



UNITED STATES  
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

October 9, 2007

Mr. Michael D. Lees, President  
Babcock & Wilcox Canada  
581 Coronation Blvd.  
Cambridge, Ontario  
Canada N1R 5V3

SUBJECT: NRC INSPECTION REPORT 99900067/2007-201, NOTICE OF VIOLATION,  
AND NOTICE OF NONCONFORMANCE

Dear Mr. Lees:

On August 27-30, 2007, U.S. Nuclear Regulatory Commission (NRC) completed an inspection at the Babcock & Wilcox Canada (BWC) facility in Cambridge, Ontario, Canada. The enclosed report presents the results of that inspection.

This was a limited scope inspection which focused on assessing your compliance with the provisions of Part 21 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 21), "Reporting of Defects and Noncompliance," and selected portions of Appendix B to 10 CFR Part 50, "Quality Assurance Program Criteria for Nuclear Power Plants and Fuel Processing Plants." This NRC inspection report does not constitute NRC endorsement of your overall quality assurance or Part 21 programs.

During this inspection, it was found that the implementation of your quality assurance program failed to meet certain NRC requirements which are discussed in the enclosed Notice of Violation (NOV), Notice of Nonconformance (NON), and NRC Inspection Report. Specifically, a review of BWC's 10 CFR Part 21 implementation identified that BWC did not adopt appropriate procedures to evaluate deviations and failures to comply associated with substantial safety hazards. The violation of 10 CFR Part 21 is cited in the enclosed NOV and the circumstances surrounding the NOV are discussed in the enclosed report. Please note that you are required to respond to this letter and should follow the instructions in the enclosed NOV when preparing your response. The NRC will use your response, in part, to determine whether further enforcement action is necessary to ensure compliance with regulatory requirements.

In addition, the NRC inspectors identified that the implementation of your quality assurance program failed to meet certain NRC requirements imposed on you by your customers. Specifically, BWC personnel failed to adequately implement procedure guidance for contract changes and welding operations associated with replacement reactor vessel closure head (RRVCH) activities. Finally, BWC's procedures did not adequately address implementation of a corrective action or nonconformance system. These nonconformances are cited in the enclosed NON, and the circumstances surround them are described in the enclosed report. You are requested to respond to the nonconformances and should follow the instructions specified in the enclosed NON when preparing your response.

In accordance with 10 CFR 2.390 of the NRC's "Public inspections, exemptions, requests for withholding," of 10 CFR Part 2, "Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders," a copy of this letter, its enclosures and any associated correspondence will

M. D. Lees

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be placed in the NRC's Public Document Room (PDR) or from the NRC's document system (ADAMS), accessible from the NRC Web site 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.

Sincerely,

**(/RA by P. L. Hiland)**

Patrick L. Hiland, Director  
Division of Engineering  
Office of Nuclear Reactor Regulation

Docket No. 99900067

Enclosures:

1. Notice of Violation
2. Notice of Nonconformance
3. Inspection Report No. 99900067/2007-201

M. D. Lees

- 2 -

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Sincerely,

*(/RA by P.L. Hiland)*

Patrick L. Hiland, Director  
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## NOTICE OF VIOLATION

Babcock & Wilcox Canada  
581 Coronation Blvd.  
Cambridge, Ontario, Canada N1R 5V3

Docket Number 99900067  
Inspection Report Number 2007-201

Based on the results of a Nuclear Regulatory Commission (NRC) inspection conducted August 27-30, 2007, at Babcock & Wilcox Canada (BWC), a violation of NRC requirements was identified. In accordance with the NRC Enforcement Policy, the violation is listed below:

10 CFR Part 21, Section 21.21, "Notification of failure to comply or existence of a defect and its evaluation," paragraph 21.21(a), requires, in part, each individual, corporation, partnership, or other entity subject to 10 CFR Part 21 shall adopt appropriate procedures to (1) evaluate deviations and failures to comply associated with substantial safety hazards as soon as practicable.

Contrary to the above, as of August 30, 2007:

BWC's 10 CFR Part 21 implementing procedure QOP-004, "Reporting of Defects and Noncompliance," Revision 4, dated August 14, 2007, was not appropriate in that it did not provide procedural guidance for the interface of the corrective action and nonconformance reporting processes with the Part 21 program to ensure effective identification and evaluation of deviations and failures to comply associated with a substantial safety hazard.

