

December 21, 2016

Mr. Stewart Shannon  
Senior Director, Product Assurance  
Curtiss-Wright Electro-Mechanical Division  
1000 Wright Way  
Cheswick, PA 15024

SUBJECT: NUCLEAR REGULATORY COMMISSION VENDOR INSPECTION OF  
CURTISS-WRIGHT ELECTRO-MECHANICAL DIVISION REPORT  
NO. 99901383/2016-201 AND NOTICE OF NONCONFORMANCE

Dear Mr. Shannon:

On November 14-18, 2016, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an inspection at the Curtiss-Wright Electro-Mechanical Division (hereafter referred to as EMD) facility in Cheswick, PA. The purpose of the inspection was to assess EMD'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 EMD's implementation of quality activities associated with the fabrication and testing of the Reactor Coolant Pumps (RCPs) for the Westinghouse Electric Company (WEC) AP1000 reactor design. The enclosed report presents the results of the inspection. This NRC inspection report does not constitute NRC endorsement of EMD's overall quality assurance (QA) program.

During this inspection, the NRC staff observed qualification tests and inspected records associated with inspections, tests, analyses, and acceptance criteria (ITAAC) from Revision 19 to the certified AP1000 Design Control Document (DCD). Specifically, these activities were associated with ITAAC 2.1.02.02a, ITAAC 2.1.02.03a, ITAAC 2.1.02.08b, and ITAAC 2.1.02.08c for Vogtle Electric Generating Plant Unit 3. The NRC inspection team did not identify any findings associated with the ITAAC contained in Section (4) of the attachment to this report.

Based on the results of the inspection, the NRC inspection team found that the implementation of your QA program did not meet certain regulatory requirements imposed on you by your customers. Specifically, the NRC inspection team determined that EMD was not fully implementing its QA program in the areas of design control and control of purchased material, equipment, and services. The specific findings and references to the pertinent requirements are identified in the Notice of Nonconformance (NON) and in the enclosures to this letter.

Please provide a written explanation or statement within 30 days from the date of this letter in accordance with the instructions specified in the enclosed NON. We will consider extending the response time if you show good cause for us to do so.

In accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in 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>. To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material be withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the disclosure of information would create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,

*/RA/* (RMclntyre for)

John Burke, Chief  
Quality Assurance Vendor Inspection Branch-2  
Division of Construction Inspection  
and Operational Programs  
Office of New Reactors

Docket No.: 99901383

Enclosures:

1. Notice of Nonconformance
2. Inspection Report No. 99901383/2016-201  
and Attachment

In accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in 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>. To the extent possible, your response should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material be withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the disclosure of information would create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

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and Attachment

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NRO-002

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<b>DATE</b>	12/15/16	12/15/16	12/20/16	

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## NOTICE OF NONCONFORMANCE

Curtiss-Wright Electro-Mechanical Division  
1000 Wright Way  
Cheswick, PA 15024

Docket No. 99901383  
Report No. 2016-201

Based on the results of a U.S. Nuclear Regulatory Commission (NRC) inspection conducted at the Curtiss-Wright Electro-Mechanical Division (hereafter referred to as EMD) facility on November 14-18, 2016, certain activities were not conducted in accordance with NRC requirements which were contractually imposed on EMD by its customers or NRC licensees:

- A. Criterion III, "Design Control," of Appendix B "Quality Assurance Program 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," states, in part, that, "Measures shall be established to assure that applicable regulatory requirements and the design basis, as defined in 10 CFR 50.2, and as specified in the license application, for those structures, systems, and components to which this appendix applies are correctly translated into specifications, drawings, procedures, and instructions."

Westinghouse Electric Company (WEC) design specification document, APP-MP01-M2-001, "AP1000 Reactor Coolant Pump," Revision 4, dated March 1, 2013, Section 5.1.3, "Flywheel Materials," states in part, that, "The flywheel assembly shall be encased within a welded Alloy 625 enclosure to protect the heavy alloy from contact with the reactor coolant."

Contrary to the above, as of November 18, 2016, EMD failed to transfer all pertinent design requirements into applicable instructions and failed to use the material specified in the design specification. Specifically, Alloy 600 weld filler material was used for weld numbers 37, 38, 39, and 61 of the flywheel enclosure. By not correctly transferring the material requirements to the EMD drawings and weld procedures, the flywheel welds are not made from Alloy 625 material, as required by WEC APP-MP01-M2-001.

The safety function of the Reactor Coolant Pump when power is removed is to provide coastdown flow to maintain adequate core cooling. The flywheel enclosure is part of the flywheel assembly which is critical to this function.

This issue has been identified as Nonconformance 99901383/2016-201-01.

- B. Criterion III, of Appendix B to 10 CFR Part 50, states, in part, that, "Measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of the structures, systems and components."

Criterion VII, "Control of Purchased, Material, Equipment, and Services," of Appendix B to 10 CFR Part 50 states, in part, that, "Measures shall be established to assure that purchased material, equipment, and services, whether purchased directly or through contractors or subcontractors, conform to the procurement documents. These measures shall include provisions, as appropriate, for source evaluation and selection, objective

evidence of quality furnished by the contractor or subcontractor, inspection at the contractor or subcontractor source, and examination of products upon delivery.”

EMD Product Assurance Instruction No. 224, “Commercial Grade Surveys,” Revision 2, dated November 5, 2015, states, in part, that, “The Commercial Grade Survey Checklist shall be used to guide the evaluation process, document the observed control of critical characteristics, and provide adequate objective evidence to support the conclusions regarding the adequacy of the supplier’s controls.”

Contrary to the above, as of November 18, 2016, the NRC inspection team identified two examples where EMD failed to establish adequate measures for the selection and review for suitability of application of materials and processes that are essential to the safety-related functions of structures, systems, and components. Also, EMD failed to provide objective evidence of quality furnished by the contractor or subcontractor. Specifically, EMD failed to verify through the conduct of a commercial-grade survey or another acceptance method that certain critical characteristics identified in the technical evaluation of the impeller casting, impeller weld repair, and calibration services were adequately controlled. EMD’s commercial-grade survey of Precision Castparts Corporation did not verify that they had imposed and verified the necessary controls on their commercial sub-suppliers for performing hot isostatic pressing activities and control and testing of weld filler material. In addition, EMD’s commercial-grade survey of R.L. Holliday (RLH) did not verify that they had imposed and verified the necessary controls on their commercial sub-suppliers for the calibration of RLH’s equipment. For both of these suppliers, EMD did not perform any additional verification or acceptance activities to ensure that the identified critical characteristics were adequately controlled and the components would perform their intended safety function.

The safety function of the Reactor Coolant Pump when power is removed is to provide coastdown flow to maintain adequate core cooling. The impeller is part of the safety-related rotor assembly which performs this function.

This issue has been identified as Nonconformance 99901383/2016-201-02.

Please provide a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Chief, Quality Assurance Vendor Inspection Branch - 2, Division of Construction Inspection and Operational Programs, Office of New Reactors, within 30 days of the date of the letter transmitting this Notice of Nonconformance. This reply should be clearly marked as a “Reply to a Notice of Nonconformance” and should include for each noncompliance: (1) the reason for the noncompliance or, if contested, the basis for disputing the noncompliance; (2) the corrective steps that have been taken and the results achieved; (3) the corrective steps that will be taken to avoid further noncompliance; and (4) the date when the corrective action will be completed. Where good cause is shown, the NRC will consider extending the response time.

Because your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC’s Agencywide Documents Access and Management System, which is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>, to the extent possible, it should not include any personal privacy, proprietary, or Safeguards Information (SGI) so that the NRC can make it available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your

response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material be withheld, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If SGI is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Dated this the 21<sup>st</sup> day of December 2016.

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

Docket No.: 99901383

Report No.: 99901383/2016-201

Vendor: Curtiss-Wright Electro-Mechanical Division  
1000 Wright Way  
Cheswick, PA 15024

Vendor Contact: Mr. Stewart Shannon  
Senior Director, Product Assurance  
E-mail: sshannon@curtisswright.com  
Phone: 724-275-5671

Nuclear Industry Activity: Curtiss-Wright Electro-Mechanical Division (EMD) located in Cheswick, PA is under contract from Westinghouse Electric Company (WEC) to design, manufacture, test, and deliver the Reactor Coolant Pumps (RCPs) for the WEC AP1000 design.

Inspection Dates: November 14-18, 2016

Inspectors: Brent Clarke NRO/DCIP/QVIB-2, Team Leader  
Yamir Diaz-Castillo NRO/DCIP/QVIB-2  
Edgardo Torres NRO/DCIP/QVIB-2  
John Honcharik NRO/DEIA/MCB  
Thomas Scarbrough NRO/DEIA/MEB  
Katherine McCurry RII/DCO/CIB2

Approved by: John Burke, Chief  
Quality Assurance Vendor Inspection Branch-2  
Division of Construction Inspection  
and Operational Programs  
Office of New Reactors

## **EXECUTIVE SUMMARY**

Curtiss-Wright Electro-Mechanical Division  
99901383/2016-201

The U.S. Nuclear Regulatory Commission (NRC) staff conducted a vendor inspection at the Curtiss-Wright Electro-Mechanical Division (hereafter referred to as EMD) facility to verify that it had implemented an adequate 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 verified that EMD implemented a program under 10 CFR Part 21, "Reporting of Defects and Noncompliance," that met NRC's regulatory requirements. The NRC inspection team conducted the inspection from November 14-18, 2016.

This technically-focused inspection specifically evaluated EMD's implementation of quality activities associated with the design, fabrication, and testing of the Reactor Coolant Pumps (RCPs) for the Westinghouse Electric Company (WEC) AP1000 reactor design.

Some of the specific activities observed by the NRC inspection team included:

- Slip testing of an international RCP (Serial Number (S/N) 3)
- Coastdown testing of an international RCP (S/N 3)
- Flywheel over speed testing of the lower flywheel for a domestic RCP (Virgil C. Summer Nuclear Station (VC Summer) RCP No. 5)
- Penetrant Inspection of Weld No. 44 for the lower seal ring canopy of an international RCP (S/N 13)
- Welding of the thermal barrier/diffuser locking device for an international RCP (S/N 13)
- Stud heating and torqueing for an international RCP (S/N 13)
- Flip and interference fit of flywheel onto rotor for an international RCP (S/N 13)
- Lower thrust bearing assembly for an international RCP (S/N 17)
- Graphite shoe inspection for an international RCP (S/N 17)
- Stator assembly for an international RCP (S/N 17)
- Rotor balancing for a domestic RCP (Vogtle Electric Generating Plant RCP No. 6)
- Receipt inspection of a graphite thrust shoe insert for a domestic RCP (VC Summer Unit 2)

These regulations served as the bases for the NRC inspection:

- Appendix B to 10 CFR Part 50
- 10 CFR Part 21

During the course of this inspection, the NRC inspection team implemented Inspection Procedure (IP) 43002, "Routine Inspections of Nuclear Vendors," dated June 15, 2013; IP 43004, "Inspection of Commercial-Grade Dedication Programs," dated November 29, 2013; IP 36100, "Inspection of 10 CFR Part 21 and Programs for Reporting Defects and



Noncompliance,” dated February 13, 2012; and IP 65001.A, “Inspection of the As-Built Attributes for Structures, Systems, and Components (SSCs) Associated with ITAAC,” dated September 25, 2013.

