



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

December 1, 2017

Mr. David Gobbi  
Quality Assurance Manager  
Flowserve Pump Division  
2300 E. Vernon Ave.  
Vernon, CA 90058

SUBJECT: FLOWSERVE PUMP DIVISION'S NUCLEAR REGULATORY COMMISSION  
INSPECTION REPORT NO. 99901369/2017-201

Dear Mr. Gobbi:

On October 23-26, 2017, the U.S. Nuclear Regulatory Commission (NRC) staff conducted an inspection at the Flowserve Pump Division's facility (hereafter referred to as FLS) in Vernon, CA. The purpose of this limited-scope routine inspection was to assess FLS'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 FLS's implementation of the quality activities associated with the design, fabrication, and testing of the pumps being supplied to domestic operating reactors and for the Westinghouse Electric Company AP1000 reactor design for Vogtle Electric Generating Plant (hereafter referred to as Vogtle), Units 3 and 4. Specifically, the NRC inspection team reviewed activities and documents related to the refurbishment of the High Pressure Safety Injection pump AB shaft for Waterford Steam Electric Station, Unit 3, and the fabrication of two of the AP1000 pumps for Vogtle Units 3 and 4. The AP1000 pumps were the Vogtle Unit 4 Chemical and Volume Control System Makeup pump APP-CVS-MP-01A (Serial Number 10RLCU0008908001) and the Vogtle Unit 3 Normal Residual Heat Removal System Centrifugal pump RNS-MP-01A (Serial Number 10RLCU0008701001). The enclosed report presents the results of the inspection. This NRC inspection report does not constitute NRC endorsement of FLS's overall quality assurance (QA) or Part 21 programs.

Based on the results of this inspection, the NRC inspection team found the implementation of your QA program met the requirements imposed on you by your customers or NRC licensees. No findings of significance were identified.

In accordance with 10 CFR 2.390, "Public Inspections, Exemptions, Requests for Withholding," of the NRC's "Rules of Practice," the NRC will make available electronically for public inspection

a copy of this letter and its enclosure through the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System, which is accessible at <http://www.nrc.gov/reading-rm/adams.html>.

Sincerely,

***/RA/***

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

Docket No.: 99901369

EPID: 99901369/I-2017-201-0035

Enclosure:  
Inspection Report No. 99901369/2017-201  
and Attachment

SUBJECT: FLOWSERVE PUMP DIVISION'S NUCLEAR REGULATORY COMMISSION  
INSPECTION REPORT NO. 99901369/2017-201

Dated: December 1, 2017

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

Docket No.: 99901369

Report No.: 99901369/2017-201

Vendor: Flowserve Pump Division  
2300 E. Vernon Ave.  
Vernon, CA 90058

Vendor Contact: Mr. David Gobbi  
Quality Assurance Manager  
E-mail: dgobbi@flowserve.com  
Phone: (980) 722-6770

Nuclear Industry Activity: Flowserve Pump Division, located at 2300 E. Vernon Ave. Vernon, CA, is an American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel (B&PV) Code Certificate Holder holding an N and NPT stamp. Flowserve Pump Division's scope of supply includes manufacturing, repair, and replacement of safety-related ASME B&PV Code Class 1, 2, and 3 and non-ASME B&PV Code safety-related pumps, including spare/replacement parts, components, appurtenances, and the associated engineering and field services.

Inspection Dates: October 23-26, 2017

Inspectors:	Jonathan Ortega-Luciano	NRO/DCIP/QVIB-2	Team Leader
	Terry Jackson	NRO/DCIP/QVIB-2	Branch Chief
	Ilka Berrios	NRO/DCIP/QVIB-2	
	Yamir Diaz-Castillo	NRO/DCIP/QVIB-2	
	Robert Wolfgang	NRR/DE/EMIB	
	Cheol SHEEN	KINS	Observer
	Han-ok KO	KINS	Observer

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

Enclosure

## **EXECUTIVE SUMMARY**

Flowserve Pump Division  
99901369/2017-201

The U.S. Nuclear Regulatory Commission (NRC) staff conducted a vendor inspection at the Flowserve Pump Division's (hereafter referred to as FLS) facility in Vernon, CA, 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 also verified that FLS implemented a program under 10 CFR Part 21, "Reporting of Defects and Noncompliance." Furthermore, the NRC inspection verified that FLS had implemented a program in accordance with the applicable requirements of Section III, "Rules for Construction of Nuclear Facility Components," of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code. The NRC inspection team conducted the inspection on October 23-26, 2017. This was the fourth NRC inspection at the FLS facility.

The Korea Institute of Nuclear Safety (KINS) participated in the inspection as observers. These observations foster the sharing of international experiences with the construction of new reactors, oversight of vendors, and modular construction techniques consistent with the objectives of the Multinational Design Evaluation Program.