This issue has been identified as Violation 99900067/2007-201-01.

This is a Severity Level IV violation (Supplement VII).

Pursuant to the provisions of 10 CFR 2.201, "Notice of Violation," BWC is hereby required to submit a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555-0001, with a copy to the Director, Division of Engineering, Office of Nuclear Reactor Regulation, within 30 days of the date of the letter transmitting this Notice of Violation. This reply should be clearly marked as a "Reply to a Notice of Violation" and should include: (1) the reason for the violation, or, if contested, the basis for disputing the violation; (2) the corrective steps that have been taken and the results achieved; (3) the corrective steps that will be taken to avoid further violations; and (4) the date when full compliance will be achieved. Your response may reference or include previous docketed correspondence, if the correspondence adequately addresses the required response. Where good cause is shown, consideration will be given to 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 Agency-wide Documents Access and Management System (ADAMS), to the extent possible, it should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. 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

**ENCLOSURE 1**

request withholding of such material, 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 safeguards information is necessary to provide an acceptable response, please provide the level of protection, described in 10 CFR 73.21.

Dated at Rockville, Maryland this 9<sup>th</sup> day of October 2007.

## NOTICE OF NONCONFORMANCE

Babcock & Wilcox Canada  
581 Coronation Blvd.  
Cambridge, Ontario, Canada N1R 5V3

Docket Number 99900067  
Inspection Report Number 2007-201

Based on the results of a Nuclear Regulatory Commission (NRC) inspection conducted August 27-30, 2007, of activities performed at Babcock & Wilcox Canada (BWC), it appears that certain activities were not conducted in accordance with NRC requirements which were contractually imposed upon BWC by NRC licensees.

- A. Criterion V, "Instructions, Procedures, and Drawings," of Appendix B to 10 CFR Part 50, states in part that, "Activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings."

Section 4.6 of BWC Operating Procedure MOP-082, Revision 11, "Preparation and Issuance of CIS [Contract Information Sheet] for Nuclear Contracts," states in part that, "Upon receipt of a customer approved NCC [Notification of Contract Change], the PM [Project Manager] shall initiate an internal review, if necessary, of the NCC and any associated documentation. It shall be the PM's responsibility to notify departments of pending changes and to act according to the needs of the department. The PM shall issue a CIS revision, within one month reflecting the agreed change."

Section 6.2.6 of BWC Shop Instruction Sheet [SIS] 259695, Revision 1, "ICI [Incore Instrumentation] and CRDM [Control Rod Drive Mechanism] to RPV [Reactor Pressure Vessel] Reactor Head Welding," states in part that, "upon completion of an entire machine buttering layer, the layer is to be ground and visually examined by the operator for any cracking. If no cracking is observed by the operator, machine buttering of the next layer may proceed. If any cracking is observed, the operator is to log the pocket number in the daily log book, inform shop supervision and flag that pocket as not to be buttered until the cracking has been ground removed and PT [penetrant test] inspected to verify removal. After any cracks have been ground removed and PT inspected to verify their removal, machine buttering of the next layer may proceed."

Contrary to the above:

1. BWC did not revise the CIS within one month following approval of NCC No. 142J-020, Revision 1, "PT Buttering Each Layer 7 Last Pockets."
2. Welding operators excessively ground completed buttering layers to an extent that all visible indications were removed prior to inspection. Therefore, PTs were not always performed to verify cracking removal in accordance with Section 6.2.6.

These issues have been identified as Nonconformance 99900067/2007-201-02.

**ENCLOSURE 2**

- B. Criterion XVII, "Quality Assurance Records," of Appendix B to 10 CFR Part 50, states in part that, "Sufficient record shall be maintained to furnish evidence of activities affecting quality. Inspection records shall, as a minimum, identify the inspector or data recorder, the type of observation, the results, the acceptability, and the action taken in connection with any deficiencies noted."

Section 6.2.6 of BWC Shop Instruction Sheet SIS 259695, Revision 1, "ICI and CRDM to RPV Reactor Head Welding," states in part that, "upon completion of an entire machine buttering layer, the layer is to be ground and visually examined by the operator for any cracking. If no cracking is observed by the operator, machine buttering of the next layer may proceed. If any cracking is observed, the operator is to log the pocket number in the daily log book, inform shop supervision and flag that pocket as not to be buttered until the cracking has been ground removed and PT inspected to verify removal. After any cracks have been ground removed and PT inspected to verify their removal, machine buttering of the next layer may proceed."

