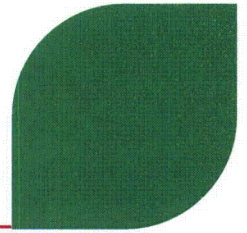


ATTACHMENT 2

CONFIRMATION OF STRESS RELIEF FOR ONS-1, ONS-2, ONS-3, AND CR3 CORE
SUPPORT SHIELD UPPER FLANGE WELDS
(ANP-3208P, R0)

[NON-PROPRIETARY]



**Confirmation of Stress Relief for ONS-1, ONS-2, ONS-3, and CR-3 Core Support
Shield Upper Flange Welds**

ANP-3208NP
Revision 0

March 2013

AREVA NP Inc.

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ANP-3208NP

Revision 0

Confirmation of Stress Relief for ONS-1, ONS-2, ONS-3, and CR-3
Core Support Shield Upper Flange Welds

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Table 3-1: B&W RV Internals Fabricators 3-3

Nomenclature

Acronym

Definition

B&W	Babcock and Wilcox
CE	Combustion Engineering
CR-3	Crystal River Unit 3
CSS	Core Support Structure
MIPO	Manufacturing Process and Inspection Outline
MRP	Materials Reliability Program
NSSS	Nuclear Steam Supply System
ONS-1	Oconee Nuclear Station Unit 1
ONS-2	Oconee Nuclear Station Unit 2
ONS-3	Oconee Nuclear Station Unit 3
PWR	Pressurized Water Reactor
QADP	Quality Assurance Data Package
RCS	Reactor Coolant System
RV	Reactor Vessel

1.0 INTRODUCTION

The Materials Reliability Program (MRP) developed inspection and evaluation guidelines in MRP-227-A [1] for managing long-term aging of reactor vessel internals components of pressurized water reactors (PWRs). These guidelines contain mandatory and needed requirements and an implementation schedule for Babcock & Wilcox (B&W) nuclear steam supply systems (NSSSs) currently operating in the United States. The guidelines also contain applicant/licensee action items that shall be addressed by applicants/licensees who choose to implement the NRC approved version of MRP-227.

The fourth of these applicant/licensee action items is for the applicants/licensees of currently operating B&W NSSS units to confirm that the core support structure (CSS) upper flange weld was stress relieved during the original fabrication of the reactor vessel (RV) in order to confirm the applicability of MRP-227, as approved by the NRC, to their facility. If the stress relief was not performed, applicants/licensees must inspect this component as a "Primary" inspection category component consistent with the recommendations in MRP-227, as approved by the NRC, for the Westinghouse and Combustion Engineering (CE) upper core support barrel welds.

The purpose of this report is to address the above action item.

2.0 SUMMARY

A records search was conducted to confirm that the CSS upper flange weld in the RV internals was stress relieved during original fabrication of the four Duke Energy B&W units. For ONS-1, which was fabricated by B&W, the detailed, signed and dated, step-by-step fabrication records of interest were readily available. The majority of the RV internals for ONS-2, CR-3, and ONS-3 were fabricated by Allis-Chalmers and these detailed fabrication records were not found. However, some alternative information (B&W QADPs, B&W Specifications, Allis-Chalmers document packages, and B&W approved Allis-Chalmers process outlines) was located and used to evaluate the stress relief performed following the welds of interest for those units assembled by Allis-Chalmers.

Based on the records search reported in the following sections, the CSS upper flange weld for the ONS-1, ONS-2, CR-3, and ONS-3 RV internals was thermally stress relieved [] during original fabrication.

3.0 RECORDS SEARCH

The double U-Groove, double V-Groove, and J-Groove welds listed in MRP-189, Rev. 1 [2] Table 4-2 were reviewed. The welds from this table selected for this records search are large structural vertical or circumferential seam welds and large nozzle welds.

After the welds were selected, applicable drawings were reviewed to gain possible fabrication sequence history and the records for the applicable mark (MK) and assembly numbers were searched. The MK numbers were obtained from the appropriate design drawings and confirmed by review of the appropriate fabrication records. In some cases, the quality assurance data package (QADP) provided additional insight into the MK numbers as well.

The fabrication records at the AREVA Lynchburg Old Forest Road facility were reviewed. The search focused on the actual weld fabrication sequences and any post-weld stress relief performed on the welds of interest. The goal of the search was to find the detailed fabrication process sheets that show signed and dated evidence of completed process steps. Additionally, any QADPs, specifications, or process outlines of interest were searched.

3.1 *RV Internals Fabricators*

The RV Internals for one of the four Duke Energy B&W units (ONS-1) was fabricated by B&W in Barberton, OH, and the other three (ONS-2, CR-3, and ONS-3) were mostly fabricated by Allis-Chalmers in York, PA.