This technically-focused inspection specifically evaluated FLS's implementation of quality activities associated with the design, fabrication, and testing of safety-related pumps for the Westinghouse Electric Company AP1000 reactor design and for the domestic operating reactors. Specific activities observed by the NRC inspection team included:

- Commercial-grade dedication for safety-related items such as O-Rings and small machined parts
- Calibration of a 1000 PSI pressure gauge

In addition to observing these activities, the NRC inspection team verified that measuring and test equipment (M&TE) was properly identified, marked, calibrated, and used within its calibrated range.

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 January 27, 2017, IP 43004, "Inspection of Commercial-Grade Dedication Programs," dated January 27, 2017, and IP36100, "Inspection of 10 CFR Part 21 and Programs for Reporting Defects and Noncompliance," dated February 13, 2012.

The NRC inspection team determined that FLS is implementing its programs for training and qualification, 10 CFR Part 21, design control, commercial-grade dedication, oversight of contracted activities, control of special processes, test control, nonconforming material, parts, or components, and corrective action 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 FLS is adequately implementing its policies and procedures associated with these programs. No findings of significance were identified.

## REPORT DETAILS

### 1. 10 CFR Part 21 Program

#### a. Inspection Scope

The NRC inspection team reviewed Flowserve Pump Division's (hereafter referred to as FLS) policies and implementing procedures that govern FLS's 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 FLS's 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 21.31, "Procurement Documents." The NRC inspection team also verified that FLS's nonconformance and corrective action procedures provide a link to the 10 CFR Part 21 program.

Furthermore, for a sample of 10 CFR Part 21 evaluations performed by FLS, the NRC inspection team verified that FLS had effectively implemented the requirements for evaluating deviations and failures to comply. The NRC inspection team verified that the notifications were performed in accordance with the requirements of 10 CFR 21.21, as applicable.

The NRC inspection team also discussed the 10 CFR Part 21 program with FLS's management and technical 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 FLS 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 FLS 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 FLS's policies and implementing procedures that govern the design control program to verify compliance with the regulatory requirements of Criterion III, "Design Control," 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," and with the applicable requirements of Subsection ND, "Class 3 Components, of Section III "Rules for Construction of Nuclear Facility Components," of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, 1998 Edition up to and including

2000 Addenda, and Section VIII, "Rules for Construction of Pressure Vessels Division 1," 2001 Edition with 2003 Addenda. The NRC inspection team also reviewed a sample of part drawings, bills of materials, data sheets, design reports, engineering change orders, and the Westinghouse Electric Company (WEC) design specifications.

With respect to FLS's process for upgrading material in accordance with the requirements of NCA-3855.5, "Utilization of Unqualified Source Material," the NRC inspection team reviewed a sample of material Certificate of Conformances, receiving documents, and the supporting laboratory test reports that included the test results of the chemical analysis and mechanical properties testing that was performed on each piece of material. The NRC inspection team also verified that the test results were consistent and from the same heat No. as part of the NCA-3855.5 material upgrade process. The NRC inspection team also confirmed that FLS received extra material for testing to support the material upgrade process.

The NRC inspection team also discussed the design control program and the process for upgrading material with FLS's management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

b. Observations and Findings

FLS has a contract from WEC to design and fabricate centrifugal normal residual heat removal (RHR) pumps for the Normal Residual Heat Removal System (RNS) and make-up pumps for the Chemical and Volume Control System (CVS) for Vogtle Electric Generating Plant, Units 3 and 4 (hereafter referred to as Vogtle). The NRC inspection team reviewed FLS's order number RLCU00087 for RNS centrifugal normal RHR pump for Vogtle Unit 3 (Serial Number 10RLCU0008701001) and FLS Order Number RLCU0008908001 for a CVS Makeup pump for Vogtle Unit 4 (Serial Number 10RLCU0008908001, and evaluated the associated design control process.

The NRC inspection team verified that the WEC design specification No. APP-MP08-Z0-001, Revision 7, dated April 12, 2012, for the RNS centrifugal normal RHR pump for Vogtle Unit 3 and the WEC design specification No. APP-MP06-Z0-001, Revision 3, dated November 27, 2010, were properly translated into FLS's specification sheets, drawings, procedures, data sheets, analyses, and calculations, and that engineering data supported this information. The specifications verified included material specifications, applicable ASME B&PV Code construction requirements, qualification reports, test requirements, and test reports. The associated documentation reviewed included design reports, pump drawings, and lists of materials of construction. All documents reviewed contained the appropriate technical details and met the WEC design specifications.

No findings of significance were identified.

c. Conclusion

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



### 3. Commercial-Grade Dedication

#### a. Inspection Scope

The NRC inspection team reviewed FLS's program for the dedication of commercial-grade items for use in safety-related applications to verify its compliance with the applicable regulatory requirements of Criterion III and Criterion VII, "Control of Purchase Equipment, Materials, and Services" of Appendix B to 10 CFR Part 50.

The NRC inspection team reviewed the policies and procedures governing the implementation of commercial-grade dedication (CGD) activities, observation of CGD activities, and review of related documentation. Specifically, the NRC inspection team reviewed CGD packages to assess the different elements of the CGD program, including the technical evaluation process, design drawings, work package instructions, and inspection reports. The NRC inspection team evaluated the criteria for the identification of item functions, credible failure mechanisms/modes, selection of critical characteristics and acceptance criteria, and the identification of verification methods to verify effective implementation of FLS's dedication process.

