codes. Transware provided acceptable documentation for all codes. The team noted that the validation and verification documents may be required for multiple versions to capture the complete picture. In some cases, if Transware performed an incremental improvement or added a single feature to their controlled software, then the validation and verification would be limited to the extent necessary to confirm that the specific change led to the intended results.

The team performed a cross-cutting review to assess Transware's bases and verification methods for updating Transware-developed computerized sub-routines that may be utilized as part of the vendor's process for generating component-specific or capsule-specific fluence calculations. The team selected the vendor's SIM2SMBGEN statepoint analysis software as the software for this review. The team verified that this software code is one of several computer codes that Transware uses to generate core outputs into useful data for the RAMA code calculations. Transware considers the SIM2SMBGEN computer code to be a controlled, Quality Level I (i.e., safety related) software code for the company.

From the records reviewed, the team determined that Transware's records appropriately documented the vendor's basis for updating the software codes from the previous versions of the codes. For the SIM2SMBGEN, Version 2.23, the team determined that the company's records appropriately document that the software code was developed to correct a stacking error in the previous version of the computer code. For the SIM2SMBGEN, Version 2.22, the team determined that the company's records appropriately document that the software code was developed to correct an error in the water property subroutine of a previous version of the computer code and to add a feature that would permit the processing of larger or additional stacking cases.

In at least one case, the results from one version of SIM2SMBGEN appear to have been used to support a report issued prior to the time that the code completed its verification and validation. However, the team determined that this was related to a separate issue (see previous section, in the EPR-CPR-001 project specific discussion) related to issuance of a

report prior to completion of the model documentation. The specific calculational file that documented the aforementioned results from the computer code was not signed until the code verification and validation documentation was signed.

b. Observations and Findings

The team did not identify any findings of significance in regard to Transware's activities or bases for updating specific Transware-developed computer codes used in its fluence assessments.

c. Conclusions

Based on the scope and depth of its review, the team concludes that Transware is implementing appropriate quality activities and taking appropriate steps to record and provide the bases for any company updates of its Quality Level I software codes.

4. Corrective Action and 10 CFR Part 21

a. Inspection Scope

The team reviewed Transware's quality assurance (QA) manual, policies, and procedures that govern the implementation of corrective action, to ensure compliance with the requirements of Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50. The team verified Transware's process for corrective action requires promptly identifying and correcting conditions adverse to quality and screening for Part 21 reporting. The team also verified that for significant conditions adverse to quality, Transware's process requires determination of cause, extent of condition, and taking action to prevent recurrence in addition to prompt identification and correction. The team reviewed the corrective action report (CAR) list from 2012 to October 2018 and selected a sample for detailed review. Specifically, the team verified for the CARs reviewed, that conditions adverse to quality were promptly identified and corrected, appropriately dispositioned and screened for Part 21 reporting. The team discussed the identification of conditions adverse to quality and the corrective action process with management and technical staff. The attachment to this inspection report lists the individuals interviewed and documents reviewed by the NRC inspection team. The team noted that Transware has not made any Part 21 notifications in the last three years.

b. Observations and Findings

No findings of significance were identified

c. Conclusions

The team concluded that Transware is implementing its policies and procedures that govern corrective actions and Part 21 consistent with the regulatory requirements of Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50, and with 10 CFR Part 21.

ATTACHMENT

1. Entrance and Exit Meetings

On October 22, 2018, the U.S. Nuclear Regulatory Commission (NRC) inspection team discussed the scope of the inspection with Mr. Dean Jones, President and other members of Transware's management and technical staff. On October 25, 2018, the NRC inspection team presented the inspection results and observations during an exit meeting with Mr. Dean Jones and other members of Transware's management and technical staff. The attachment to this report lists the attendees of the entrance and exit meetings, as well as those individuals whom the NRC inspection team interviewed.