The last NRC inspection of EMD occurred in June 2014 (ML14240A517).

With the exception of two nonconformances described below, the NRC inspection team concluded that EMD’s QA policies and procedures comply with the applicable requirements of Appendix B to 10 CFR Part 50 and 10 CFR Part 21, and that EMD’s personnel are implementing these policies and procedures effectively. The results of this inspection are summarized below.

### Design Control

The NRC inspection team issued Nonconformance 99901383/2016-201-01 regarding EMD’s failure to implement the regulatory requirements of Criterion III, “Design Control,” of Appendix B to 10 CFR Part 50. Nonconformance 99901383/2016-201-01 cites EMD for failing to transfer all pertinent design requirements into applicable instructions and failing to use the material specified in the design specification. Specifically, Alloy 600 weld filler material was used for weld numbers 37, 38, 39, and 61 of all flywheel enclosures. By not correctly transferring the material requirements to the EMD drawings and weld procedures, the flywheel enclosure welds are not made from Alloy 625 material as required by Westinghouse Electric Company (WEC) Design Specification APP-MP01-M2-001.

### Control of Purchased Material, Equipment, and Services

The NRC inspection team issued Nonconformance 99901383/2016-201-02 in association with EMD’s failure to implement the regulatory requirements of Criterion III and Criterion VII, “Control of Purchased Material, Equipment, and Services,” of Appendix B to 10 CFR Part 50. Nonconformance 99901383/2016-201-02 cites EMD for failing to verify through the conduct of a commercial-grade survey or another acceptance method that certain critical characteristics identified in the technical evaluation of the impeller casting, impeller weld repair, and calibration services were adequately controlled. EMD’s commercial-grade survey of Precision Castparts Corporation did not verify that they had imposed and verified the necessary controls on their commercial sub-suppliers for performing hot isostatic pressing activities and control and testing of weld filler material. In addition, EMD’s commercial-grade survey of R.L. Holliday (RLH) did not verify that they had imposed and verified the necessary controls on their commercial sub-suppliers for the calibration of RLH’s equipment. For both of these suppliers, EMD did not perform any additional verification or acceptance activities to ensure that the identified critical characteristics were adequately controlled and the components would perform their intended safety function.

### Other Inspection Areas

The NRC inspection team determined that EMD is implementing its programs for 10 CFR Part 21, Test Control, Control of Special Processes, Identification and Control of Material, Parts, and Components, Nonconforming Material, Parts, or Components, Corrective Actions, Control of Measuring and Test Equipment, and Inspection in accordance with the applicable regulatory requirements of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed and activities observed, the NRC inspection team also determined that EMD is implementing its policies and procedures associated with these programs.

## REPORT DETAILS

### 1. 10 CFR Part 21 Program

#### a. Inspection Scope

The NRC inspection team reviewed Curtiss-Wright Electro-Mechanical Division (hereafter referred to as EMD) policies and implementing procedures that govern the Title 10 of the *Code of Federal Regulations* (10 CFR) Part 21, "Reporting of Defects and Noncompliance," program to verify compliance with the regulatory requirements. In addition, the NRC inspection team evaluated the 10 CFR Part 21 postings and a sample of EMD purchase orders (POs) for compliance with the requirements of 10 CFR 21.21, "Notification of Failure to Comply or Existence of a Defect and its Evaluation," and 10 CFR Part 21.31, "Procurement Documents." The NRC inspection team also verified that EMD's nonconformance and corrective action procedures provide a link to the 10 CFR Part 21 program. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

#### b. Observations and Findings

No findings of significance were identified.

#### c. Conclusion

The NRC inspection team concluded that EMD is implementing its 10 CFR Part 21 program in accordance with the regulatory requirements of 10 CFR Part 21. Based on the limited sample of documents reviewed, the NRC inspection team also determined that EMD is implementing its policies and procedures associated with the 10 CFR Part 21 program. No findings of significance were identified.

### 2. Design Control

#### a. Inspection Scope

The NRC inspection team reviewed EMD's policies and implementing procedures that govern the design control program for the AP1000 Reactor Coolant Pumps (RCPs) to verify their compliance with the regulatory requirements of Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. The NRC inspection team also reviewed a sample of AP1000 RCP design documentation, Westinghouse Electric Company (WEC) design specifications, EMD engineering memoranda, an impeller incident report, an impeller redesign report, engineering drawings, shop travelers, administrative procedures, engineering procedures, assembly/test procedures, manufacturing procedures, design verification procedures/reports, and corrective action reports. The NRC inspection team discussed RCP impeller redesign and verification to resolve an impeller resonance issue, extent of condition evaluation for other RCP internal parts, flywheel/rotor interface integrity, coastdown flow justification, loss of cooling water analysis, and motor slip analysis with EMD engineers. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

The NRC inspection team focused its evaluation of EMD's policies and implementing procedures on those activities associated with the safety functions of the AP1000

RCPs – maintaining the reactor coolant pressure boundary and providing coastdown flow to maintain adequate core cooling in the event of a loss of power. Based on its review, the NRC inspection team found that EMD Engineering Memorandum 7250, “AP1000 RCP Generic Safety-Related Components Report,” Revision 5, dated October 28, 2015, and EMD Engineering Memorandum 7460, “AP1000 RCP Modified Impeller Design Report,” Revision 0, dated November 14, 2016, were consistent with WEC design specification document, APP-MP01-M2-001, “AP1000 Reactor Coolant Pump,” Revision 4, dated March 1, 2013, for functional capability of the AP1000 RCPs. In particular, the NRC inspection team found that EMD Engineering Memorandum 7250 provided an analysis for the safety-related components of the AP1000 RCP to provide assurance that the pump will coast down after a loss of power and a seismic event to provide the required coolant flow rate over the specified time period.

In addition, the NRC inspection team evaluated the resolution of an impeller failure in 2015 as described in an EMD incident report dated October 28, 2015. The NRC inspection team found that EMD Engineering Memorandum 7460 for the redesign of the RCP impeller evaluated the cause of the impeller failure, described the modified impeller design, specified the analysis to support the modified impeller design, provided verification testing of the modified impeller design, described the inspection of the modified impeller following verification testing, addressed nonconformances identified during those inspections, and implemented corrective action to address the design control weakness that led to the failure to identify vane passing frequency resonance as a potential cause of impeller failure. The NRC inspection team found that EMD demonstrated that the redesign of the impeller will avoid the resonance issue with the vane passing frequency. In addition, the NRC inspection team found that EMD Design Report No. 15-APK-096, “AP1000 RCP SN4 Impeller Event Extent of Condition,” dated November 12, 2015, provided an acceptable extent of condition evaluation that demonstrated that resonance issues will be avoided for other RCP internal parts, such as the rotor and flywheel.

The NRC inspection team sampled other technical aspects of the RCP design for detailed review. The NRC inspection team evaluated the design aspects of the interface between the flywheel and rotor, and found that EMD had justified the structural integrity of the flywheel/rotor interface. Further, the NRC inspection team evaluated the EMD analysis of the loss of external RCP cooling water, and found that EMD had adequate support for the RCP design in the event of the loss of external cooling water.

With respect to the coastdown design requirements, the NRC inspection team found that the coastdown flow verification of EMD Test Report No. U601-SN501 is based on a table for normalized flow at specific time-second intervals consistent with WEC Design Specification APP-MP01-M2-001. The NRC inspection team identified to EMD that the coastdown flow comparison to the design requirements in the RCP test reports does not include flow measurement uncertainty in the flow curve or the itemized table of one-second time intervals. For the sampled test report, the NRC inspection team evaluated the RCP coastdown flow test data with flow measurement uncertainty addressed by hand calculations, and did not identify any concerns with the adequacy of the RCP coastdown flow in comparison to the itemized one-second flow requirements in WEC Design Specification APP-MP01-M2-001.

With respect to the AP1000 ITAAC for RCP flow coastdown, the NRC inspection team observed that AP1000 ITAAC 2.1.02.08b includes a normalized flow curve rather than

an itemized table of one-second time intervals as provided in WEC Design Specification APP-MP01-M2-001. Therefore, the NRC inspection team noted that the licensees for Vogtle Electric Generating Plant (Vogtle) Units 3 and 4 and Virgil C. Summer Generating Station (VC Summer) Units 2 and 3 will need to convert the coastdown flow data provided by EMD into a curve to demonstrate that the RCP flow coastdown ITAAC has been satisfied with appropriate consideration of flow measurement uncertainty.

b. Observations and Findings

The inspection team identified an issue with welding of the flywheel enclosure. WEC Design Specification APP-MP01-M2-001, Section 5.1.3, "Flywheel Materials," states in part, "The flywheel assembly shall be encased within a welded Alloy 625 enclosure to protect the heavy alloy from contact with the reactor coolant." In addition, Section 5.4.1.3.6.3 of Revision 19 of the AP1000 Design Certification Document (DCD), Revision 19 (ADAMS Accession No. ML11171A454), which is incorporated in the Combined License (COL) for Vogtle Units 3 and 4 and VC Summer Units 2 and 3, states, in part, "The assembly is hermetically sealed from primary coolant by endplates and an outer thin shell of Alloy 625. Ni/Fe/Cr Alloy 600 is not used for this application." The DCD is supported by NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," Supplement 2, dated September 2011 (ADAMS No. ML11293A120), Section 5.4.1.4.2, which states that, "The NRC also notes that the 18Mn-18Cr alloy steel outer hub will be enclosed in an Alloy 625 flywheel enclosure to prevent the outer hub from contacting the reactor coolant," and further that, "Therefore, the NRC staff considers Alloy 625, as referenced in American Society for Testing and Materials (ASTM) B-443, "Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06626) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Plate, Sheet, and Strip," and ASTM B-564, "Standard Specification for Nickel Alloy Forging," to be an acceptable material for the flywheel enclosure, based on current operating experience in fuel assemblies and testing performed by Bettis Atomic Power Laboratory, which was discussed in the applicant's letter dated October 5, 2007." Further information addressing the Alloy 625 enclosure welds was documented in Section 5.2.1 of EMD Report AP1000RCP-06-009, "Structural Analysis Summary for the AP1000 Reactor Coolant Pump High Inertia Flywheel," dated July 16, 2009, referenced in the AP1000 DCD, which states, in part, that, "The Alloy 625 end plates/welds and the surrounding water were also neglected from the energy absorption calculations." Finally, the NRC Advisory Committee on Reactor Safeguards (ACRS) specifically addressed the enclosure welds in, "Report on the Final Safety Evaluation Report Associated with the Amendment to the AP1000 Design Control Document, dated December 13, 2010 (ADAMS No. ML103410351), which states, "This assembly is seal-welded within a thin wall Alloy 625 (nickel base) cylindrical enclosure," and further that, "The design of the AP1000 pump makes it impractical (but not impossible) to perform periodic inservice inspection (ISI) of the Alloy 625 welds to assure the enclosure remains leak tight."