The NRC inspection team also discussed the CGD program with FLS's management and technical 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 FLS is implementing its CGD program in accordance with the regulatory requirements of Criterion III and Criterion VII of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that FLS is implementing its policies and procedures associated with CGD program. No findings of significance were identified.

### 4. Oversight of Contracted Activities

#### a. Inspection Scope

The NRC inspection team reviewed FLS's policies and implementing procedures that govern the implementation of its oversight of contracted activities to verify compliance with the requirements of Criterion IV, "Procurement Document Control," and Criterion VII of Appendix B to 10 CFR Part 50.

The NRC inspection team reviewed a sample of POs of several safety-related nuclear and commercial suppliers on FLS's Approved Suppliers' List. 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 the safety-related POs invoked the requirements of Appendix B to 10 CFR Part 50 and 10 CFR Part 21.

The NRC inspection team reviewed FLS's measures established for the use of accreditation in lieu of commercial-grade surveys for procurement of calibration and testing services. FLS's QA manual allows for the utilization of the International Laboratory Accreditation Cooperation (ILAC) accreditation process in lieu of commercial-grade surveys for calibration services as approved by the NRC in the Arizona Public Service Company QA program safety evaluation (Agencywide Documents Access Management System Accession Number ML052710224).

The NRC inspection team reviewed a sample of external audit reports for audits performed since the last NRC inspection in 2013. The NRC inspection team verified that: (1) the audits were performed at the required frequency; (2) the audits were performed using approved checklists and procedures; (3) and that the audit reports contained objective evidence of the review of the relevant QA criteria of Appendix B to 10 CFR Part 50. Additionally, the NRC inspection team reviewed a sample of supplier's annual assessments to verify FLS's measures for ensuring that its suppliers are continuing to meet the quality requirements imposed.

The NRC inspection team also reviewed a sample of training and qualification records of quality control inspection personnel, lead auditors and auditors. The team also confirmed that inspection personnel, lead auditors and auditors had completed the required training and maintained qualification and certification in accordance with FLS's policies and procedures.

The NRC inspection team also discussed the supplier oversight program with FLS's management and technical 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 FLS is implementing its oversight of contracted activities in accordance with the regulatory requirements of Criterion IV and Criterion VII of Appendix B to 10 CFR Part 50. Based on the limited sample of documents reviewed, the NRC inspection team also determined that FLS is implementing its policies and procedures associated with the oversight of contracted activities. No findings of significance were identified.

5. Control of Special Processes

a. Inspection Scope

The NRC inspection team reviewed FLS's policies and implementing procedures that govern the 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 and with the requirements of Subsection NCA, "General Requirements for Division 1 and Division 2," Subsection NB, "Class 1 Components," Subsection NC, "Class 2 Components," and Subsection ND, "Class 3 Components," of Section III, "Rules for Construction of Nuclear Facility Components," Section V, "Nondestructive

Examination,” and Section IX, “Welding and Brazing Qualification,” of ASME B&PV 1998 Edition, 2000 Addenda, and the American Society for Nondestructive Testing (ASNT) SNT-TC-1A, “Personnel Qualification and Certification in Nondestructive Testing.”

The NRC inspection team reviewed a sample of weld procedure specifications (WPS), and supporting procedure qualification records (PQRs). The NRC inspection team verified that the applicable welding data was adequately recorded in the WPSs and PQRs. The NRC inspection team also reviewed FLS’s process for controlling weld filler metal and observed FLS’s weld filler material control storage area. The NRC inspection team witnessed FLS’s process for issuing weld filler metal rod issue to ensure that the weld filler metal was adequately controlled at all times until its consumption, and reviewed records associated with the storage, issuance, and return of weld filler metal. The weld filler metal was kept in containers and the environmental condition of the storage facility was controlled.

The NRC inspection team also reviewed the associated welder qualification records and confirmed that the welders had completed the required training and had maintained their qualifications in accordance with the applicable FLS procedures. The NRC inspection team also verified that the FLS’s procedure for welder qualification meets the applicable requirements of Sections III and IX of the ASME B&PV Code.

In addition, the NRC inspection team reviewed a sample of procedures and test reports associated with ultrasonic testing (UT), liquid penetrant testing (PT), magnetic particle testing (MT); Level II and Level III inspector qualifications, and the calibration certificates of the measuring and test equipment (M&TE). The NRC inspection team confirmed that the non-destructive examination (NDE) personnel were qualified in accordance with the requirements of ASNT SNT-TC-1A.

The NRC inspection team also discussed the control of special processes with FLS’s management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

b. Observation and Findings

No findings of significance were identified.

c. Conclusion

The NRC inspection team concluded that FLS is implementing its control of special processes to 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, the NRC inspection team also determined that FLS is implementing its policies and procedures associated with the control of special processes program. No findings of significance were identified.