Contrary to the above, for Job 142J, Work Order No. 854852, for the Palisades replacement reactor vessel closure head, BWC personnel were unable to produce penetrant test reports that verified flaw removal of all identified flaws, as required by Section 6.2.6 of SIS 295695. The inspectors identified several other cracks to BWC that required entry into the Daily Log Book.

This issue has been identified as Nonconformance 99900067/2007-201-03.

- C. Criterion V, "Instructions, Procedures, and Drawings," of Appendix B to 10 CFR Part 50, states in part that, "Activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings. Instructions, procedures, or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished."

Contrary to the above:

1. BWC did not have procedures to implement a corrective action system.
2. BWC did not have procedures to implement a nonconformance control system.

These issues have been identified as Nonconformance 99900067/2007-201-04.

Please provide a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, D.C. 20555-0001, with a copy to the Director, Division of Engineering, Office of Nuclear Reactor Regulation, 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: (1) a description of steps that have been or will be taken to correct this item; (2) a description of steps that have been or will be taken to prevent recurrence; and (3) the dates your corrective action and preventive measures

were or will be completed. Where good cause is shown, consideration will be given to 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 Agency-wide Document Access and Management System (ADAMS), to the extent possible, it should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. ADAMS is accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. 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 withholding of such material, 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 safeguards information is necessary to provide an acceptable response, please provide the level of protection, described in 10 CFR 73.21.

Dated at Rockville, Maryland this 9<sup>th</sup> day of October 2007.



**U.S. NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR REACTOR REGULATION  
DIVISION OF ENGINEERING**

**VENDOR INSPECTION REPORT**

Report No: 99900067/2007-201

Organization: Babcock & Wilcox Canada  
581 Coronation Blvd  
Cambridge, Ontario  
Canada N1R 5V3

Vendor Contact: Mr. William Huson, Quality Assurance Manager  
Babcock & Wilcox Canada  
581 Coronation Blvd.  
Cambridge, Ontario  
Canada N1R 5V3  
(519) 621-2130

Nuclear Industry: Babcock & Wilcox Canada (BWC) designs and manufactures large components for the nuclear industry. BWC provides these components to the current US fleet of nuclear reactors as replacement components.

Inspection Dates: August 27-30, 2007

Inspection Team Leader: Paul Prescott, DE/NRR

Inspectors: Richard P. McIntyre, DCIP/NRO  
Milton Concepcion Robles, DCIP/NRO

Technical Specialist: Jay Collins, DCI/NRR

Approved By: *(/RA by D. F. Thatcher)* *10-04-2007*  
Dale F. Thatcher Date  
Quality & Vendor Branch  
Division of Engineering (DE)  
Office of Nuclear Reactor Regulation (NRR)

## 1.0 INSPECTION SUMMARY

The purpose of this inspection was to review selected portions of the quality assurance (QA) and 10 CFR Part 21 (Part 21) controls that Babcock and Wilcox Canada (BWC) has established and implemented. Specifically, the inspectors focused on BWC's manufacturing activities associated with the replacement reactor vessel closure heads (RRVCHs) for Oconee Nuclear Station, Units 1, 2, and 3 (Oconee); R. E. Ginna Nuclear Power Plant (Ginna); Calvert Cliffs Nuclear Power Plant, Units 1 and 2 (Calvert Cliffs); and Palisades Plant (Palisades). The Palisades RRVCH was the only one still at the facility. The inspection was conducted at BWC's facility in Cambridge, Ontario, Canada. The NRC inspection bases were:

- Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to Part 50 of Title 10 of the *Code of Federal Regulations*,
- 10 CFR Part 21, "Reporting of Defects and Noncompliance," and
- 10 CFR 50.55a, "Codes and Standards."

### 1.1 VIOLATIONS

Violation 99900067/2007-201-01 was identified and is discussed in Section 3.1 of this report.