Contrary to the above, EMD fabricated flywheel enclosure welds 37, 38, 39, and 61 using the following approved welding procedures that designate Alloy 600 as the weld filler material:

- Weld 37 used Weld Procedure 82127PS137, "GTAW of Nickel Alloy on Martensitic Stainless Steel," Revision A, dated May 6, 2011
- Weld 38 used Weld Procedure 82121PS045, "SMAW of Nickel Alloy on Martensitic Stainless Steel," Revision B, dated October 18, 2011
- Weld 39 used Weld Procedure 82121PS047, "SMAW of Nickel Alloy Materials," Revision A, dated March 16, 2012
- Weld 61 used Weld Procedure 82127PS143, "GTAW of Nickel Alloy Materials," Revision A, dated October 21, 2011

The NRC inspection team identified this issue as Nonconformance 99901383/2016-201-01 for EMD failing to transfer all pertinent design requirements into applicable fabrication instructions and failing to use the material specified in the design specification. EMD initiated corrective action report (CAR) No. 2016-00272 to address this issue.

c. Conclusion

The NRC inspection team issued Nonconformance 99901383/2016-201-01 in association with EMD's failure to implement the regulatory requirements of Criterion III of Appendix B to 10 CFR Part 50. Nonconformance 99901383/2016-201-01 cites EMD for failing to transfer all pertinent design requirements into applicable instructions and failing to use the material specified in the design specification. Specifically, Alloy 600 weld filler material was used for weld numbers 37, 38, 39, and 61 of all flywheel enclosures. By not correctly transferring the material requirements to EMD drawings and weld procedures, the flywheel enclosure welds are not made from Alloy 625 material as required by WEC Design Specification APP-MP01-M2-001.

3. Supplier Oversight and Commercial-Grade Dedication

a. Inspection Scope

The NRC inspection team reviewed EMD policies and implementing procedures that govern the implementation of its supplier oversight and commercial-grade dedication (CGD) programs to verify compliance with the requirements of Criterion III, Criterion IV, "Procurement Document Control," and Criterion VII, "Control of Purchased Material, Equipment, and Services," of Appendix B to 10 CFR Part 50.

The NRC inspection team verified that the POs included, as appropriate: the scope of work, right of access to facilities, and extension of contractual requirements to subcontractors. In addition, the NRC inspection team confirmed that all safety-related POs reviewed included clauses invoking the provisions of 10 CFR Part 21.

The NRC inspection team reviewed a sample of external audits to evaluate compliance with EMD's program and technical requirements. The NRC inspection team confirmed that the audit reports contained objective evidence of the review of the relevant quality assurance (QA) criteria of Appendix B to 10 CFR Part 50. The NRC inspection team

also reviewed a sample of training and qualification records of EMD auditors, lead auditors, and inspection personnel and confirmed that auditing personnel had completed all the required training and had maintained qualification and certification in accordance with EMD's policies and procedures. In addition, the NRC inspection team verified that external audits were performed by qualified auditors and lead auditors.

The NRC inspection team observed the receipt inspection of a graphite thrust shoe insert for VC Summer Unit 2. The NRC inspection team observed the EMD Quality Control (QC) inspector perform the receipt inspection in accordance with the Receipt Inspection Plan, which included reviewing documentation, confirming the PO information, conducting a review for any obvious damage, and verifying the quantity received.

The NRC inspection team also reviewed a sample of CGD plans, checklists, reports and POs, and commercial-grade surveys of several commercial vendors on EMD's Qualified Supplier's List, with a focus on Precision Castparts Corporation (PCC), the commercial supplier of the impeller casting and impeller weld repair modifications. The NRC inspection team evaluated a sample of technical evaluations and verified that the technical evaluations in the CGD plans appropriately identify the critical characteristics and technical attributes necessary to provide reasonable assurance that the components being dedicated would perform their intended safety function. The NRC inspection team also evaluated the criteria for the selection of critical characteristics and the selection and implementation of verification methods to verify effective implementation of EMD's CGD process.

The NRC inspection team also discussed the supplier oversight and CGD programs with EMD's management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

b. Observations and Findings

The NRC inspection team reviewed the dedication activities associated with the impeller casting, impeller weld repair, and certain calibration services. EMD procured the impeller casting and the impeller weld repairs from PCC and calibration services for their ultrasonic testing (UT) equipment from R.L Holliday (RLH). During the review of the commercial-grade survey of PCC, the NRC inspection team noted that EMD did not verify that PCC had imposed and verified the necessary controls on their commercial sub-suppliers for performing hot isostatic pressing (HIP) activities and control and testing of weld filler material. HIP and control and testing of weld filler material were identified as critical characteristics in the technical evaluation of the impeller casting and the impeller repairs, respectively. Similarly, during the review of the commercial-grade survey of RLH, the NRC inspection team noted that EMD did not verify that RLH had imposed and verified the necessary controls on their commercial sub-suppliers for the calibration of RLH's equipment. Sub-supplier calibration was identified as a critical characteristic in the technical evaluation for calibration services. For both of these suppliers, EMD did not perform any additional verification or acceptance activities to ensure that the identified critical characteristics were adequately controlled and the components would perform their intended safety function.

The NRC inspection team identified this issue as Nonconformance 99901383/2016-201-02 for EMD's failure to verify through the conduct of a commercial-grade survey or another acceptance method that certain critical characteristics identified in the technical evaluation of the impeller casting, impeller weld repair, and calibration services were adequately controlled. EMD initiated CAR No. 2016-00268 to address this issue.

c. Conclusion

The NRC inspection team issued Nonconformance 99901383/2016-201-02 in association with EMD's failure to implement the regulatory requirements of Criterion III and Criterion VII of Appendix B to 10 CFR Part 50. Nonconformance 99901383/2016-201-02 cites EMD for failing to verify through the conduct of a commercial-grade survey or another acceptance method that certain critical characteristics identified in the technical evaluation of the impeller casting, impeller weld repair, and calibration services were adequately controlled. Specifically, EMD's commercial-grade survey of PCC did not verify that they had imposed and verified the necessary controls on their commercial sub-suppliers for performing hot isostatic pressing activities and control and testing of weld filler material. In addition, EMD's commercial-grade survey of RLH did not verify that they had imposed and verified the necessary controls on their commercial sub-suppliers for the calibration of RLH's equipment. For both of these suppliers, EMD did not perform any additional verification or acceptance activities to ensure that the identified critical characteristics were adequately controlled and the components would perform their intended safety function.

4. Test Control

a. Inspection Scope

The NRC inspection team reviewed EMD's policies and implementing procedures that govern the test control program for the AP1000 RCPs to verify their compliance with the requirements of Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50. The NRC inspection team also reviewed a sample of RCP test and assembly procedures, records of completed tests, qualification and production test reports, nonconformance reports, corrective action reports, and qualification and training records for test, assembly, and QC personnel. The NRC inspection team addressed "build for testing" activities being conducted by EMD, including QC inspection of the lower thrust bearing, and assembly of the lower thrust bearing and stator end plate for an RCP to be supplied to an international AP1000 reactor; and stator end plate stud heating, RCP flip operation, and flywheel hydraulic press fit of the flywheel onto the rotor for a separate RCP to be supplied for an international AP1000 reactor. The NRC inspection team also observed motor slip and coastdown flow testing of an RCP to be supplied to an international AP1000 reactor, overspeed testing of a flywheel for an RCP to be supplied to VC Summer Unit 3, and balance testing of the rotor for an RCP to be supplied to Vogtle Unit 4.

In particular, the NRC inspection team evaluated EMD Test Specifications (TS) TS10088 and TS10150, EMD Standard QS10143, and EMD Test Procedures TP-88TT and 82 for the AP1000 RCPs to verify that they were consistent with WEC Design Specification APP-MP01-M2-001. The NRC inspection team reviewed EMD TS10088, which describes the testing requirements for the RCP lead unit and production units for RCP

Model N-10086-A1, including forward and reverse rotation testing, cold and hot performance characteristics testing, temperature rise and electrical balance testing, hot insulation resistance testing, load slip testing, service cycle testing, pressure pulsation measurements testing, reduced voltage testing, load of power testing, loss of external cooling water testing, operational testing, revised rotation operability testing, forward restart of reverse rotating RCP testing, net positive suction head testing, and coastdown testing, as applicable for the lead RCP unit, production units, and engineering and endurance retesting. The NRC inspection team also reviewed EMD TS10150, which describes the production test requirements for RCP Model N-10087-A1, including hot performance characteristics testing, temperature rise and electrical balance testing, hot insulation resistance testing, service cycle testing, operational testing, reverse rotation operability testing, and coastdown testing.

In addition, the NRC inspection team observed “build for testing” activities in addition to sampled testing activities being conducted by EMD for RCPs (and their internal parts) to be supplied to domestic and international AP1000 reactors. For example, the NRC inspection team observed motor slip and coastdown flow testing of RCP S/N 3 to be supplied to an international AP1000 reactor. The NRC inspection team also observed a QC inspection of the lower thrust bearing following initial testing, lower thrust bearing assembly, and stator end plate assembly of RCP S/N 17 to be supplied to an international AP1000 reactor. The NRC inspection team observed RCP stator end plate stud heating, RCP flip operation, and hydraulic press fit of the flywheel onto the rotor shaft for RCP S/N 13 to be supplied to an international AP1000 reactor. The NRC inspection team observed overspeed testing of a flywheel for RCP No. 5 to be supplied to VC Summer, and balance testing of the rotor for RCP No. 6 to be supplied to Vogtle. During the observation of assembly and test activities, the NRC inspection team evaluated whether the EMD staff followed the assembly and test procedures with proper QC oversight, and evaluation of acceptance criteria. The NRC inspection team also evaluated a sample of test and assembly equipment for current calibration.

