

March 29, 2017

EA-2017-038

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

SUBJECT: RESPONSE AND REVISION TO TWO DISPUTED NOTICES OF
NONCONFORMANCE CONTAINED IN NUCLEAR REGULATORY
COMMISSION INSPECTION REPORT 99901383/2016-201

Dear Mr. Shannon:

I am responding to your letter dated February 3, 2017 (ML17047A369), in which you disputed Nonconformances 99901383/2016-201-01 and 99901383/2016-201-02 as identified in the Notice of Nonconformance (NON) attached to the Inspection Report No. 99901383/2016-201 (ML16350A967). The Nuclear Regulatory Commission (NRC) staff identified these NONs during an inspection conducted from November 14-18, 2016, at your facility in Cheswick, PA. The NONs described examples where Curtiss-Wright Electro-Mechanical Division (EMD) was not fully implementing its quality assurance (QA) program in the areas of design control and control of purchased material, equipment, and services.

In your letter, you disputed NON 99901383/2016-201-01, which concerned the use of Alloy 600 material for certain welds performed on the reactor coolant pump flywheel enclosure. The NRC identified that the use of this material was contrary to the requirements contained in EMD's customer's (Westinghouse Electric Company's (WEC's) design specification which required the use of Alloy 625 material for the flywheel enclosure. Your letter responded that the design specification only specifies the base material to be used on the flywheel, but does not impose any requirements on the weld filler material used on the flywheels. Since there are no additional requirements imposed on the weld material, EMD states that the design specification allows the use of Alloy 600 type filler metals and therefore is in compliance with the requirements of the design specification. In addition, EMD states that they submitted documentation that identified Alloy 600 weld material to WEC for approval, and WEC approved the submittals and issued Revision 2 of the design specification to state the acceptability of the alloy 600 weld material for use on the flywheels. You also noted that a single comprehensive document providing details of the engineering evaluation and justification was not available at the time of the NRC inspection.

The NRC staff has independently reviewed the information provided in your letter dated February 3, 2017, and has concluded that for the reasons presented in the enclosed evaluation that NON 99901383/2016-201-01 was valid but will be supplemented to include the lack of a formal engineering evaluation for the use of the alternate Alloy 600 material, since the WEC design specification does not allow the use of Alloy 600 filler metals for the flywheel without a formal engineering evaluation being performed. To date, EMD has not provided any documentation indicating WEC approval to use Alloy 600 weld material for the flywheel welds.

It is the NRC's conclusion that there remains a conflict between the existing Westinghouse design specifications, the AP1000 Design Control Document (DCD), the associated combined operating licenses, and the actual manufactured component in this area. Even if the use of Alloy 600 material for these welds could be justified through the performance of a documented engineering evaluation or by revision of the Westinghouse design specifications, additional actions would have to be taken to rectify the conflict with paragraph 5.4.1.3.6.3 of the AP1000 DCD and the associated combined operating licenses. Therefore, it would be prudent to inform your customer concerning this issue so that any additional actions necessary to rectify the conflict with the manufactured component and the DCD can be performed. This letter provides an update to the NON and the inspection report.

You also disputed NON 99901383/2016-201-02, which concerned 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. Specifically, the NRC identified that 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. Your letter provided your rationale as to why you believe that EMD had met the requirements of Appendix B to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 and 10 CFR Part 21 with regard to this issue.

We concluded that 99901383/2016-201-02 occurred as stated in the NON dated December 21, 2016. The bases for the NRC's conclusions regarding this matter are provided in the enclosure to this letter. We have no further questions or comments related to these two examples at this time and may review the implementation of your corrective actions during a future NRC staff inspection to determine whether full compliance has been achieved and maintained.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter will be made available electronically for public inspection in the NRC Public Document Room or from

the NRC Agencywide Documents Access and Management System (ADAMS), accessible from the NRC site at <http://www.nrc.gov/readingrm/adams.html>.

Should you have any additional questions, please contact John Burke of my staff at 301-415-2343.

Sincerely,

/RA/

Paul G. Krohn, Deputy Director
Division of Construction Inspection
and Operational Programs
Office of New Reactors

Docket No.: 99901383

Enclosure:
NRC Evaluation and Conclusion
for NONs 99901383/2016-201-01
and 99901383/2016-201-02

NOTICE OF NONCONFORMANCE (Revised)

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."

WEC design specification document, APP-MP01-M2-001 references WEC design specification document, APP-GW-VLR-010, "AP1000 Supplemental Fabrication and Inspection Requirements," Revision 1, dated May 11, 2010, Section 4.2.5, which states in part, that, "Any uses of alloy 600 filler metals in contact with reactor coolant at temperatures less than 400°F (204°C) require engineering evaluation and justification."

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 without performing a documented engineering evaluation as required by WEC design specification APP-GW-VLR-010, Section 4.2.5.

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.

SUBJECT: RESPONSE AND REVISION TO TWO DISPUTED NOTICES OF
NONCONFORMANCE CONTAINED IN NUCLEAR REGULATORY
COMMISSION INSPECTION REPORT 99901383/2016-201

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NUCLEAR REGULATORY COMMISSION'S EVALUATION AND CONCLUSION

Statement of Nonconformance 99901383/2016-201-01 (original)

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.