2. Entrance/Exit Meeting Attendees/Persons Interviewed

Name	Title	Affiliation	Entrance	Exit	Interviewed
Jeffrey Jacobson	Inspection Team Leader	NRC	X	X	
Andrea Keim	Reactor Operations Engineer	NRC	X	X	
Scott Krepel	Nuclear Engineer	NRC	X	X	
James Medoff	Senior Mechanical Engineer	NRC	X	X	
Dean Jones	President	Transware	X	X	X
Kenneth Watkins	Quality Assurance Manager	Transware	X	X	X
Patrick Crane	Fluence Engineer	Transware		X	X
Jean Evans	Quality Assurance Specialist	Transware	X	X	
Kathy Jones	Special Council	Transware	X		
Steven Baker	Principal Consultant	Transware			X
Alex Scheppers	Engineer II	Transware			X
Patrick Crane	Engineer II	Transware			X
Brandon Distler	Principal Engineer	Transware			X
Timothy Lampe	Engineer I	Transware			X
Ethan Taber	Engineer I	Transware			X
Aaron Dayan	Engineer II	Transware			X

3. Inspection Procedures Used

Inspection Procedure (IP) 36100, “Inspection of 10 CFR Part 21 and Programs for Reporting Defects and Noncompliance,” dated February 13, 2012

IP 43002, “Routine Inspections of Nuclear Vendors,” dated January 27, 2017

IP 43004, “Inspection of Commercial-Grade Dedication Programs,” dated January 27, 2017

IP 35710, “Quality Assurance Inspection of Software Used in Nuclear Applications,” dated January 30, 2018

4. List of Items Opened, Closed, and Discussed

N/A

5. Applicable ITAAC

N/A

6. Documents Reviewed

NRC Regulations and Guidance

- Title 10, *Code of Federal Regulations* (10 CFR) Part 50, Appendix G “Fracture Toughness Requirements”
- 10 CFR 50.61, Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events”
- 10 CFR Part 50, Appendix H, “Reactor Vessel Material Surveillance Program Requirements”
- NRC Regulatory Guide (RG) 1.190, “Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence,” March 2001
- NRC RG 1.99, Revision 2, “Radiation Embrittlement of Reactor Vessel Materials,” May 1988
- 10 CFR Part 50, Appendix B, “Quality Assurance Requirements for Nuclear Power Plants and Fuel Reprocessing Plants”

EPRI Documentation Previously Reviewed and Approved by the NRC

- NRC Correspondence Letter and Safety Evaluation to D. Czufin, Chairman, BWR Vessel and Internals Project, “NRC Final Safety Evaluation for Electric Power Research Institute Boiling Water Reactor Vessel and Internals Project Report 1016575, “BWRVIP-86, Revision 1: BWR Vessel and Internals Project, Update BWR Integrated Surveillance Program (ISP) Implementation Plan,” dated October 20 2011. (ADAMS Accession Nos. ML112780497 for the correspondence letter and ML112780503 for the safety evaluation).
- EPRI Proprietary Technical Report No. 1025144, “BWRVIP-86, Revision 1-A: BWR Vessel and Internals Project, Updated BWR Integrated Surveillance Program (ISP) Implementation Plan,” dated October 2012. (ADAMS Accession Nos. ML13176A099, ML13176A100, and ML13178A098 for the proprietary report; the publically available,

non-proprietary version of the report may be accessed at ADAMS Accession No. ML13176A097).

- EPRI Proprietary Technical Report No. 1019050, "BWRVIP-115-A: BWR Vessel and Internals Project, RAMA Fluence Methodology Benchmark Manual – Evaluation of RG 1.190 Benchmark Problems," dated June 2009. (ADAMS Accession Nos. ML100540357 for the EPRI cover letter, and ML100540375 for the proprietary report; the publically available, non-proprietary version of the report may be accessed at ADAMS Accession No. ML100540367).
- EPRI Proprietary Technical Report No. 1019052, "BWRVIP-121-A: BWR Vessel and Internals Project, RAMA Fluence Methodology Procedures Manual," dated June 2009. (ADAMS Accession Nos. ML100110355 for the EPRI cover letter, and ML100110357 for the proprietary report; the publically available, non-proprietary version of the report may be accessed at ADAMS Accession No. ML100310356).