With respect to RCPs for which testing requirements have been completed, the NRC inspection team reviewed test reports for a sample of RCPs for international and domestic AP1000 reactors. These reports included EMD Test Report No. U597-SN4 (AP1000 international reactor), Test Report No. U597-SN6 (AP1000 international reactor), and Test Report No. U601-SN501 (Vogtle Units 3 and 4). The NRC inspection team evaluated whether these EMD test reports satisfied the EMD Test Specifications TS10088 and TS10150 and WEC Design Specification APP-MP01-M2-001, as applicable, for the functional capability of the AP1000 RCPs.

The NRC inspection team discussed the RCP assembly and test activities with EMD assemblers, test technicians, test engineers, and QC inspectors. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

b. Observations and Findings

No findings of significance were identified

c. Conclusion

The NRC inspection team concluded that EMD is implementing its test control program in accordance with the regulatory requirements of Criterion XI of Appendix B to



10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that EMD is implementing its policies and procedures associated with the test control program. No findings of significance were identified.

## 5. Control of Measuring and Test Equipment

### a. Inspection Scope

The NRC inspection team reviewed EMD policies and implementing procedures that govern the measuring and test equipment (M&TE) program to verify compliance with the requirements of Criterion XII, "Control of Measuring and Test Equipment," of Appendix B to 10 CFR Part 50.

The NRC inspection team reviewed the use of M&TE during inspections and tests to ensure it was calibrated, controlled, and documented in accordance with the procedural requirements. The NRC inspection team reviewed a sample of twelve records to ensure documentation matched the observed use of M&TE, that M&TE was calibrated to a nationally recognized standard, and the calibration was current. The NRC inspection team verified that EMD's staff properly segregated, documented, and evaluated when M&TE was found out of calibration, lost, or out of service.

The NRC inspection team performed a walk-down of the gage M&TE lab to ensure that equipment located in the M&TE storage area, the M&TE hold area, inspection and test facility were labeled, handled, and stored in a manner that indicated the calibration status of the instrument and ensured its traceability to calibration test data.

The NRC inspection team discussed the M&TE program with EMD's management and staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

### b. Observations and Findings

No findings of significance were identified.

### c. Conclusion

The NRC inspection team concluded that EMD is implementing its M&TE program in accordance with the regulatory requirements of Criterion XII of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that EMD is implementing its policies and procedures associated with the M&TE program. No findings of significance were identified.

## 6. Control of Special Processes

### a. Inspection Scope

The NRC inspection team reviewed EMD's policies and implementing procedures that govern control of special processes to verify compliance with the regulatory requirements of Criterion IX, "Control of Special Processes," of Appendix B to 10 CFR Part 50 as well as with the requirements of Section III, "Rules for Construction of Nuclear Facility Components" of the American Society of Mechanical Engineers Boilers and

Pressure Vessel (ASME B&PV) Code, and American Society for Nondestructive Testing (ASNT) SNT-TC-1A, "Personnel Qualification and Certification in Nondestructive Testing."

Specifically, for welding activities, the NRC inspection team reviewed shop travelers, weld procedure specifications, supporting procedure qualification records, welder qualifications, ASME B&PV Code Data Reports, and the calibration certificates of the welding equipment. For nondestructive examination (NDE), the NRC inspection team reviewed magnetic particle testing (MT) procedures, liquid penetrant testing (PT) procedures, PT reports, Radiographic (RT) procedures, and Level II and Level III inspector qualifications, and the calibration certificates of the measuring equipment.

With respect to welding process, the NRC inspection team witnessed welding of the Thermal Barrier/Diffuser Lock Device for international RCP S/N 13 in accordance with the applicable EMD procedures. The NRC inspection team verified that the welding procedure specifications (WPS) were qualified in accordance with the requirements of ASME B&PV Code, Sections III and IX, "Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators," using the supporting procedure qualification records (PQRs) and the applicable EMD procedures.

The NRC inspection team verified that the applicable welding data; such as weld material and heat/lot number, WPS, inspection procedures used, and that the final inspection results were recorded in accordance with the applicable EMD procedures and instructions; the welding data was recorded on the associated weld record for each weld joint along with the applicable NDE results; and all applicable information, including drawings, procedures, instructions and non-destructive examination test results are included in the electronic version of the traveler.

With respect to control of weld material, the NRC inspection team observed weld material storage and verified that weld material was adequately controlled, including that flux covered weld electrodes were either in hermetically sealed containers or kept in baking/portable ovens to control the moisture content within the requirements of the applicable filler metal specification and ASME Code Section III. The inspectors also verified that calibrated thermocouples/ovens were used and had valid calibration documentation in accordance with applicable EMD procedures. The inspectors verified that weld material was controlled at all times until its consumption.

With respect to nondestructive examination, the NRC inspection team witnessed PT inspections of a lower seal ring canopy weld for international RCP S/N 13 in accordance with the applicable EMD procedures. The inspector verified that the examinations were performed by qualified personnel and qualified procedures in accordance with the requirements of ASME Code (Sections III and V) and ASNT SNT-TC-1A. The NRC inspection team also observed appropriate cleaning was performed in accordance with applicable EMD procedures.

With respect to qualification and training of welding and nondestructive examination personnel, the NRC inspection team reviewed the associated welder qualification records and confirmed that the welders had completed the required training and had maintained their qualifications in accordance with EMD procedures. The NRC inspectors also verified that the applicable procedure for welder qualification meets the requirements of ASME Code (Sections III and IX).

The NRC inspection team reviewed the EMD procedures for MT, PT, and RT inspections, and verified that they were consistent with the applicable ASME Code requirements. The inspectors also reviewed the Level III non-destructive examiner and Level II non-destructive inspector qualification records and confirmed they were qualified in accordance with the requirements in ASNT SNT-TC-1A and had sufficient training and previous inspection experience.

The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

b. Observations and Findings

No findings of significance were identified.

c. Conclusions

The NRC inspection team concluded that EMD is implementing its special processes program in accordance with the regulatory requirements of Criterion IX of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed and interviews conducted, the NRC inspection team also determined that EMD is adequately implementing its policies and procedures associated with the use of controlling special processes. No findings of significance were identified.

7. Nonconforming Materials, Parts, or Components and Corrective Action

a. Inspection Scope

The NRC inspection team reviewed EMD's policies and implementing procedures that govern the nonconformance and corrective action programs (CAP) to verify compliance with the requirements of Criterion XV, "Nonconforming Materials, Parts, or Components," and Criterion XVI, "Corrective Action," of Appendix B to 10 CFR Part 50.

The NRC inspection team reviewed EMD's CARs and nonconformance reports (NCRs) to verify that EMD implemented an adequate program to ensure that nonconforming items and conditions adverse to quality were promptly identified and corrected. The NRC inspection team verified that nonconforming components were properly identified, marked, and segregated when practical, to ensure they were not reintroduced into the manufacturing processes. Finally, the NRC inspection team verified that the EMD nonconformance program and CAP provided a connection to the 10 CFR Part 21 program.

b. Observations and Findings

b.1 Corrective Action Associated with Nonconformance 99901383/2014-201-01

During an NRC inspection conducted at EMD in June 2014 (ML14240A517), NRC issued Nonconformance 99901383/2014-201-01 for EMD's failure to perform effectiveness reviews (EFR) for significant conditions adverse to quality (SCAQ) as required by EMD's CAP and failure to ensure that conditions adverse to quality were promptly identified and corrected. Specifically, the NRC inspection team identified that 7 out of 17 SCAQ EFR reviews were not completed by EMD. In addition, the NRC

inspection team identified that corrective actions for NON 99901383/2009-201-03 were not adequately implemented in that design review of action item self-assessments were not completed; several CAR corrective action dispositions were past due dates without justification; and corrective action program IDPQ17, "Corrective Action Request Procedure," had not incorporated guidance to establish a timeframe for verification of corrective actions.

In its response to the NRC, EMD's corrective actions included launching a corrective action review board (CARB) to conduct EFRs on a periodic basis. EMD changed the design review of action item self-assessments to a core technical design review committee (TRDC) to perform more frequent reviews throughout the design of a safety-related component. Further, EMD added the status of CARs to the General Manager performance weekly meeting. Finally, EMD added guidance to the corrective action procedure on timeframes for verification of corrective actions.

The NRC inspection team reviewed an EFR performed by the CARB, TRDC self-assessments completed from 2014-2016, procedure INSIDP26, "Corrective Action Review Board Process," procedure IDP-22, "Design Verification and Reviews," and procedure INSIDP 34, "Responding to a Corrective Action Request." Consequently, the NRC inspection team determined that the corrective actions documented in EMD's letter to the NRC, dated November 7, 2014 (ADAMS No. ML14316A546), were adequate to address the identified nonconformance. Based on the review, the NRC inspection team closed Nonconformance 99901383/2014-01.

No findings of significance were identified.

c. Conclusion

The NRC inspection team concluded that EMD is implementing its nonconformance and corrective action programs in accordance with the regulatory requirements of Criterion XV and Criterion XVI of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the inspectors also determined that EMD is implementing its policies and procedures associated with the CAP. No findings of significance were identified.

8. Inspection

a. Inspection Scope

The NRC inspection team reviewed EMD policies and implementing procedures that govern the inspection program to verify their compliance with the regulatory requirements of Criterion X, "Inspection," in Appendix B to 10 CFR Part 50. Specifically, the NRC inspection team reviewed procedures for receipt, in-process, and final inspection to verify adequate measures were provided for inspection control including the generation of documents such as work orders, process sheets, and nonconformance reports. The NRC inspection team verified that the inspection control documents included the item inspected, inspection date, type of observation, results of examination, and signature and date of approval from the authorized representative for the activities

witnessed. When applicable, the NRC inspection team verified that mandatory hold points were indicated in the controlling documents and that work did not proceed without appropriate approval.

The NRC inspection team observed inspection procedures, work orders, and in-process QC inspections and oversight of the graphite thrust bearing shoe, assembly and installation of the lower thrust bearing, as well as final stator assembly for international RCP S/N 17, including controls in place for initiating and implementing changes to work instructions. The NRC inspection team also observed the rotor balance for a domestic RCP (Vogtle Unit 4) and the process for creating an NCR and Quarantine Tag when test results are rejected. The NRC inspection team reviewed the inspection results to verify they were properly documented by the QC inspector and, when applicable, reviewed by authorized personnel qualified to evaluate the technical adequacy of the inspection results. The NRC inspection team also interviewed the inspectors and reviewed their qualifications to verify that these inspections and reviews were performed by qualified and knowledgeable personnel.