The fabrication of the ONS-2 RV internals started in Barberton and included the CSS upper flange circumferential seam weld. The partial assemblies were then shipped to Allis-Chalmers for completion.

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The welds and subsequent stress relief of interest in this document are performed in preliminary and intermediate processing steps. However, during the time the RV internals were fabricated, some components and/or assemblies were switched from one contract to another, as the examples discussed above show. The B&W QADPs and Allis-Chalmers document packages were used to verify the final assembly containing welds and stress reliefs referenced in the detailed process sheets from preliminary and intermediate processing steps.

Table 3-1 provides a summary of the preceding paragraphs.

Table 3-1: B&W RV Internals Fabricators

B&W Contract Number for NSSS	Unit Description	[]	Primary Fabricator
620-0003	Oconee Unit 1 (ONS-1)	[]	B&W
620-0004	Oconee Unit 2 (ONS-2)	[]	Allis-Chalmers
620-0007	Crystal River Unit 3 (CR-3)	[]	Allis-Chalmers
620-0009	Oconee Unit 3 (ONS-3)	[]	Allis-Chalmers

3.2 RV Internals fabricated by B&W

Detailed signed and dated fabrication process sheets for the complete ONS-1 RV internals and several ONS-2 RV internals components were located within the microfilm rolls at the AREVA Lynchburg Old Forest Road facility. These records are summarized below as follows:

- ONS-1: The welds investigated in this records search, including the CSS Upper Flange weld, are confirmed to have been thermally stress relieved

[]

- ONS-2: Several ONS-2 welds performed by B&W at Barberton, including the CSS upper flange weld. These preliminary assemblies were shipped to Allis-Chalmers for completion of the ONS-2 RV Internals.

3.3 RV Internals Fabricated by Allis-Chalmers

As shown in Table 3-1, the RV internals for ONS-2, ONS-3, and CR-3 were generally fabricated at Allis-Chalmers in York, PA.

[

] The detailed fabrication

process sheets (signed and dated step-by-step records) for the Allis-Chalmers manufactured RV internals were not found at the AREVA OFR facility. An extended search in other locations for these records, including contacting a successor company of Allis-Chalmers, turned up no additional information. Alternative sources regarding the Allis-Chalmers fabrication are the following: B&W QADPs and Specifications and Allis-Chalmers data packages and Manufacturing Process and Inspection Outlines (MIPOs).

3.3.1 ***B&W Quality Assurance Data Packages and Specifications***

The B&W QADPs for the RV internals for ONS-2, ONS-3 and CR-3 were located and reviewed.

A letter of certification contained in the QADP for the CR-3 RV internals certifies the RV internals meet the 9/20/73 revision of the equipment specification, CS-3-23. Section 6.9 of this equipment specification contains a requirement that the residual stresses in every welded component be equalized and reduced to a minimum by one of the following methods: 1) heat treatment [

] or

2) vibratory stress equalization. After residual stresses have been equalized and reduced to a minimum and during machining every effort is made to minimize producing additional residual stress in the components. The CS-3-23 record of revision shows that the 9/20/73 revision of CS-3-23 was the first revision to permit the use of vibratory stress relief.

A letter of certification contained in the ONS-3 QADP for the RV internals certifies the RV internals meet the 11/11/71 revision of the equipment specification, CS-3-23. This revision of CS-3-23 was not found in this records search, nor is it listed in the record of

revision for the 9/20/73 revision of CS-3-23. However, an 11/1/71 revision of specification CNC-3-23 was located and reviewed. CNC-3-23 is an equipment specification for RV internals specific to the sublet relationship between Allis-Chalmers and B&W. CNC-3-23 appears to have the same content as CS-3-23 but is worded specifically to Allis-Chalmers. Thus, the reference to an 11/1/71 revision of CS-3-23 may be a misprint. The 11/1/71 revision of CNC-3-23 specifies a post weld heat treatment [] but permits Allis-Chalmers to substitute a vibratory stress equalization treatment upon acceptance and approval by B&W of a satisfactory procedure for vibratory treatment.

The B&W QADP for the ONS-2 RV internals does not contain certain information related to original fabrication, such as a letter certifying conformance to a given equipment specification. A 9/30/73 revision of CS-3-23 specific to ONS-2 does exist; it contains the same requirements related to stress relief as that discussed for CR-3 above.

Both of these specifications (9/30/73 revision of CS-3-23 and 11/1/71 revision of CNC-3-23) require the reactor internals manufacturer to provide suitable process standards and procedures for all manufacturing and quality control operations, including component stress equalization treatment procedures.