## 6. Test Control

### a. Inspection Scope

The NRC inspection team reviewed FLS's policies and implementing procedures that govern the test control program to verify compliance with the requirements of Criterion XI, "Test Control," of Appendix B to 10 CFR Part 50.

The NRC inspection team also verified that the test plans and procedures met the applicable requirements of ASME Section III (1998 Edition through 2000 Addenda) and ASME Section VIII (2001 Edition with 2003 Addenda) of the ASME B&PV Code. The NRC inspection team reviewed the test plans, test procedures, and test results for the AP1000 RNS centrifugal normal RHR pump and CVS make-up pumps.

The NRC inspection team discussed the test control program with FLS's management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

### b. Observations and Findings

#### b.1 Test Plans and Procedures

The NRC inspection team verified that FLS's test procedures adequately included the technical, quality and regulatory requirements identified in WEC's design specifications. The NRC inspection team also verified that FLS's test procedures provided an adequate description of the test responsibilities, objectives, sequences, instructions, parameters, M&TE usage, acceptance criteria and post-test activities.

#### b.2 Test Results and Data Evaluation

The NRC inspection team verified the test data results for the RNS centrifugal normal RHR pump documented in Test Report No. 280-RLCU0087-01, dated June 12, 2012, and for the CVS Makeup pump documented in Test Report No. 280-RLCU00089-04, dated September 20, 2012. There was one deviation for each pump from the WEC design requirements, and WEC accepted the deviation. The deviation was that the performance curves were not showing a continuously rising curve to shutoff at low flows. The NRC inspection team evaluated the dispositions, and agreed with the conclusions.

No findings of significance were identified.

### c. Conclusion

The NRC inspection team concluded that FLS 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 FLS is implementing its policies and procedures associated with the test control program. No findings of significance were identified.

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

### a. Inspection Scope

The NRC inspection team reviewed FLS's policies and implementing procedures that govern the control of nonconformances and corrective action program 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 a sample of nonconformance reports (NCRs) to verify that FLS: (1) dispositioned the NCRs in accordance with the applicable procedures; (2) documented an appropriate technical justification for various dispositions; and (3) took adequate corrective action with regard to the nonconforming items. For NCRs that were dispositioned as use as is, the NRC inspection team confirmed that the technical justifications were documented to verify the acceptability of the nonconforming item. The NRC inspection team also verified that FLS's NCR process provides a link to the 10 CFR Part 21 program.

The NRC inspection team also reviewed a sample of correction action reports (CARs) to ensure that conditions adverse to quality were promptly identified and corrected. In addition, the NRC inspection team verified that the CARs provided: (1) adequate documentation and description of conditions adverse to quality; (2) an appropriate analysis of the cause of these conditions and the corrective actions taken to prevent recurrence; (3) direction for review and approval by the responsible authority; (4) a description of the current status of the corrective actions; and (5) the follow-up actions taken to verify timely and effective implementation of the corrective actions. In addition, the NRC inspection team verified that FLS's corrective action process provides a link to the 10 CFR Part 21 program.

The NRC inspection team also discussed the nonconforming materials, parts, or components and corrective action programs with FLS's management and technical staff. The attachment to this inspection report lists the documents reviewed by the NRC inspection team.

### b. Observations and Findings

As part of this inspection the NRC inspection team verified FLS's corrective actions resulting from a rejected replacement part that was sent to Waterford Steam Electric Station (hereafter referred to as Waterford).

Waterford sent a high pressure safety injection (HPSI) pump bundle to the FLS facility in Memphis, TN for repair. During the post balance disassembly, the ninth stage impeller got stuck and after several attempts the impeller could not be removed. It was decided by FLS and the licensee to rework the rotor to destructively remove and replace the ninth stage impeller and key. There was a trouble report from the licensee following the rotor assembly arrival at Waterford. The licensee determined that the shaft galling rework under FLS's NCR No. 9810 rendered areas unacceptable to the licensee (stress risers and potential for corrosion and pitting in the gall location). In a letter dated April 5, 2017, from FLS to Waterford, FLS explained that while the remaining condition of the shaft is outside of the original requirements, the condition of the shaft is acceptable

for use due to the low impact on stress and crevice corrosion. The licensee did not accept the pump bundle and returned it to FLS.

FLS determined that the root cause of the galling was human performance error. There was not a final inspection of the shaft following the rework, and a fit-up of the mating parts to the shaft was not performed. As part of the corrective actions taken to address this issue, the FLS's Memphis manager and inspector were reminded of their first priority, which is to provide quality parts to customers. Also, test fit-up of mating parts is required to be performed as a practice when parts are available.

The NRC inspection team agreed with FLS conclusion that the root cause was human performance error. The NRC inspection team determined that the corrective action taken by FLS were adequate to correct this condition adverse to quality.

c. Conclusion

The NRC inspection team concluded that FLS is implementing its nonconforming materials, parts, or components 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 NRC inspection team also determined that FLS is implementing its policies and procedures associated with the control of nonconforming materials, parts, or components and corrective action. No findings of significance were identified.