The NRC inspection team observed the receipt inspection of a graphite thrust shoe insert for VC Summer Unit 2. The NRC inspection team observed the EMD Quality Control inspector perform the receipt inspection in accordance with the Receipt Inspection Plan, which included a review of the documentation, confirming the PO information, conducting a review for any obvious damage, and verifying the quantity received. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

b. Observations and Findings

No findings of significance were identified.

c. Conclusion

The NRC inspection team concluded that EMD is implementing its inspection program in accordance with the regulatory requirements of Criterion X of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that EMD is implementing its policies and procedures associated with the inspection program. No findings of significance were identified.

9. Entrance and Exit Meetings

On November 14, 2016, the NRC inspection team discussed the scope of the inspection with Brian Eckels, General Manager, and other members of EMD's management and technical staff. On November 18, 2016, the NRC inspection team presented the inspection results and observations during an exit meeting with Mr. Eckels, and other members of EMD'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.

## ATTACHMENT

### 1. ENTRANCE/EXIT MEETING ATTENDEES

Name	Title	Affiliation	Entrance	Exit	Interviewed
	Test Engineer	EMD			X
	Welder	EMD			X
	Supplier Quality Engineer	EMD	X	X	
	Process Manager	EMD	X		
	Senior Manager, Quality Assurance	EMD	X	X	
	Senior Principal Engineer	EMD			X
	Assembler	EMD			X
	Test Engineer	EMD			X
	Test Technician	EMD			X
	Director, Sourcing	EMD		X	
	Gage Laboratory Calibration Inspector	EMD			X
	Design Engineer	EMD			X
	General Manager	EMD	X	X	
	Director, Engineering	EMD	X		
	Engineer	EMD			X
	Director, Operations – AP1000	EMD	X	X	
	Welder	EMD			X
	Test Engineer	EMD			X
	Supervisor / Inspection	EMD	X	X	
	Engineer	EMD			X
	Test Technician	EMD			X
	Analytical Engineer	EMD			X
	Manager, Dynamics and Hydraulics	EMD		X	
	Engineering Technical Manager	EMD	X	X	
	Contractor Engineer	EMD	X		
	Level III QC Inspector	EMD			X
	Principal Engineer	EMD			X
	Assembler	EMD			X
	Engineering Manager	EMD			X

<b>Name</b>	<b>Title</b>	<b>Affiliation</b>	<b>Entrance</b>	<b>Exit</b>	<b>Interviewed</b>
	Quality Manager	EMD	X	X	
	Welding Engineer	EMD			X
	Director, Commercial Power Business	EMD	X	X	
	Assembler	EMD			X
	QA Engineer	EMD			X
	Consultant	EMD	X		
	Test Engineer	EMD			X
	Contractor	EMD			X
	Operations Supervisor	EMD			X
	Manager, Business Development	EMD	X		
	Contractor	EMD			X
	QC Inspector	EMD			X
	Principal Engineer	EMD			X
	Test Manager	EMD			X
	Senior Controller	EMD		X	
	Supplier Quality Engineer	EMD			X
	QC Inspector	EMD			X
	Engineer	EMD			X
	Contractor, Senior Marketing and Contracts Advisor	EMD	X		
	Manager, Supplier Quality	EMD		X	
	Mechanical Design Engineer	EMD			X
	QC Inspector	EMD			X
	Senior Manager, Human Resources	EMD	X	X	
	Chief Engineer	EMD	X		
	Welding Engineer	EMD			X
	Assembler	EMD			X
	Mechanical Engineer	EMD			X
	Machinist	EMD			X
	Engineer	EMD			X

Name	Title	Affiliation	Entrance	Exit	Interviewed
	Principal Sourcing Compliance Specialist	EMD	X		
	Supplier Quality Engineer	EMD			X
	Authorized Nuclear Inspector	WEC			X
	Primary Equipment Engineer	WEC		X	
	Senior Procurement Engineer	WEC		X	
Brent Clarke	Inspection Team Leader	NRC	X	X	
Yamir Diaz-Castillo	Inspector	NRC	X	X	
John Honcharik	Inspector	NRC	X	X	
Paul Krohn	Deputy Director	NRC	X	X	
Katherine McCurry	Inspector	NRC	X	X	
Randall Musser	Branch Chief, Region II	NRC		X	
Thomas Scarbrough	Inspector	NRC	X	X	
Edgardo Torres	Inspector	NRC	X	X	
Wang Yihao	Inspector	NNSA	X	X	
Zhou Xin	Inspector	NNSA	X	X	

## 2. 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 June 15, 2013

IP 43004, "Inspection of Commercial-Grade Dedication Programs," dated November 29, 2013

IP 65001.A, "Inspection of the As-Built Attributes for Structures, Systems, and Components (SSCs) Associated with ITAAC," dated September 25, 2013

## 3. LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Item Number	Status	Type	Description
99901383/2014-201-01	Closed	NON	Criterion XVI
99901383/2016-201-01	Opened	NON	Criterion III
99901383/2016-201-02	Opened	NON	Criterion III, VII



#### 4. INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA (ITAAC)

The U.S. Nuclear Regulatory Commission (NRC) inspection team identified the following ITAAC related to the RCPs being designed and fabricated by EMD. At the time of the inspection, EMD was testing, assembling, disassembling, and shipping both international and domestic RCPs. Related to the ITAAC listed below, the NRC inspection team reviewed N-2 Code data reports for the RCP external heat exchanger, the outer stator jacket, and Class 1 supports; base material and filler metal certified material test reports and nondestructive examination (NDE) records for pressure boundary welds (joint numbers 2, 3, 4, and 73A-K); and welding procedure specifications (WPSs) and supporting procedure qualifications records (PQRs) as well as NDE procedures used during the welding activities of those welds. The NRC inspection team also witnessed tests and reviewed test reports for flywheel overspeed and coastdown. The ITAAC design commitments referenced below are for future use by the NRC staff during the ITAAC closure process. The listing of these ITAAC design commitments does not indicate that they have been met and closed. The NRC inspection team did not identify any findings associated with the ITAAC identified below.

Appendix C from the Combined License for Vogtle Unit 3	No. 13	ITAAC 2.1.02.02a
Appendix C from the Combined License for Vogtle Unit 3	No. 15	ITAAC 2.1.02.03a
Appendix C from the Combined License for Vogtle Unit 3	No. 30	ITAAC 2.1.02.08b
Appendix C from the Combined License for Vogtle Unit 3	No. 31	ITAAC 2.1.02.08c

#### 5. DOCUMENTS REVIEWED

##### Policies and Procedures

- CW-EMD Quality Assurance Program Manual, Edition 1, Revision 2, dated March 18, 2016
- PA-2633, "Additional Administrative, Quality, and Technical Requirements (Commercial Orders)," Revision 10, dated January 27, 2016
- PA-3157TT, "Additional Administrative, Quality, and Technical Requirements (AP1000 RCP - Technology Transfer)," Revision 7, dated January 27, 2016
- CTTAP5.01, "Marking Procedure AP1000 RCP," Revision 0, dated July 15, 2008
- CTTAP6.03, "Welder Performance Qualification AP1000 RCP," Revision 0, dated July 15, 2008
- CTTAP6.04, "Welding and Braze Qualification Procedure AP1000 RCP," Revision 0, dated July 15, 2008
- CTTAP6.05, "Procedure for Routing Effectivity and Control AP1000 RCP," Revision 0, dated March 3, 2009
- CTTAP6.06, "Serialization Control AP1000 RCP," Revision 0, dated July 15, 2008
- CTTAP6.07, "Use of the On-Line System for AP1000 RCP," Revision 0, dated July 15, 2008
- CTTAP6.11, "NDT and Test Personnel Qualification AP1000 RCP," Revision 0, dated July 28, 2008

- DS10046, "Acceptance Criteria for AP1000 Reactor Coolant Pump Test Results," Revision 1, dated September 24, 2012
- EP022, "Engineering Checklists," Revision 4, dated December 9, 2015
- IDPE06, "Engineering Procedures," Revision 8, dated March 31, 2015
- IDPE21, "Design and Equipment Specifications," Revision 6, dated January 30, 2015
- IDPE23, "Control of Design/Analysis Computer Programs," Revision 13, (no date available)
- IDPE24, "Material Ordering Documents (MODs)," Revision 7, dated February 12, 2016
- IDPE26, "Design Documentation," Revision 7, dated July 25, 2014
- IDPE27, "Engineering Document Signature Requirements," Revision 9, dated June 7, 2013
- IDPE29, "Field Service and Field Procedures," Revision 8, dated August 20, 2012
- IDPE32, "Commercial Dedication of Items Not Classified Safety Related by EMD," Revision 6 (no date available)
- IDPE38, "Control of EMD Product Drawings Prepared by Suppliers," Revision 3, dated December 31, 2014
- IDPE39, "AP1000 RCP China Technology Transfer," Revision 2, dated June 1, 2015
- IDPE41, "Commercial Dedication Procedure (Other Than RCP Seals)," Revision 2 (no date available)
- IDPQ02, "Identification and Reporting of Conditions Adverse to Safety in a Commercial Nuclear Power Plant Per 10CFR21," Revision 21, dated November 14, 2016
- IDPQ17, "Corrective Action Request Procedure," Revision 18, (no date available)
- IDPQ21, "Shop Floor Gage Control Procedure," Revision 2, (no date available)
- IDPQ26, "Dedication of Commercial Calibration Services," Revision 3, dated July 27, 2015
- INSIDP26, "Corrective Action Review Board Process," Revision 4, (no date available)
- INSIDP32, "Initiating a Corrective Action Request," Revision 0, (no date available)
- INSIDP33, "Assigning and Prioritizing a Corrective Action Request," Revision 0, (no date available)
- INSIDP34, "Responding to a Corrective Action Request," Revision 0, (no date available)
- INSQP001, "Supplier Audits," Revision 7, (no date available)
- INSQP002, "Process Surveillances," Revision 1, dated March 14, 2011
- INSQP004, "External Auditing Services," Revision 4, dated November 5, 2015
- INSQP005, "Annual Supplier Performance Assessment Process," Revision 0, dated January 4, 2016
- INSQP006, "ASME Performance Assessment for Suppliers," Revision 0, dated January 4, 2016
- ND10000, "Nondestructive Testing Written Practice Procedure For Qualification of Nondestructive Testing Personnel," Revision 4, dated May 11, 2016
- NDPQ01, "Control of Nonconforming Materials," Revision 23, (no date available)
- LP10003, "Liquid Penetrant Inspection Procedure," Revision 2, dated October 22, 2015
- MP-0942TT, "Instructions for Riverhawk," Revision 4, dated October 27, 2016
- MT10002, "Magnetic Particle Test Procedure," Revision 1, dated February 4, 2009
- PIP0684, "Procedure for Control in the EMD Weld Shop," Revision 21, dated September 26, 2012
- QS10106, "ASME Acceptance Standards for Visual and Dimensional Inspection of Welds and Adjacent Base Material," Revision 1, dated November 18, 2008
- QS10121, "Liquid Penetrant Acceptance Standards," Revision 1, dated October 7, 2008
- QS10126, "Magnetic Particle Acceptance Standards," Revision 1, dated February 4, 2009