Basis for Disputing the Nonconformance, Example 1

In its response to the NRC, EMD stated that the design specification only specifies the base material to be used on the flywheel, but does not impose any requirements on the weld filler material used on the AP1000 RCP Flywheel Assemblies. Since there are no additional requirements imposed on the weld material, EMD states that the design specification allows the use of Alloy 600 type filler metals, and therefore is in compliance with the requirements of the design specification. In addition, EMD states that they submitted documentation that identified alloy 600 weld material to Westinghouse for approval, and Westinghouse approved the submittals and issued Revision 2 of the design specification (APP-MP01-M2-001) to state the acceptability of the alloy 600 weld material for use on the flywheels. EMD, did not however provide a reference to a specific document that provided this approval for each of the specific welds. EMD also provided a basis for why they currently believe the Alloy 600 is a suitable material for this application.

NRC Evaluation of Vendor's Response to Example 1

An independent reviewer from the NRC staff has evaluated EMD's response and has concluded that Nonconformance 99901383/2016-201-01, occurred as stated in our letter dated December 21, 2016. The independent reviewer's basis for this determination is as follows:

The independent reviewer considered the available regulatory guidance, the NRC inspection report, EMD's response, and held discussions with the NRC inspection team. The independent reviewer determined that at the conclusion of the inspection, EMD had not provided an evaluation through a documented process regarding the acceptability of the use of Alloy 600 weld filler material for the reactor coolant pump flywheel enclosure. This is contrary to Section 4.2.5 of Westinghouse design specification document, APP-GW-VLR-010, "AP1000 Supplemental Fabrication and Inspection Requirements," Revision 1, dated May 11, 2010, which states in part, that, "Any uses of alloy 600 filler metals in contact with reactor coolant at temperatures less than 400°F (204°C) require engineering evaluation and justification." While EMD's response to the NON dated February 3, 2017, provided some supplemental information regarding the acceptability of Alloy 600 for the subject welds, the NRC does not believe this additional information constitutes a formal engineering evaluation through a documented process, nor is it clear that there is a documented record of Westinghouse's acceptance of this material for these specific weld applications. The formal engineering evaluation should take into consideration all aspects of the processes used during manufacturing, including welding, grinding, etc., as well as the operational conditions such as temperature, stresses, etc., and how it affects the Alloy 600 material for this application. This also includes considering information (including flywheel temperature) provided in the 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. In addition, since Alloy 600 weld material is used for weld numbers 37, 38, 39, and 61 of the flywheel enclosure on all flywheels, this becomes the basis for the flywheel design and should be submitted to Westinghouse so that it can be included in the design specification.

As stated in the design specification, an engineering evaluation is required to justify the use of a material other than Alloy 625 for the flywheel enclosure. This includes the weld filler material used for the flywheel enclosure. Therefore, we disagree with your statement that Sections 5.1.3 and 5.1.1.6 of the design specification allows the use of Alloy 600 weld material for the Alloy 625 welded enclosure. As stated in the NRC Inspection Report 99901383/2016-201, WEC Design Specification APP-MP01-M2-001, 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." Therefore, any material used to manufacture the enclosure is required to be Alloy 625 including the associated weld materials. It is standard practice that welding of one material type is performed with its matching filler metal as summarized in WEC Design Specification APP-MP01-M2-001, Section 7.1(d), "Nickel Alloy Filler Metals." Therefore, the design specification does not allow the use of Alloy 600 filler metal without an engineering evaluation as stated above.

In addition, even if the use of Alloy 600 material for these welds could be justified through the performance of a documented engineering evaluation or by revision of the Westinghouse design specifications, additional actions would have to be taken to rectify the conflict with the AP1000 Design Control Document (DCD). Section 5.4.1.3.6.3 of the AP1000 DCD, Revision 19 (ADAMS Accession No. ML11171A454), which is incorporated in the Combined License (COL) for Vogtle Units 3 and 4 and V.C. Summer Units 2 and 3, states, in part, that, "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.” As such, the currently manufactured components are not in accordance with the DCD or associated COLs.

Statement of Nonconformance 99901383/2016-201-02

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.

Specific Basis for Disputing the Nonconformance, Example 2

In response to the nonconformance, EMD stated that they had established 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. Specifically EMD stated that they had performed commercial-grade surveys of their contractors, and those surveys in combination with objective evidence provided by subcontractors provided reasonable assurance that the items supplied by EMD would perform their intended safety function.

NRC Evaluation of Vendor's Response to Example 2

An independent reviewer from the NRC staff has evaluated EMD's response and has concluded that Nonconformance 99901383/2016-201-02, occurred as stated in our letter dated December 21, 2016. The independent reviewer's basis for this determination is as follows:

The independent reviewer considered the available regulatory guidance, the NRC inspection report, EMD's response, and held discussions with the NRC inspection team. The independent reviewer determined that while EMD did have procedures in place for the selection and review for suitability of application of materials and processes, EMD's implementation of their procedure was not sufficient to provide reasonable assurance that certain critical attributes of safety-related components were met. Specifically, while the NRC inspection team recognized that EMD had performed a commercial-grade survey of its supplier Precision Castparts Corporation, this survey did not address how work performed by sub-suppliers would be verified. For example, EMD did not address (either within their survey of Precision Castparts or by other methods) how they had verified that the hot isostatic pressing performed by a commercial sub-supplier was properly controlled. Likewise, EMD did not address (either within the survey of Precision Castparts or by other methods) how they verified that weld material used by a commercial sub-supplier was properly controlled.

In their response, EMD states that through their commercial-grade survey and other methods that they had established that Precision Castparts controls were adequate, but EMD has not provided any specific documentation or explanation as to what other methods were utilized to verify the adequacy of the impeller casting, specifically with respect to the isostatic pressing or the weld repair material. Specifically, it is not apparent that EMD has taken sufficient actions to ensure the adequacy of the impeller casting either through an evaluation of supplier/sub-supplier controls, or through other methods such as post production examination or testing.

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.