8. Entrance and Exit Meetings

On October 23, 2017, the NRC inspection team discussed the scope of the inspection with Mr. Dan Baehner (General Manager of Nuclear Products Operations), Mr. David Gobbi (Quality Assurance Manager), and other members of FLS's management and technical staff. On October 26 2017, the NRC inspection team presented the inspection results and observations during an exit meeting with Mr. Baehner, Mr. Gobbi, and other members of FLS'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

<b>Name</b>	<b>Title</b>	<b>Affiliation</b>	<b>Entrance</b>	<b>Exit</b>	<b>Interviewed</b>
Jonathan Ortega-Luciano	Inspection Team Leader	NRC	X	X	
Terry Jackson	Branch Chief	NRC		X	
Ilka T. Berrios	Inspector	NRC	X	X	
Yamir Diaz-Castillo	Inspector	NRC	X	X	
Robert Wolfgang	Inspector	NRC	X	X	
KO, Hanok	Observer	Korean Institute of Nuclear Safety (KINS)	X	X	
SHEEN, Cheol	Observer	KINS	X	X	
Kenan Alpan	General Manager, After Market Operations	Flowserve (FLS)	X	X	
Willis Antonio	Welder	FLS			X
Dan Baehner	Director/General Manager Nuclear Power Operations	FLS	X	X	
Benjamin Busse	Engineer	FLS	X		
Gerardo Galvan	Quality Assurance (QA) Engineer	FLS	X		X
David Gobbi	QA Manager	FLS	X	X	X
Michael Eftychiou	Nuclear Engineering Manager	FLS	X	X	
Kevin Jones	Welding Supervisor	FLS			X
Hiep D Le	Quality Control Supervisor	FLS			X
Minh Le	Manufacturing Engineer	FLS	X		
Nancy Macias	QA Engineer	FLS	X	X	X
David Shaw	Metallurgist	FLS	X	X	X
Ronald Schneeberger	Metallurgist	FLS	X		
Ed Villalva	Facility Quality Manager	FLS	X	X	X
Keith Wilson	QA Manager - Charlotte	FLS	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 January 27, 2017.

IP 43004, "Inspection of Commercial-Grade Dedication Programs," dated January 27, 2017.

## 3. DOCUMENTS REVIEWED

### Policies and Procedures

- Flowserve Nuclear Products Operations (FNPO) Nuclear Quality Assurance Manual, Edition 3, Revision 3, dated October 20, 2016
- FNPO American Society of Mechanical Engineers (ASME) Code Nuclear Quality Assurance Manual, Edition 5, Revision 1, dated April 6, 2017
- GS-1640, "Alloy Verification Procedure Using Niton® X-Ray Fluorescent Alloy Analyzers," Revision E, dated July 8, 2015
- IP-1777, "Inspection Requirements for Elastomeric Seals for Nuclear Service," dated October 9, 2015
- MR-1533, "Requirements for Stock Conversion of Castings from QL-3 Vendors for ASME Section III Pumps and Parts," Revision A, dated December 2, 2016
- MT-1508, "Magnetic Particle Examination Procedure Wet Fluorescent and Dry Methods ASME Section III Components," Revision G, dated April 25, 2017
- NPO-ACP-04, "Implementing Procedure - Supplier Audits," Revision 1, dated September 14, 2017
- NPO-ACP-09, "Requirements for Qualifying Supplier Quality Programs, Accepting Supplier Products and Services and for the Maintenance of the NPO Approved Vendor List," Revision 1, dated December 16, 2013
- NPO-ACF-09, "NPO Approval of Audits and Surveys," Revision 2, dated July 25, 2017
- NPO-ACP-10, "Requirements for the Application and Use of Method 2, Commercial Grade Survey and Method 3, Source Verification for Commercial Grade Dedication," Revision 1, dated August 13, 2015
- NPO-ANP-02, "Internal Quality Audit Program," Revision 5, dated July 24, 2017
- NPO-CNP-04, "Implementation of the Nuclear Products Operations Corrective Action Program and the Implementation of DMAIC Light," Revision 0, dated December 4, 2013
- NPO-DNP-01, "Dedication of Commercial Grade items for 10CFR50 Application," Revision 00, dated December 21, 2013
- NPO-E-105, "Utilizing Commercial Items as Safety Related Components," Revision B, dated May 18, 2010
- NPO-E-122, "Reconciliation of ASME Code Items," Revision 0, dated September 17, 2015
- NPO-ENP-05, "Procedure for the Qualification and Certification of Levels I, II, III Non-Destructive Test Personnel," Revision 5, dated April 20, 2017
- NPO-ICP-06, "Procedure for the Identification, Handling, and Disposing of Material, Items, and Components that are Unsuitable for Use," Revision 0, dated July 10, 2013
- NPO-NNP-03, "Reporting of Defects which may Result in Substantial Safety Hazards (10CFR21)," Revision 1, dated May 2, 2013