- QS10143, "Before and After Test Inspection Requirements and Acceptance Criteria for the RCP – AP1000 RCP Technology Transfer," Revision 7, dated September 22, 2015
- RT10002, "Radiographic Test Procedure AP1000 RCP," Revision 1, dated May 10, 2011
- PAI108, "Qualification Requirements for Audit Personnel," Revision 15, (no date available)
- PAI110, "Gage Lab Operation," Revision 32, (no date available)
- PAI200TT, "Receiving Inspection Instructions for AP1000 RCP – Technology Transfer," Revision 2, dated June 5, 2015
- PAI221, "Supplier Qualification and Assessment," Revision 24, dated January 4, 2016
- PAI224, "Commercial Grade Surveys," Revision 2, dated November 5, 2015
- TP12, "Computer Control of Instrument Calibration," Rev AG, (no date available)
- TP-82, "Lockout/Tagout (LOTO) Energy Control Procedure," Revision E, dated June 26, 2012
- TP-88TT, "AP1000 Test Procedure," Revision B, dated May 3, 2013
- TS10088, "AP1000 Model N-10086-A1 RCP Lead Unit and Production Units Test Specification, AP1000 RCP – Technology Transfer," Revision 6, dated October 21, 2014
- TS10150, "AP1000 Model N-10087-A1 RCP Production Unit Test Specification," Revision 3, dated January 15, 2016

#### Design Documents and Reports

- Certificate of Qualification (COQ) 02507, "Rotor Lamination Material," Revision 0, dated April 30, 2014
- COQ 02508, "Rotor Lamination Material," Revision 0, dated April 30, 2013
- COQ 02544, "Impeller R.T. Casting AP1000," Revision 0, dated October 19, 2015
- COQ 02561, "AP1000 Impeller Modification," Revision 0, April 5, 2016
- COQ 02572, "Axial Shoe Insert," Revision 0, dated October 27, 2016
- COQ 02573, "Retaining Pin," Revision 0, dated October 27, 2016
- EMD Incident Report Final Report – Phase III, "AP1000 RCP (SN4) Impeller (SN 2765) Indication," Revision 1, dated October 28, 2015
- EMD Design Report No. 15-APK-096, "AP1000 RCP SN4 Impeller Event Extent of Condition," dated November 12, 2015
- EMD Engineering Memorandum 7250, "AP1000 RCP Generic Safety-Related Components Report," Revision 5, dated October 28, 2015
- EMD Engineering Memorandum 7460, "AP1000 RCP Modified Impeller Design Report," Revision 0, dated November 14, 2016
- Form 3511, "Verification of Critical Characteristics, Description: Axial Shoe Insert," Revision 0, dated October 27, 2016
- Form 3511, "Verification of Critical Characteristics, Description: Retaining Pin," Revision 0, dated October 27, 2016
- Form 3511, "Verification of Critical Characteristics, Description: Radial Shoe Insert," Revision 0, dated November 3, 2016
- Form 3511, "Verification of Critical Characteristics, Description: "Rough Turned Impeller Casting for the AP1000 Pump," Revision 0, dated October 3, 2015
- Safety Class Assessment (SCA) No. 10015, "Carbon Graphite Radial Bearing Pad," Revision 1, dated June 6, 2016
- SCA 4D00541G01, "No. 1 Seal Ring, Assembly – High Temperature O-Rings," Revision 5, dated September 15, 2009
- SCA 6D70125H02, "Rotor Lamination," Revision 1, dated May 20, 2013
- SCA 6D71864H03, "Radial Shoe Insert," Revision 1, dated January 21, 2013
- SCA 6D71865H03, "Axial Shoe Insert," Revision 1, dated January 17, 2013

- SCA 6D71866H03, "Retaining Pin," Revision 1, dated January 17, 2013
- SCA 6D72015H01, "Impeller Rough Turned Casting," Revision 2, dated September 29, 2014
- SCA 6D72418, "Impeller Modification AP1000 RCP - Technology Transfer," Revision 3, dated September 2, 2015
- Safety Class Dedication for General Order No. 4500692702 for a seal ring and a seal runner, Revision 0, dated November 1, 2016
- WEC Design Specification APP-MP01-M2-001, "AP1000 Reactor Coolant Pump Design Specification," Revision 4, dated August 31, 2015

### Welding Records

- AT&F Weld Procedure 410, "GTAW of Nickel Alloy on Martensitic Stainless Steel," Revision 1, dated May 31, 2011
- AT&F Weld Record for U601=6D70204 G02-4, Job Work Order 62374-1, for Upper Flywheel base plate Joints 41 and 62, dated September 26, 2012
- PA 0052D, "Balancing Record of Rotating Parts," Serial No. 2428, Part No. 6D71212G01, Shop Order No. U601, Operation No. 500, Work Order No. 979867, Revision 2, dated November 17, 2016
- PA 2397TT, "Build Record for AP1000 RCP Technology Transfer," Lower Thrust Bearing, Pump S/N 17, dated November 14, 2016
- PQR 21071, "SMAW of Nickel Alloy," dated July 10, 2008
- PQR 21077, "SMAW of Nickel Alloy," dated December 11, 2008
- PQR 27233, "GTAW Buttering of Nickel Alloy on Martensitic Stainless Steel," dated July 10, 2008
- PQR 27236, "GTAW of Nickel Alloy," dated June 26, 2008
- PQR 27242, "GTAW of Nickel Alloy," dated December 10, 2008
- PQR 27106, "GTAW," dated January 22, 2009
- PQR 27237, "GTAW," dated January 23, 2009
- PQR 30038, "Submerged Arc Welding," dated February 19, 2010
- PQR 30039, "Submerged Arc Welding," dated August 2, 2016
- PQR 30040, "Submerged Arc Welding," dated February 19, 2010
- PQR 30041, "Submerged Arc Welding," dated May 29, 2008
- PQR 30042, "Submerged Arc Welding," dated April 5, 2011
- PQR 48018, "GTAW (Insert), SMAW," dated April 17, 2012
- PQR 934D153G01, "Gas Tungsten Arc Weld," dated April 17, 2012
- PQR GTAW-43.43.410-AM, "GTAW of Nickel Alloy," Revision 0, dated June 13, 2011
- Traveler for U597=6D70795G03, Work Order 981841, for S/N 13, Weld 44 seal canopy, dated September 15, 2015
- Traveler for U597=6D70795G03, Work Order 981841, for S/N13, Weld 70 thermal barrier/diffuser lock device, dated September 15, 2015
- Traveler for U600=6D71651G01, for S/N 275 flywheel overspeed, dated April 15, 2016
- Weld Joint Record for Joint No. 3, S/N 1749, Work Order No. 810995, Shop Order No. U601-6D71119G01-005, Shell/Flange Fab and Mach, dated September 26, 2013
- Weld Joint Record for Joint No. 4, S/N 1749, Work Order No. 810995, Shop Order No. U601-6D71119G01-003, Shell and Flange Assy, dated June 22, 2012
- Weld Joint Record for Joint No. 73A thru K, S/Ns 315, 241, 217, 223, and 262, Work Order Nos. 877348, 873569, 824894, 824898, 824899, 824895, Shop Order No. U601=6D71049G01-003, HT. EX. Upper Pipe Assy., dated July 26, 2013
- Weld Procedure 82121PS045, "SMAW of Nickel Alloy on Martensitic Stainless Steel," Revision B, dated October 18, 2011

- Weld Procedure 82121PS047, "SMAW of Nickel Alloy Materials," Revision A, dated March 16, 2012
- Weld Procedure 82127PS137, "GTAW of Nickel Alloy on Martensitic Stainless Steel," Revision A, dated May 6, 2011
- Weld Procedure 82127PS143, "GTAW of Nickel Alloy Materials," Revision A, dated October 21, 2011
- Weld Procedure 82127PS155, "GTAW of Nickel Alloy Materials" Revision A, dated March 16, 2012
- Weld Record for U601=6D71650 G01-3, Work Order 849419, for Upper Flywheel Inner hub and Flywheel End Plate Joint 39, dated April 26, 2013
- Weld Record for U601=6D71650 G01-2, Work Order 97872, for Upper Flywheel Leak Test Plug Joint 61, dated March 3, 2013
- Weld Record for U601=6D711186 G01-3, Work Order 932257, for Upper Flywheel Shell, Hub and End Plates Joint 40, dated August 13, 2015
- Weld Record for U601=6D70093 H01-4, Work Order 819684, for Upper Flywheel Hub Joint 38, dated September 17, 2012
- Weld Record for U601=6D70093 H01-4, Work Order 819684, for Upper Flywheel Hub Joint 37, dated September 17, 2012
- Weld Record for U601=6D70101 G01-6, Work Order 932287, for Upper Flywheel Shell Joint 42, dated January 9, 2014
- Welding Procedure Specification (WPS) 82130PQ015, "300 Series SST Buttering of P-1 Carbon Steel," Revision C, dated March 10, 2011
- WPS 82130PQ016, "SAW of Stainless Steel – P8 to P8, P8 to A8 (Buttering)," Revision B, dated April 6, 2011
- WPS 82130PW006, "SAW of Carbon Steel – P1 to P1," Revision C, dated February 22, 2010
- WPS 82148PQ036, "GTAW and SMAW of Austenitic Stainless Steel Piping," Revision B, dated April 17, 2012
- Welding Procedure Qualification Record (PQR) 21076, "SMAW," dated September 18, 2008

#### Inspection and Test Reports

- AP1000 RCP #3 Assembly/Test Procedure U597=6D70795G0X=P2=MOD, Revision 13, dated April 2, 2015
- AP1000 RCP #13 Assembly/Test Procedure U597=6D70795G03, Revision 13, (no date available)
- AP1000 RCP #17 Assembly/Test Procedure U597=6D70795GP3, Revision 13, dated March 8, 2016.
- AP1000 RCP #5 Assembly/Test Procedure U600=6D71651G01, Revision 5, dated April 15, 2016
- AP1000 RCP #6 Assembly/Test Procedure U601=6D71186=P1A, Revision 4, dated December 11, 2015
- PT Test Report U601=6D70093H03, Work Order 819684 for upper flywheel hub S/N248, dated September 17, 2012
- PT Test Report U601=6D70099H01-3, Work Order 818684 for upper flywheel retainer S/N350, dated May 17, 2012
- PT Test Report U597=6D70795G03-13, Work Order 981841 for S/N 13 lower canopy seal weld, dated November 14, 2016
- PT Test Report U601=6D71650G01-3, Work Order 849419 for upper flywheel assembly S/N248, dated March 14, 2013