Transware Quality Assurance Procedures

- QAP 1.1, "Organizational Responsibilities," Revision 1, dated August 14, 2003
- QAP 1.2, "Management Review of Quality Program," Revision 0, dated July 2, 1999
- QAP 2.1, "Control of Quality-Related Projects," Revision 2, dated May 31, 2002
- QAP 2.2, "Qualification, Training, and Indoctrination of Project Personnel," Revision 3, dated May 31, 2002
- QAP 2.3, "Lead Auditor Qualification," Revision 1, dated March 1, 2013
- QAP 2.4, "Auditor Qualification," Revision 0, dated July 2, 1999
- QAP 2.5, "Certification System," Revision 1, dated March 1, 2013
- QAP 3.1, "Design Control of Project Activities," Revision 4, dated August 14, 2002
- QAP 3.2, "Specification, Selection, and Qualification of Items and Services," Revision 1, dated December 11, 2001
- QAP 3.3, "Development and Control of Computer Systems," Revision 2, dated April 9, 2015
- QAP 4.1, "Procurement of Items and Services," Revision 1, dated May 31, 2002
- QAP 5.1, "Preparation, Review, Revision, and Distribution of QA Procedures," Revision 1, dated December 7, 2001
- QAP 6.1, "Processing and Control of Project Documents," Revision 2, dated May 31, 2002
- QAP 6.2, "Initiation, Distribution, and Revision of Technical and Activity Control Documents," Revision 4, dated August 14, 2003
- QAP 6.3, "Design Document Change Control," Revision 1, dated August 14, 2003
- QAP 7.1, "Supplier Qualification," Revision 0, dated July 3, 1999
- QAP 7.2, "Control of Approved Suppliers List," Revision 0, dated July 3, 1999
- QAP 7.3, "Receipt Inspection," Revision 2, dated March 1, 2013
- QAP 7.4, "Commercial Grade Dedication," Revision 3, dated March 1, 2013
- QAP 8.1, "Identification and Control of Materials, Parts, and Components," Revision 0, dated July 3, 1999
- QAP 9.1, "Control of Special Processes," Revision 0, dated July 3, 1999
- QAP 10.1, "In-process and Final Inspection of Quality Items," Revision 1, dated May 31, 2002
- QAP 11.1, "Test Control," Revision 2, dated April 9, 2015
- QAP 12.1, "Control of Measuring and Test Equipment," Revision 0, dated July 3, 1999

- QAP 13.1, “Requirements for Handling, Storage, and Shipping,” Revision 2, dated March 1, 2013
- QAP 15.1, “Control of Nonconforming Materials, Parts, and Components,”, Revision 3, dated May 31, 2002
- QAP 15.2, “Test Deviation Report,” Revision 2, dated May 31, 2002
- QAP 16.1, “Deviation Reporting and Corrective Action,” Revision 4, dated August 7, 2018
- QAP 16.2, “Reporting of Defects and Non-compliances per 10CFR21,” Revision 4, dated March 1, 2013
- QAP 16.3, “User Problem Reporting,” Revision 1, dated August 14, 2003
- QAP 17.1, “Collection, Storage, and Maintenance of Project Records,” Revision 5, dated April 24, 2015
- QAP 18.1, “QA Audits and Reviews,” Revision 4, dated April 7, 2015
- QAP 19.1, “Order Entry Process,” Revision 4, dated March 1, 2013
- QAP 19.2, “Project Closure Process,” Revision 0, dated December 7, 2001

Corrective Action Reports

- CAR 2017-002 dated October 9, 2017 NUPIC finding
- CAR 2017-001, dated July, 20, 2017, Error in RAFTER inputs
- CAR 2016-001, dated June 24, 2016, Internal Audit Finding
- CAR 2015-004, dated November 12, 2015
- CAR 2015-002, dated October 2, 2015

Transware Documentation

- *Project SNC-HA1-004, “Fluence Monitoring Program for Edwin I. Hatch Unit 1 at End of Cycle 27”*
- Calc No. SNC-HA1-004-A-001, “Hatch 1 - Core Shroud Fluence Evaluation for EOC 27,” Revision, Draft 1 & final version
- Calc No. SNC-HA1-004-A-002, “Hatch 1 - Tie Rod Fluence Evaluation for EOC 27,” Revision, Draft 1 & final version
- Calc No. SNC-HA1-004-A-003, “Hatch 1 - Fluence Trend Analysis for EOC 27,” Revision, Draft 1 & final version
- Report SNC-HA1-004-R-001, “Edwin I. Hatch Nuclear Power Plant Unit 1 Fluence Assessment Report - End of Cycle 27,” Revision 0