3.3.2 Allis-Chalmers Manufacturing and Inspection Process Outline and Document Packages

The Allis-Chalmers document packages for the RV internals for ONS-2, ONS-3, and CR-3 were located on microfilm and reviewed. The Index for the ONS-2 Allis-Chalmers document package is typical of those for ONS-3 and CR-3:

Section I	Certificate of Compliance and Certification
Section II	Base Material Identification and Material Test Certificates
Section III	Outline of Welds and Filler Material Certifications
Section IV	Welding Procedures and PQ's
Section V	UT, PT and RT Procedures
Section VI	Cleaning Procedure
Section VII	Heat Treat Procedure
Section VIII	Repair Procedures

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Section IX	Description of How Variations Are Implemented
Section X	Variations
Section XI	Furnace Charts
Section XII	Certified As-Built Drawings
Section XIII	General Arrangement Drawings - Reference Section II

In each of the three Allis-Chalmers data packages, Sections IV through VIII contain B&W approved procedures for each specific weld, for various non-destructive testing techniques, for cleaning, and for thermal stress relief. This is consistent with the CS-3-23 and CNC-3-23 requirement to provide suitable process standards and procedures for all manufacturing and quality control operations. Of worthy note: there is no mention in any of the three Allis-Chalmers document packages of a vibratory stress relief procedure.

Section VII of the three document packages contains Procedure MP-364, Revision 2 "Stress Relief of Welded Stainless Steel Reactor Internals -- Low Temperature" This procedure was approved by B&W on 3-12-71 and covers stress relief heat treatment of stainless steel components []. The procedure includes instructions for stress relieving seven components: the core barrel, thermal shield, plenum cylinder, flow distributor, core support shield, plenum cover, and lower grid assembly. The drawings attached to this procedure specify thermocouple locations for each of these components.

Sections XI through XIII are not included on the rollfilm with the Allis-Chalmers data packages, with one exception: the ONS-3 Allis-Chalmers data package identifies a list of furnace charts for the seven components listed in the previous paragraph, but only contains two unique furnace charts, both of which reference MP-364, Rev. 2. The first chart is for the ONS-3 core support shield and plenum cover assemblies, and the second chart is for the CR-3 core support shield assembly and the ONS-3 plenum cylinder assembly. These charts record a heat treatment [] for these components. No other stress relief furnace charts were found in this records search.

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The Allis-Chalmers MIPO for NSSS internals (Procedure MP-367) gives applicable procedures, general requirements, and process outlines for the ONS-2, ONS-3 and CR-3 RV internals. The MIPO is not used as the detailed shop process, but it is the B&W review and approval document for the Allis-Chalmers manufacturing work. The complete MP-367 procedure as of 8/10/70, plus partial revisions dated up to 3/31/71 represent the latest known version of the MIPO approved by B&W on 4/7/71. The MIPO shows that each of the welds investigated in this records search, including the CSS upper flange weld, were to be thermally stress relieved []. There is no mention of vibratory stress relief in the latest known B&W approved MIPO.

3.3.3 Summary of Records for RV Internals Fabricated by Allis-Chalmers

As discussed in Section 3.3.1, the B&W QADPs for the CR-3 and ONS-3 RV internals certify conformance to CS-3-23, the RV internals equipment specification. A version of CS-3-23 specific to ONS-2 exists, but an RV internals equipment specification is not mentioned in the ONS-2 QADP. CS-3-23 requires either thermal or vibratory stress relief accompanied by B&W approved procedures. As discussed in Section 3.3.2, the Allis-Chalmers data packages for ONS-2, ONS-3, and CR-3 include the B&W approved procedure for thermal stress relief [] (MP-364, Revision 2) and a limited number of furnace charts. There is no record of vibratory stress relief procedures in the Allis-Chalmers data packages. The B&W approved MIPO for ONS-2, ONS-3, and CR-3 prescribes thermal stress relief per MP-364 following all the welds selected in this records search. There is no mention of vibratory stress in the B&W approved MIPO.

Based on these records, the CSS upper flange welds for ONS-2, ONS-3 and CR-3 are concluded to have been thermally stress relieved [].

4.0 REFERENCES

1. Materials Reliability Program: Pressurized Water Reactor Internals Inspection and Evaluation Guidelines (MRP-227-A). EPRI, Palo Alto, CA: 2011. 1022863.
2. Materials Reliability Program: Screening, Categorization, and Ranking of B&W-Designed PWR Internals Component Items (MRP-189-Rev. 1). EPRI, Palo Alto, CA: 2009. 1018292.