- Receipt Inspection Report for PO No. 476659 for an axial shoe insert and a radial shoe insert supplied by Federal Carbide Company, Revision 1, dated April 4, 2014
- Receipt Inspection Report for PO No. 488377 for chemistry testing services provided by NSL Analytical Services, Revision 1, dated February 23, 2016
- Receipt Inspection Report for PO No. 481910 for the impeller, Revision 2, dated April 6, 2015
- Receipt Inspection Report for PO No. 495215 for a thrust shoe insert from Kingsbury Incorporated, Revision A, dated November 8, 2016
- Test Report No. U597-SN4, "AP1000 Reactor Coolant Pump Model No. N-10086-A1," Revision 3, dated August 21, 2015
- Test Report No. U597-SN4, "AP1000 Reactor Coolant Pump Model No. N-10086-A1," Revision 5, dated November 9, 2015
- Test Report No. U597-SN6, "AP1000 Reactor Coolant Pump Model No. N-10086-A1," Revision 2, dated October 23, 2015
- Test Report No. U601-SN501, "AP1000 Reactor Coolant Pump Model No. N-10087-A1," Revision 1, dated March 2, 2016

### Drawings

- Drawing 3A82648, "Weld Map Data for AP1000 RCP," Revision 4, dated October 4, 2016
- Drawing 384778, "Graphite Thrust Shoe Insert," Revision A, (no date available)
- Drawing 6D70092, "Flywheel Insert Machining," Revision 4, dated June 16, 2009
- Drawing 6D70093, "Flywheel Inner Hub Buttering Machining," Revision 4, dated January 26, 2011
- Drawing 6D70099, "Flywheel Retaining Ring Machining," Revision 3, dated April 8, 2010
- Drawing 6D70101, "Flywheel Shell," Revision 7, dated January 19, 2015
- Drawing 6D70204, "Flywheel End Plate Fabrication and Machining," Revision 4, dated February 25, 2011
- Drawing 6D70374, "Rotor Assembly and Final Machining," dated January 9, 2010
- Drawing 6D70374, "Rotor Assembly and Final Machining," Revision 4, dated December 6, 2012
- Drawing 6D70683, "Flywheel Initial and Final Assembly," dated January 6, 2012
- Drawing 6D71117, "Impeller Final Machining," Revision 6, dated November 12, 2015
- Drawing 6D71580, "Weld Map AP1000 RCP," Revision 3, dated February 28, 2014
- Drawing 6D71650, "Upper Flywheel Initial and Final Assembly," Revision 5, dated May 15, 2015
- Drawing 6D71651, "Lower Flywheel Initial and Final Assembly," Revision 5, dated May 15, 2015
- Drawing 6D71922, "Test Instrumentation AP1000 RCP," dated May 20, 2013
- Drawing 6D72418, "Impeller Modification AP1000 RCP - Technology Transfer," Revision 4, dated September 2, 2015
- Drawing 6D72426, "Impeller Modification," Revision 1, dated September 18, 2015
- Drawing 9392C45, "Upper Flywheel Key," dated January 6, 2012

### Calibration Records

- Instrument 04990 - Automatic accelerometer calibration system
- Instrument 05335 – Vibration monitor calibration detail inquiry
- Instrument 05337 – Vibration monitor calibration detail inquiry
- Instrument 05338 – Vibration monitor calibration detail inquiry

- Instrument 05339 – Vibration monitor calibration detail inquiry
- Instrument 05351 – Vibration monitor calibration detail inquiry
- Instrument 05573 – FT0304A Loop Flow DP #1 calibration detail inquiry
- Instrument 05586 – TT0310 Loop Suction Temp calibration detail inquiry
- Certificate of Calibration, Chart Recorder, TH8P2
- Certificate of Calibration, Digital Multimeter, 34401A
- Certificate of Calibration, Dead Weight Tester, RK-300
- Certificate of calibration, Decade Resistor, RTD-100
- Certificate of calibration, Dead Weight Tester, TQ-155

#### Commercial-Grade Surveys

- Commercial Grade Survey (CGS) No. SQE-2012-36 of Federal Carbide Company for a survey performed on February 20-21, 2012
- CGS No. SQE-2015-01 of Federal Carbide Company for a survey performed on February 16-17, 2015
- CGS No. SQE-2016-23 of Morgan Advanced Material Technology for a survey performed on June 16-17, 2016
- CGS No. SQE-2011-39 of Laser Technology Inc. for a survey performed on May 2-3, 2011
- CGS No. SQE-2014-18 of Laser Technology Inc. for a survey performed on October 14, 2014
- CGS No. SQE-2009-11 of Surahammars Bruks AB for a survey performed on June 15, 2009
- CGS No. SQE-2014-032 of United Testing Systems, Inc. for a survey performed December 9, 2014
- CGS No. SQE-2015-13 of Surahammars Bruks AB for a survey performed on March 25-26, 2015
- CGS No. SQE-2010-08 of Engineering & Manufacturing Resources, Inc. for a survey performed on June 9-10, 2010
- CGS No. SQE-2014-14 of Precision Castparts Corporation for a survey performed May 14-15, 2014
- CGS No. SQE-2014-31 of R.L. Holliday Company for a survey performed December 5-9, 2014

#### Purchase Orders

- Purchase Order (PO) No. 447243 to Insulator Seal for the terminal gland assembly, Revision 55, dated October 18, 2013
- PO No. 479752 to Patriot Forge Inc. for retainer material, Revision 1, dated May 10, 2013
- PO No. 485919 to Ultra Electronics for a resistance temperature detector, Revision 13, dated June 24, 2015
- PO No. 489807 to ATI Powder Metals for thrust runner hiping, Revision 32, dated May 26, 2016
- PO No. 49063 to Precision Castparts Corporation for impeller modifications, Revision 44, dated November 14, 2016
- PO No. 492747 to Exelon Powerlabs for gage calibration services, Revision 1, dated October 30, 2015
- PO No. 493011 to IMR Test Labs for hot isostatic pressing powder evaluation, Revision 3, dated July 31, 2015

- PO No. 493052 to Tooling Specialists Inc. for heat shield grinding of a thrust shoe body, Revision 11, dated March 1, 2016
- PO No. 49321 to Jorgensen Forge Corporation for thrust bearing sleeve material, Revision 6, dated October 15, 2015
- PO No. 494939 to R.L. Holliday for calibration of ultrasonic test instruments, Revision 0, dated December 3, 2015
- PO No. 494940 to United Testing Systems, Inc. for calibration of magnetic particle test instruments, Revision 0, dated December 3, 2015
- PO No. 495215 to Kingsbury Inc. for a thrust shoe insert, Revision 6, dated November 3, 2016
- PO No. 495601 to Pioneer Motor Bearing for a lower thrust bearing shoe, Revision 5, dated April 13, 2016
- PO No. 498794 to NSL Analytical Services for a coupon test of an axial shoe insert, Revision 1, dated November 14, 2016
- PO No. 499740 Automated Precision Inc. for calibration services of a gage, Revision 0, dated November 1, 2016

#### Nonconformance Reports

- NCR No. A00566, "Lower Thrust Bearing Assembly," dated June 3, 2015
- NCR No. A00677, "Impeller Final Machining," dated June 16, 2015
- NCR No. A00758, "Impeller Inspection," dated October 8, 2015
- NCR No. A02128, "Disassembly and Inspect after Test," dated February 1, 2016
- NCR No. A04090, "RCP Disassembly – Lower Thrust Bearing," dated November 2, 2016
- NCR No. A04306, "Impeller Final Machining," dated November 3, 2016
- NCR No. A04448, "Impeller Inspection," dated November 17, 2016
- Disposition Record for NCR No. A03760, "Upper Flywheel Initial and Final Assembly," Deviation 1, dated August 15, 2016
- Disposition Record for NCR No. A00653, "Upper Flywheel Initial and Final Assembly," Deviation 2, dated December 14, 2015
- Disposition Record for NCR No. A00705, "AP1000 RCP – Disassembly and Inspect," Deviation 10, dated September 22, 2015
- Disposition Record for NCR No. A00705, "AP1000 RCP Disassembly and Inspect," Deviation 13, 14, 15, 18, dated December 18, 2015
- Disposition Record for NCR No. A00710, "AP1000 RCP – Disassembly and Inspect," Deviation 10, dated September 22, 2015
- Disposition Record for NCR No. A00710, "AP1000 RCP – Disassembly and Inspect," Deviation 16, 19, dated January 22, 2016
- Disposition Record for NCR No. A00711, "AP1000 RCP – Disassembly and Inspect," Deviation 8, dated July 21, 2015
- Material Review Report (MRR) No. 0358AA, "AP1000 RCP – Lower thrust Runner," dated March 26, 2014
- MRR No. 0363AA, "AP1000 RCP – Lower Flywheel Assembly," dated April 1, 2014
- MRR No. 0455AA, AP1000 RCP – Lower Flywheel Assembly," dated February 11, 2014
- MRR No. 0456AA, "AP1000 RCP – Lower Flywheel Assembly," dated February 11, 2014
- MRR No. 0457AA, "AP1000 RCP – Lower Flywheel Assembly," dated February 11, 2014
- MRR No. 0625AA, "AP1000 RCP – Upper Thrust Bearing Assembly," dated March 7, 2014



- MRR No. 0626AA, "AP1000 RCP – Lower Flywheel Initial and Final Assembly," dated March 7, 2014
- MRR No. 0925AA, "AP1000 RCP – Lower Thrust Bearing Parts," dated March 27, 2014
- A04561, A01408
- Quarantine Tag for NCR No. A04573, Item No. U601=6D71186=P1A, Job No. 979867, "Grindout areas," dated November 17, 2016