- *Project EXL-JAF-001, “Peak Fluence and Peak Fluence Location for N16 Nozzle at 40 and 54 EFPY for James A. Fitzpatrick Nuclear Power Station”*
- Calc No. EXL-JAF-001-A-001, “FitzPatrick - N16 Nozzle Fluence Evaluations for 40 and 54 EFPY,” Revision 0, Draft 1 & final version
- Report EXL-JAF-001-R-001, “Determination of Fast Neutron Fluence (>1.0 MeV) in the James A. Fitzpatrick Reactor Pressure Vessel N16 Instrumentation Nozzle at 40 EFPY and 54 EFPY,” Revision 1
- *Project EPR-DR3-001, “Fluence Modeling of the Dresden Unit 3* ***[[EPRI Proprietary Information]]*** *and RPV”*
- Calc No. TWE-FLU-001-F-022-001, “Dresden 3 - State Point Selections For Cycles 6-24 for EPR-DR3-001,” Revision 0, Drafts 1-3*

- Calc No. TWE-FLU-001-FA-022-001, “Dresden 3 - Verification of Fluence Statepoint Files for Cycle 6-24,” Revision 0, final version**
- Calc No. TWE-FLU-001-F-022-002, “Dresden 3 - Geometry Inputs for ISP Fluence Model of EPR-DR3-001,” Revision 0, final version
- Calc No. TWE-FLU-001-F-022-003, “Dresden 3 - PMB and SMB Model Inputs for EPR-DR3-001,” Revision 0, Draft 1 & final version
- Calc No. TWE-FLU-001-F-022-004, “Dresden 3 - 2D Meshing and Parameter Sensitivities for EPR-DR3-001,” Revision 0, Draft 1***
- Calc No. TWE-FLU-001-F-022-005, “Dresden 3 - Utility Data File Generation for EPR-DR3-001,” Revision 0, Draft 1***
- Calc No. TWE-FLU-001-F-022-006, “Dresden 3 - Cycle-Dependent Inputs for EPR-DR3-001,” Revision 0, Draft 1***
- Calc No. TWE-FLU-001-F-022-007, “Dresden 3 - Transport Inputs for EPR-DR3-001,” Revisions 0 & 1, final versions***
- Calc No. TWE-FLU-001-F-022-008, “Dresden 3 - 3D Meshing Specifications for EPR-DR3-001,” Revision 0, Draft 1***
- Calc No. TWE-FLU-001-F-022-009, “Dresden 3 - POW/SPL/PRJ Inputs EPR-DR3-001,” Revision 0, Draft 1 & final version**
- Calc No. TWE-FLU-001-F-022-010, “Dresden 3 - RPV and Nozzle Fluence Inputs for EPR-DR3-001,” Revision 0, Draft 1 & final version***
- Calc No. TWE-FLU-001-F-022-011, “Dresden 3 - Dosimetry Evaluation Inputs for EPR-DR3-001,” Revision 0, Draft 1 & final version***
- Calc No. TWE-FLU-001-F-022-012, “Dresden 3 - Analytical Uncertainty Parameter List for EPR-DR3-001,” Revision 0, Draft 1 & final version***
- Calc No. TWE-FLU-001-F-022-013, “Dresden - Water Densities,” Revision 0, Draft 1 & final version
- Calc No. EPR-DR3-001-A-001, “Dresden 3 - RAMA Transport Calculations for Cycles 1-24,” Revisions 0 & 1 (final versions)***
- Calc No. EPR-DR3-001-A-002, “Dresden 3 - RPV and Nozzle Fluence Evaluations at EOC24,” Revision 0, Draft 1 & final version; Revision 1, Drafts 1, 3, and final version***
- Calc No. EPR-DR3-001-A-003, “Dresden 3 - Capsule Fluence and Activation Evaluations at EOC 24,” Revision 0, Draft 1 & final version. Calc No. EPR-DR3-001-A-004, “Dresden 3 - Analytical Uncertainty Evaluation,” Revision 0, Draft 1 & final version***
- Calc No. EPR-DR3-001-A-005, “Dresden 3 - Combined Uncertainty Evaluation,” Revision 0, Draft 1 & final version***
- Report EPR-DR3-001-R-001, “Dresden Unit 3 **[[EPRI Proprietary Information]]** Evaluation using the RAMA Fluence Methodology,” Revision 0
- Calc No. TWE-FLU-001-A-001, “Fluence Modeling Practices - BWR Dosimetry Database (RAMA),” Revision 0, Draft 1***