- NPO-QNF-06, "NPO Tier Level II Procedure Index," Revision 18, dated September 18, 2017
- PO-E-104, "Nuclear Item Master, BOM's and ECO's," Revision C, dated June 22, 2010
- PS-1688, "Procurement Requirements for Castings Purchased from QL-3 Foundries to be Used for ASME Stock Conversion," Revision B, dated December 2, 2016
- PT-1505, "Liquid Penetrant Examination ASME Section III Subsection NB for Class 1 Primary Coolant Components," Revision J, dated April 25, 2017
- PT-1516, "Liquid Penetrant Examination ASME Section III Subsection NC or ND for Class 2 or 3 Nuclear Service Pumps," Revision A, dated June 16, 2005
- QA-1717, "Control of Nonconforming Items," Revision D, dated July 25, 2016
- QA-2002, "Conducting Annual Evaluations and Performance Assessments of Nuclear Products Operations (NPO) Qualified Material Organizations," Revision 0, dated June 1, 2011
- WC-100, "Weld Filler metal Storage and Control," Revision P, dated March 14, 2014

#### Design and Test Documents

- 280-RLCU00087-01, "Test Report," dated June 12, 2012
- 280-RLCU00089-04, "Test Report," dated September 20, 2012
- APP-GW-VLR-002, "Technical Requirements of Stainless Steels, Nickel Based Alloys, Carbon and Low Alloy Steels, and Welding Materials for the AP1000," Revision 1, dated February 27, 2009
- APP-MP06-Z0-001, "Design Specification," Revision 3, dated November 27, 2010
- APP-MP06-Z0R-001, "CVS Makeup Pump Datasheet Report," Revision 3, dated August 6, 2010
- APP-MP08-Z0-001, "Design Specification," Revision 7, dated April 2, 2012
- APP-MP08-Z0R-01, "RNS Centrifugal Normal Residual Heat Removal Pumps, ASME B&PV Section III, Class 3," Revision 2, dated August 20, 2010
- FLTP-T-0001, "General Pump Performance Test," Revision D, dated September 28, 2016
- Form NPV-1, "Certificate Holder's Data Report for Nuclear Pumps & Valves," dated May 14, 2013
- MC-1743, "Materials of Construction – Make-Up Pump," Revision G, dated June 18, 2014
- Procurement Advisory Release (PAR) No. 4500328256-A, "Deviation – Envelope Drawing," dated July 24, 2012
- PAR No. 4500328256-041-C, "Customer Data Sheet – Pump," dated April 23, 2012
- PAR No. 4500328256-102-0, "Deviation – Seal Cooler Unit (Zinc Plating)," dated October 18, 2012
- PAR No. 4500328256-115-A, "Deviation – Pump Support Bolting," dated March 26, 2013
- PAR No. 4500328256-092-A, "Deviation – Pump Test," dated July 16, 2012
- SR-1422, "Design Qualification Report of the Residual Heat Removal Pump Structural Integrity," Revision G, dated October 25, 2013
- SR-1423, "Environmental Qualification Report of the RNS Centrifugal Normal Residual Heat Removal Pump," Revision D, dated November 15, 2012
- SR-1449, "Structural Integrity Analysis CVS Makeup Pump," Revision E, dated November 15, 2013
- SVO-MP06-GNR-004, "Deviation Notice for AP1000 MP06 CVS Makeup Pump Ultrasonic Testing Requirements," Revision 0, dated October 22, 2014

- SVO-MP08-GNR-002, "Deviation Notice for AP1000 MP08 RNS Normal Centrifugal RHR Pumps Cleaning Requirements," Revision 0, dated August 6, 2012

#### Design and Commercial-Grade Dedication Records

- NPO EE-1026, "Engineering Evaluation of Sheet Gasket Materials for Safety Related Use," Revision E, dated December 16, 2010
- NPO EE-1053, "Engineering Evaluation for the Dedication of Miscellaneous Small Machined Parts for Safety Related Services," Revision 0, dated October 17, 1997
- NPO EE-1098, "Engineering Evaluation for the Elastomeric Seal Gaskets," Revision C, dated October 15, 2015
- NPO EE-1122, "Engineering Evaluation for the Dedication of Calibration Services," Revision 1, dated October 9, 2015
- NPO EE-1140, "Engineering Evaluation for the Dedication of Material Testing for Safety Related Service," Revision 0, dated January 31, 2014
- NPO EE-1170, "Engineering Evaluation of Software – Lateral Rotordynamic Analysis by Qualified Commercial Grade Supplier," Revision 0, dated October 7, 2016
- NPO EE-1171, "Engineering Evaluation of Software – Torsional Rotordynamic Analysis by Qualified Commercial Grade Supplier," Revision 0, dated October 7, 2016
- NPO GS-1640, "Alloy Verification Procedure Using Niton X-Ray Fluorescent Alloy Analyzers," Revision E, dated July 8, 2015