### 1.2 NONCONFORMANCES

- Nonconformance 99900067/2007-201-02 was identified with two examples and is discussed in Section 3.3 and 3.4 of this report.
- Nonconformance 99900067/2007-201-03 was identified and is discussed in Section 3.4 of this report.
- Nonconformance 99900067/2007-201-04 was identified with two examples and is discussed in Section 3.5 of this report.

## 2.0 STATUS OF PREVIOUS INSPECTION FINDINGS

There were no recent previous NRC inspections performed at BWC's facility in Cambridge, Ontario, Canada, prior to this inspection.

## 3.0 INSPECTION FINDINGS AND OTHER COMMENTS

### 3.1 10 CFR PART 21 PROGRAM

#### a. Inspection Scope

The inspectors reviewed BWC's policy and procedures governing the 10 CFR Part 21 program to ensure those guidelines provided an adequate description of the process and implemented the requirements described in 10 CFR Part 21, "Reporting of Defects and Noncompliance."

b. Observations and Findings

b.1. Part 21 Program

The inspectors reviewed the QA program requirements and implementing procedures governing BWC's Part 21 program to verify that the guidance was consistent with the requirements described in Part 21. The inspectors reviewed BWC's process to determine if it adequately outlined the requirements for identification, evaluation, and reporting of significant conditions adverse to quality.

Procedure QOP-004, titled "Reporting of Defects and Noncompliance," Revision 4, established the process and responsibilities for the reporting of defects and noncompliance under Part 21. The procedure established measures for the evaluation of identified deviations, timeliness guidance to comply with the reporting requirements of Part 21, and record retention controls. The procedure stated that nonconforming conditions found during fabrication are to be documented using the Nonconformance Report (NR) system. In addition, the procedure stated that if a deviation is identified after a basic component is shipped, a notification shall be made to the Director Operational Excellence and Quality in writing or verbally.

The inspectors discussed BWC's Part 21 program with the Director Operational Excellence and Quality and with the Manager Nuclear Quality Programs, and inquired as to how a nonconformance identified as a condition adverse to quality in an NR, a corrective action request (CAR), or audit finding, would be evaluated under the Part 21 program. The inspectors determined that QOP-004 did not contain adequate provisions for the evaluation of deviations and failures to comply associated with substantial safety hazards for issues identified in BWC's quality processes such as CARs, audit findings (internal and external), and root cause analyses. In addition, the inspectors could not find guidance to determine if a significant condition adverse to quality identified in the NR system warranted a Part 21 evaluation. Therefore, the inspectors found that BWC's Part 21 program did not adopt appropriate procedures pursuant to 10 CFR 21.21(a) for evaluating deviations and failures to comply to determine if they could be associated with a substantial safety hazard. This issue has been identified as Violation 99900067/2007-201-01.

b.2. 10 CFR Part 21 Program Implementation

The inspectors reviewed several Part 21 evaluations to determine whether BWC had implemented a program consistent with the requirements described in Part 21. The inspectors noted that the sampled Part 21 evaluations were not consistent with the requirements of QOP-004. For example, some of the NRs that were originated to address the deviations and included as an attachment to the Part 21 evaluations lacked information on the disposition and required signatures. Additionally, there were some Part 21 evaluations with no NR attached or referenced. The inspectors questioned the Manager Nuclear Quality Programs and the Director Operational Excellence and Quality regarding this matter, and they informed the inspectors that the original signed NRs are maintained in each individual project file and are not duplicated for the Part 21 file. The BWC managers also stated that the inspectors' concern would be addressed in

response to this observation to ensure consistency among evaluations. The inspectors found BWC's suggested corrective actions to be adequate.

The inspectors also noted that BWC had not generated Part 21 reports during the past 2 years. After conversations with BWC management, the inspectors learned that most of BWC's activities were contracts for Canadian utilities that do not require evaluation of deviations in accordance with Part 21.

c. Conclusions

The inspectors determined that BWC's Part 21 program implementation was generally acceptable with one exception. The exception was a violation of Part 21 for the lack of procedural guidance for the interface of the CAR and NR processes with the Part 21 program to ensure effective identification and evaluation of deviations or failures to comply associated with substantial safety hazards. This issue is identified as Violation 99900067/2007-201-01.

3.2 ORGANIZATION

a. Inspection Scope

The inspectors reviewed BWC's Quality Assurance Manual (QAM), Revision 33 and implementing policies and procedures governing BWC's organizational structure.

b. Observation and Findings

Section 3.0, "Organization," of the QAM described the organizational structure, functional responsibilities, authority and lines of communication for personnel performing activities affecting quality.