* Project EPR-CPR-001, “Fluence Modeling of the Cooper **[[EPRI Proprietary Information]]** and RPV”

- Purchase Order and Statement of Work Record No. MA-10007226NQA, Fluence Modeling of the Cooper 120 Surveillance Capsule and RPV,” dated March 16, 2017
- Report EPR-CPR-001-R-001, Revision 0, “**[[EPRI Proprietary Information]]** Evaluation Using the RAMA Fluence Methodology,” dated March 31, 2018
- Document No. TWE-TFX-001-FA-013-011, “SIM2SMBGEN Version 2.23 – Implementation and Verification,” dated October 18, 2018

- Calc No. TWE-FLU-001-F-005-055, “Cooper – Utility Data Files for Cycle 29,” dated October 19, 2018
- Calc No. NPP-FLU-002-R-002, Revision 0, “Cooper Nuclear Station Reactor Pressure Vessel Fluence Evaluation at the End of Cycle 23, 32 EFPY, and 54, EFPY,” dated August 24, 2007
- Calc No. NPP-FLU-004-R-001, Revision 0, “Cooper Nuclear Evaluation Update at EOC 28,” dated October 12, 2016
- Calc No. TWE-FLU-001-F-005-046, “Cooper – Utility Files for Cycle 29,” dated October 19, 2018
- Calc No. TWE-FLU-001-F-005-056, “Cooper Core Shroud RAFTER and RAFFLE Inputs for NPP-FLU-005,” dated October 24, 2018
- Calc No. TWE-FLU-001-F-005-057, “Cooper Top Guide RAFTER and RAFFLE Inputs for NPP-FLU-005,” dated October 24, 2018
- Calc No. TWE-FLU-001-F-005-058, “Cooper Core Support Plate RAFTER and RAFFLE Inputs for NPP-FLU-005,” dated October 24, 2018
- Calc No. TWE-FLU-001-F-005-059, “Cooper Core Support Plate Rim Hold-Down Bolt RAFTER and RAFFLE Inputs for NPP-FLU-005,” dated October 24, 2018
- Document No. TWE-TFX-001-FA-013-010, “SIM2SMBGEN Version 2.22 – Implementation and Verification,” dated October 19, 2018
- Document No. TWE-TFX-001-FA-013-090, “SIM2SMBGEN Version 2.21 – Implementation and Verification,” dated March 25, 2014

*This calculational file involved multiple iterations to reconcile differences of opinion between the preparer and reviewer, and was eventually superseded by TWE-FLU-001-FA-022-001 for the purpose of issuance of the first deliverable report.

**The document provided to the NRC staff did not include the design review forms.

***The document had not yet received final signatures, so it was not an official QA record yet. In cases where a “final version” was reviewed by NRC staff, the document was waiting on final signature for (an)other document(s) referenced as a source for some of the data used.

7. Acronyms and Abbreviations

BWR	boiling water reactor
CAR	corrective action request
CAP	corrective action program
CFR	Code of Federal Regulations
CGD	commercial grade dedication
EPRI	Electric Power Research Institute
ISP	integrated surveillance program
IV&V	independent verification and validation
NON	Notice of Nonconformance
NRC	U.S. Nuclear Regulatory Commission
PO	purchase order
QA	quality assurance
QAP	quality assurance procedure
RG	regulatory guide
RPV	reactor pressure vessel
RVI	reactor vessel internals