#### American Society of Mechanical Engineers (ASME) and Welding Records

- Chemical Test Certificate No. FLO021-08-12-38396-1 from Element, dated August 4, 2011
- Certificate of Compliance No. 494702 from Certified Steel Treating Corporation for the shaft of the MP08 6x19 WD pump, ASTM A-479, dated August 22, 2011
- Certificate of Conformance No. 4623 from Seacast Inc. for the impeller of the MP08 6x19 WD pump, ASTM A-487 CA6NM-A, dated May 18, 2011
- Certified Material Test Report (CMTR) No. 114432 from Arcos Industries, LLC for Gas Tungsten Arc Welding (GTAW) filler metal, grade 308/308L, dated September 28, 2010
- CMTR No. 120530 from Arcos Industries, LLC for SAW filler metal, grade 308/308L, dated July 25, 2011
- CMTR from Flowserve for a bearing housing foot casting made of ASTM A-351 grade CF8M material, heat No. SDCB, lot No. RWNA07330, ASME Section III, Class 2, Division 1, 2001 Edition, dated February 18, 2013
- Liquid Penetrant (PT) NDE inspection report for the rotor assembly of the MP08 6x19 WD Centrifugal Normal Residual Heat Removal Pump, ASME Code, Section III, Class 3, for Vogtle Electric Generating Plant, Unit 3, dated December 12, 2011
- Magnetic Particle (MT) NDE inspection report for the impeller casting of the MP08 6x19 WD pump, dated June 8, 2011
- Mechanical Test Certificate No. FLO021-07-19-34837-1 from Element, dated August 4, 2011
- Procedure Qualification Record (PQR) No. P-4115 for Submerged Arc Welding (SAW), dated March 15, 1994
- PQR No. P-2598 for SAW, dated May 13, 1987
- PQR No. P-2557 for GTAW, dated July 15, 1986
- PQR No. P-2167 for GTAW, dated October 15, 1981

- PT NDE inspection report for the impeller casting of the MP08 6x19 WD pump, dated September 17, 2011
- PT NDE inspection report for the shaft of the MP08 6x19 WD pump, dated November 8, 2011
- PT NDE inspection report for the stuffing box forging of the MP08 6x19 WD pump, dated July 2, 2012
- PT NDE inspection report for the seal cooler assembly of the MP08 6x19 WD pump, dated January 30, 2012
- Ultrasonic Testing (UT) NDE inspection report for the pump shaft of the MP08 6x19 WD pump, dated September 28, 2011
- Visual Testing Inspection Report for a pump shaft for Waterford Steam Electric Station, Unit 3, dated April 5, 2017
- Welding Procedure Specification (WPS) No. 1544, "Fabrication and Repair Welding Gas Tungsten Arc Welding Process P-8 Austenitic Stainless Steel," Revision F, dated April 4, 2017
- WPS No. 1040, "Fabrication and Repair Welding Gas Tungsten Arc Welding Process P-8 Austenitic Stainless Steel," Revision D, dated April 4, 2017
- WPS No. 1053, "Fabrication and Repair Welding SAW Machine Process P-8 to P-8 (Austenitic Stainless Steel), Revision O, dated July 26, 1990
- WPS No. 1055, "Fabrication and Repair Welding Machine SAW Process P-Number 8 to P-Number 8 (725F PWHT), Revision O, dated February 24, 1995

#### Calibration, Heat Treatment, Non-Destructive Examination, Inspection and Test Records

- Calibration Report, Gauge Repair Service – Report No. 52273.001, dated October 16, 2017
- Calibration Service Request, Gauge Repair Service – Request No. 1544, dated October 4, 2017
- Certificates of Calibration
  - Cylinder Standard Plug 1.0" – dated September 25, 2017
  - Durometer Shore – dated September 25, 2017
  - Digital Durometer – dated September 25, 2017
- Inspection Report for Product order RLSA30008 for Gasket, 026/.036 THK., dated October 23, 2017
- Inspection Report for Product order RLSA30008 for Gasket, 026/.036 THK., September 29, 2017
- Inspection Report for Product Order RLSA29723 for Pin, Spring, Slotted, dated May 11, 2017

#### Purchase Orders, Audit Reports, and Commercial-Grade Surveys

- Commercial-Grade Survey of Integrated Quality Services, dated November 12, 2015
- Commercial-Grade Survey of Valley Metal Treating, Inc., dated September 21, 2017
- FLS Audit Report No. 2017-017 of Askew Industrial, audit performed July 11-12, 2017
- FLS QMO Annual Assessment Audit conducted on January 31, 2017, through February 1, 2017 (Audit No. 201-009) – Askew Industrial
- FLS Vernon NPO Facility Specific Approved Vendors List (AVL), dated October 17, 2017