#### Corrective Action Request (CARs)

- CAR-2013-00175, "Audit finding corrective actions"
- CAR-2014-00055, "Invoking NQA-1-1994"
- CAR-2014-00124, "IDPQ17 Corrective action program deficiencies"
- CAR-2014-00127, "IDPQ17 Corrective action program deficiencies"
- CAR-2014-00129, "EMD response to NRC notice of violation response"
- CAR-2014-00135, "Commercial Dedication Procedure"
- CAR-2014-00222, "Upper and Lower Flywheel Gaps in excesses of design requirement"
- CAR-2014-00231, "NON 99901383/2014-201-01 EMDs evaluation"
- CAR-2015-00061, "Dedication of Commercial Grade Calibration Services"
- CAR-2015-00072, "Arizona Power Service NRC Safety Evaluation Report"
- CAR-2015-00077, "After test bearing conditions of SN6 RCP"
- CAR-2015-00079, "Upper radial bearings Inside diameter"
- CAR-2015-00082, "Receipt Inspection should identify supplier's generated deviations"
- CAR-2015-00104, "RCP SN4 E&E post-test disassembly and test"
- CAR-2015-00166, "Ability of EMD's Critical CAR Process to effectively identify root cause and corrective actions"
- CAR-2015-00167, "Passdown of requirements to suppliers"
- CAR-2015-00168, "Design process"
- CAR-2015-00203, "M&TE Out of Calibration should not be used"
- CAR-2016-00247, "Update Procedure to Comply with NRC Regulatory Issue Summary 2016-01"
- CAR-2016-00012, "Follow-up to CAR-2015-00061"
- CAR-2016-00179, "Commitment to 10CFR50 Appendix B"

#### CARs Opened During NRC Inspection

- CAR-2016-00260, "10 CFR Part 21 Reporting Requirements"
- CAR-2016-00261, "10 CFR Part 21 Pass Down Requirements"
- CAR-2016-00263, "Requirements for Scrapping Parts"
- CAR-2016-00268, "Sufficient Documentation of Sub-Tier Supplier Controls During Commercial Grade Survey Activities"
- CAR-2016-00269, "Procedure PAI-110 Does Not Address Evaluating Lost Gages"
- CAR-2016-00270, "Gage Lab Inspector and QC Manager Understanding of American Gage Design Standard Tolerance Code"
- CAR-2016-00272, "RCP Flywheel Enclosure Not in Accordance With Design Specification"
- CAR-2016-00274, "Corrective Action Review Board Improvements"
- CAR-2016-00275, "Calibration Lab Record Retention"

## 10 CFR Part 21 Evaluations

- EMD Form PA1460, "10 CFR Part 21 Evaluation 16-002 - Work being Performed under contract 4500609335," dated March 16, 2016
- EMD Form PA 1460, "10 CFR Part 21 Evaluation 16-007 - Use of 304L in lieu of 304 for RTD locking nuts," dated June 2, 2016
- EMD Form PA 1460, "10 CFR Part 21 Evaluation 16-008 – Stator frame, a safety-related item, was welded without capturing weld data," dated June 3, 2016
- EMD Form PA1460, "10 CFR Part 21 Evaluation 16-009 – ASME B16.5 Flanges on the AP1000 Heat Exchanger do not have specified surface finish," dated July 29, 2016
- EMD Form PA1460, "10 CFR Part 21 Evaluation 16-010 – Use of Alloy 63000 in AP1000 RCP RTD Assembly Plug Coupling Ring," dated July 15, 2016
- EMD Form PA1460, "10 CFR Part 21 Evaluation 16-011 - Holtec External/Heat Exchanger Tube Sheet Hardness," dated September 26, 2016
- Letter from EMD to WEC, "10 CFR Part 21 Report – Analysis Work being Performed Under Contract 4500609335," dated March 24, 2016
- Letter from EMD to WEC, "10 CFR Part 21 Report – Use of Alloy 63000 in AP1000 RCP RTD Assembly Plug Coupling Ring," dated September 21, 2016

## Audit Reports

- Audit Report No. 2014-0027 of ATI Powder Metals for an audit performed on November 17-19, 2014
- Audit Report No. 20006 of Carboline Company for an audit performed on March 17-18, 2015
- Audit Report No. 20130 of Carboline Company for an audit performed on March 19-20, 2015
- Audit Report No. 21039 of Patriot Forge for an audit performed on June 14-16, 2016
- Audit Report No. 19031 of Ultra Electronics for an audit performed on May 13-16, 2014
- Audit Report No. SQE-2014-026 of Kingsbury Inc. for an audit performed on December 9-11, 2014
- Audit Report No. 18029 of NSL Analytical Services Inc. for an audit performed on September 16-18, 2013
- Audit Report No. SQE-2016-0007 of Jorgensen Forge Corporation for an audit performed on May 3-5, 2016
- Audit Report No. QAA-761 of IMR Test Labs for an audit performed on November 13-14, 2014
- Audit Report No. SQE-2016-0006 of Tooling Specialists Inc. for an audit performed on April 13-16, 2016
- Audit Report No. SQE-2016-0033 of Insulator Seal for an audit performed on July 13-14, 2016
- Audit Report No. 19078 of Pioneer Motor Bearing for an audit permed on June 24-26, 2015
- Audit Report No. 20084 of Exelon Powerlabs for an audit performed on January 26-31, 2015
- Audit Report No. SQE-2016-0033 of Insulator Seal for an audit performed on July 13-14, 2016

### Training Records

- 16 Employee Training Summaries
- 6 NDE Qualification Records (Level I, II, and III)
- 5 Lead Auditor Training Records
- Inspector Initial Qualification and Reevaluation Checklist, Shop Order No. P297, dated August 30, 2016
- Inspector Initial Qualification and Reevaluation Checklist, Shop Order No. U597, dated July 12, 2016
- Quality Control Inspector Training Record

### Work Packages

- Routing No. U597=6D70795G03=P3, "RCP Disassy and Inspect," Job No. 979445, Revision 013, (no date available)
- Routing No. U600=6D71651G01, "Lower Flywheel Initial & Final Assy," Job No. 974465, Revision 005, dated April 15, 2016
- Routing No. U601=6D71186=P1A, "Rotor Final Balance," Job No. 979867, Revision 004, dated December 11, 2015

### ASME Code Data Reports

- NPT Certificate of Authorization No. N-1489, Form N-2 Certificate Holder's Data Report for Identical Nuclear Parts and Appurtenances for the Heat Exchanger, Serial No. 2700E, (From Joseph Oat Corporation to Curtiss-Wright Electro-Mechanical Division), dated April 29, 2013
- NPT Certificate of Authorization No. N-3085, Form N-2 Certificate Holder's Data Report for Identical Nuclear Parts and Appurtenances for the Outer Stator Jacket Cylinder Assembly, Serial Nos. 110264-04 and -08, (From RANOR, Inc. to Curtiss-Wright Electro-Mechanical Division), dated May 9, 2012
- NS Certificate of Authorization No. N-3132, Form NS-1 Certificate Holder's Certificate of Conformance for Welded Supports for Class 1 Support, Serial No. 115942, (From AT&F Nuclear, Inc. to Curtiss-Wright Electro-Mechanical Division), dated March 21, 2013

### Base Metal CMTRs

- U601=6D69438H01, Serial Nos. 1748 and 1749, Tests 2179 and 2180, Heat No. 73088, "Main Flange R.T. Forging," Revision 003, dated January 17, 2014
- U601=6D69857H01, Serial Nos. 1781 and 1782, Tests 2024 and 2025, Heat No. 84730, "Shell R.T. Forging," Revision 002, dated October 8, 2013
- U601=6D69858H01, Serial Nos. 1816 and 1817, Tests 2148 and 2149, Heat No. 46461, "Lower Flange R.T. Forging," Revision 004, dated July 24, 2013
- U601=6D71035H01, Serial Nos. 297 thru 394, Heat No. 50243, "Pipe Fitting – Stator Closure Flange," Revision 001, dated September 19, 2013
- U601=3A8257201F, Heat No. I46844, "3" Sch 80 TP304 SST Pipe Per ASME SA-312," Revision 001, dated January 28, 2010

### Filler Metal CMTRs

- 3A82437H01, Heat/Lot No. 987C, "Weld Electrode EH11K 3/32" Dia.," Revision 003, dated March 10, 2011

- 3A82443H03, Heat No. 737880, Lot No. AT9023, "Bare Weld Wire - .062 Dia. ER308," Revision 002, dated February 18, 2009
- 4942A24H03, Heat No. 740786, Lot No. AT9372, "Bare Weld Wire - .062 Dia. ER308," Revision 015, dated May 31, 2012
- 4942A24H03, Heat Nos. 242002, 734815, and 735456, "Bare Weld Wire - .062 Dia. ER308-36 Inch L," Revision 015, dated June 19, 2013
- 4942A24H43, Heat No. 242022, Lot No. AH8677, "Bare Weld Wire - .062 Dia. ER308-36 Inch LG," Revision 015, dated May 31, 2012
- 4942A24H43, Heat No. 744508, Lot No. AT9824, "Bare Weld Wire - .062 Dia. ER308-36 Inch LG," Revision 015, dated June 19, 2013
- 4942A24H44, Heat No. 734815, Lot No. CT8659, "Bare Weld Wire - .093 Dia. ER308-36 Inch L," Revision 013, dated April 30, 2009
- 4942A24H44, Heat No. 744508, Lot No. CT9824, "Bare Weld Wire - .093 Dia. ER308," Revision 015, dated May 31, 2012
- U601=3A8256H08, Heat No. 737880, Lot No. DT9023, "Weld Insert: 3.00" Sched 80 Pipe Size," Revision 001, dated July 10, 2009

#### Miscellaneous

- Internal Letter No. QA-2015-21, "SQE-2014-014, SCA-6D72418, Rev. 2 thru Rev. 4, and QA-2014-035.1," Revision 1, dated January 14, 2016
- Letter No. QA-2014-035.1 from EMD to Precision Castparts Corporation File, "Commercial Grade Dedication of Impellers Supplied by Precision Castparts Corporation," Revision 0, dated August 26, 2014
- PCC Supplier Quality Assurance System Checklist for Astrolite Alloys, Revision 0, dated November 15, 2012
- PCC Supplier Quality Assurance System Checklist for Exova, Inc., Revision 0, dated August 14, 2013
- PCC Special Process Survey Hot Isostatic Pressing of Bodycote IMT Inc., Revision 0, dated October 9, 2013
- PCC Special Process Survey Hot Isostatic Pressing of Bodycote IMT Inc., Revision 0, dated October 28, 2014
- PCC Special Process Survey Hot Isostatic Pressing of Bodycote IMT Inc., Revision 0, dated October 14, 2015
- Precision Castparts Corporation (PCC) Supplier Quality Assurance System Checklist for Element Materials Technology, Revision 0, dated April 10, 2015
- Supplier Process Control Plan No. QRSCP20150009-02, "Impeller Modification AP1000 RCP - Technology Transfer," Revision 0, dated September 2, 2015
- Supplier Process Control Plan No. QRSCP20160002-00, "Radial Shoe Insert," Revision 0, dated February 29, 2016
- Statement of Compliance, Kingsbury, Inc., for a Graphite Thrust Shoe Insert, dated November 8, 2016