- FLS Vernon NPO Facility Specific AVL, Non-Safety Related (QL5) and Service Suppliers, dated October 17, 2017
- NIAC Audit Report No. 19012 (NAC No. 14-E-04) of Technetics Group LLC, audit performed June 30, 2014 - July 1, 2014
- NIAC Audit Report No. 19074 of Truesdail Laboratories, audit performed February 11, 2014
- NIAC Audit Report No. 22034 (DMP audit 17-007), dated July 25, 2017 of Element Huntington Beach
- NIAC Audit Report No. 22038 of Applied Technical Services Inc., audit performed January 23-27, 2017
- NPO Approved Vendors List (AVL), Suppliers of Product for QL-1 Code and QL-3, Safety Related Classifications, dated July 31, 2017
- Purchase Order (PO) No. 02299142 from Florida Power & Light Company (St. Lucie Plant) to Flowserve for a reactor coolant pump seal, Revision 5, dated May 2, 2014
- PO No. 00330412 from Entergy Northwest (Columbia Generating Station) to Flowserve for a centrifugal pump, ASME Section III Class 2, Revision 4, dated November 19, 2010
- PO No. 00538646 from Exelon Generation Company (Dresden Generating Station) to Flowserve for a reactor recirculation pump, ASME Section III Class 1, Revision 0, dated December 30, 2014
- PO from Flowserve to
  - Accolade Engineering Solutions – PO No. RLLU09109, dated August 27, 2014 (testing services)
  - Applied Technical Services Inc. – PO No. RLLA27527, dated July 24, 2015
  - Dayton Foundry – PO No. RLLU0160, Revision 4, dated December 29, 2012
  - Dayton Foundry – PO No. RLLU01883, Revision 4, dated February 16, 2011
  - Effort Foundry – PO No. RLLA26068, dated May 24, 2012
  - Element – PO No. RLLA28349, dated October 23, 2017
  - Element - PO No. RLLU02679, dated July 18, 2011
  - Element - PO No. RLLU02882, dated August 10, 2011
  - Flowserve Korea – PO No. RLLU11008, Revision 0, dated March 22, 2017
  - Flowserve Korea – PO No. RLLU11008, Revision 3, dated August 23, 2017
  - Garlock Sealing Technologies, – PO No. RLLU10569, dated May 24, 2016
  - Paramount Forge – PO No. RLLZ01559, dated August 2, 2017
  - Technetics Group Columbia – PO No. RLLA28177, Revision 0, dated January 27, 2017
  - Technetics Group Columbia – PO No. RLLA28177, Revision 2, dated February 15, 2017
  - Transcat – PO No. RLLU11309, dated October 5, 2017
  - Truesdail Laboratories – PO No. RLLZ01078, dated October 5, 2016
  - Truesdail Laboratories – PO No. RLLZ01080, dated October 5, 2016

#### Nonconformance Reports

- Charlotte - 9810, 9812, 9839
- Vernon - 22055, 22057, 22063, 22064, 21922, 21922, 22009

### Corrective Action Reports (CARs)

- 204452, 247119, 249532, 266912, 280912, 285012, 287792, 300412, 308852, 309072, 311973, 314312, 314413, 315072, 329114, 329712, 325594, 327892, 328192, 330135, 331932, 331874, 332112, 332374, 332392, 334292, 337232, 340953, 342523, and 343496

### Corrective Action Reports Opened During the NRC Inspection

- 352052, 352252, 352452, 352492, and 352553

### Training Records

- 156RLCU00089, "Job Specific Requirements," Revision B, dated March 14, 2012
- 156RLCU00087, "Job Specific Requirements," Revision D, dated June 13, 2012
- Flowserve NPO-ENF-01, "Registered Professional Engineer Qualification Review Record," Revision 00, dated September 30, 2017
- NDE Level II Qualification and Certification Records for James Green Jr. for MT/PT
- NDE Level II Qualification and Certification Records for Carlos Acosta for MT/PT
- NDE Level III Qualification and Certification Records for Thomas Mullen for RT/PT/MT/UT/VT
- NDE Level III Qualification and Certification Records for Charles Matthews for RT/PT/MT/UT/VT
- Re-certifications for Inspection and Test Personnel
  - John Ao, dated March 10, 2017
  - Camilo Galzote, dated June 17, 2015
  - Gabriel Carrillo, dated March 6, 2017
- Welder Qualification Records (WQRs) for GTAW for Jesus Zambrano, dated January 2, 2013, and September 4, 2014, respectively
- WQR for SAW for Jesus Zambrano, dated June 30, 1977
- WQRs for GTAW for Willis Antonio, 6G Large Diameter Pipe, dated January 2, 2013
- WQRs for GTAW for Willis Antonio, 6G Small Diameter Pipe/Tube, dated October 8, 2015

### Miscellaneous

- Element Huntington Beach Quality Assurance Manual, Edition 2 Revision 2, dated January 5, 2016
- Root Cause Analysis Summary Report, "Incorrect Impeller Trim: 28KXL ESW/RHRSW Pumps for Exelon, Limerick Station," dated March 8, 2013
- Vendor Status Memo for BRG Machinery Consulting, dated September 27, 2016
- Work Order RLSA29723 for Item 10330739, Pin, Spring, Slotted, dated April 4, 2017
- Work Order RLSA30008 for Item 10124116, Gasket .026/.036 THK, dated August 1, 2017