Organization Chart # 7 identified that the Quality Control (QC) Manager reports directly to the General Manager of Operations and indirectly reports (dotted line) to the Director of Operational Excellence and Quality. Appendix B to 10 CFR 50, Criterion I, "Organization," states, in part that persons and organizations performing quality assurance functions shall have sufficient authority and organizational freedom to identify quality problems; to initiate, recommend, or provide solutions; and to verify implementation of solutions. Such persons and organizations performing quality assurance functions shall report to a management level such that this required authority and organizational freedom, including sufficient independence from cost and schedule when opposed to safety considerations, are provided.

The inspectors discussed with BWC management the organizational reporting structure of the QC Manager reporting directly to the General Manager of Operations. The inspectors questioned if the individual ultimately has the required authority and organizational freedom, including sufficient independence from cost and schedule when opposed to safety considerations in this reporting structure when addressing quality issues. The BWC management stated that the QC Manager does not report directly to the Manager of Manufacturing and thus they believe that sufficient independence from cost and schedule when opposed to safety considerations is maintained. The inspectors

acknowledged this point, but further stated that typically a QC Manager does not report directly to Operations to maintain this level of independence.

To address the inspectors' observation, BWC committed to describe in Section 3.4, "Areas of Interface," of the QAM that the QC Manager has the organizational freedom of going directly to the Director of Operational Excellence and Quality if situations arose that would challenge the QC Manager's ability to maintain organizational freedom, including sufficient independence from cost and schedule while reporting to the General Manager of Operations. The inspectors found BWC's suggested corrective action to be adequate.

c. Conclusions

The inspectors concluded that the BWC organization and reporting structure met the requirements of Appendix B to 10 CFR Part 50, Criterion I, "Organization." However, a clarification as described above, will be included in Section 3.0, "Organization," of the QAM on the reporting structure of the QC Manager directly reporting to the General Manager of Operations and indirectly reporting to the Director of Operational Excellence and Quality.

3.3 INSTRUCTIONS, PROCEDURES AND DRAWINGS GOVERNING RRVCH ACTIVITIES

a. Inspection Scope

The inspectors reviewed the BWC policies and procedures governing the implementation of the manufacturing process controls for the fabrication of the Palisades RRVCH. The scope of the review included the purchase order, and technical specification documents and drawings through the controlling work orders. Additionally, the inspectors reviewed the adequacy of BWC's implementation of the manufacturing control procedures, documents and drawings.

b. Observations and Findings

b.1 Contract Information Sheets

The inspectors reviewed the design and manufacturing requirements for the Palisades RRVCH. Under a customer purchase order, Westinghouse developed the Palisades "Design Specification for Replacement Reactor Vessel Closure Head (RRVCH)." This document essentially formed the basis for the "Technical Specification Request for Quote No. 20190," that was developed to support the resolution process of exceptions and clarifications for the procurement of the RRVCH. BWC project management subsequently developed and issued the Contract Information Sheets (CISs) that contained information related to the design and manufacturing contract requirements and identified all applicable contract documents. Project management uses input from Engineering in the form of certified design specifications to develop the CISs. The CISs also document all accepted contractual changes identified as a Notification of Contract Change (NCC). The inspectors reviewed BWC's operating procedure MOP-082, Revision 11, which described the controls for contract information and governed the CIS document. Paragraph 4.6 of MOP-082, stated in part that it was the project manager's

(PM's) responsibility to notify departments of pending changes and to act according to the needs of the department. The PM shall issue a CIS revision within one month reflecting the agreed change. The inspectors reviewed the NCC log. The inspectors noted that NCC 142J-020, "PT Buttering Each Layer 7 Last Pockets," had been approved in October 2006. The NCC stated that for the remaining seven pockets, each layer of buttering shall be examined and shall meet the liquid penetrant test (PT) acceptance criteria of American Society of Mechanical Engineers (ASME) Code Section III, NB-5350, in addition to meeting this criteria on the final machined surface of all buttering welds. However, at the time of this inspection, the CIS had not been revised to reflect this contract change. This issue is identified as one example of Nonconformance 99900067/2007-201-02.

b.2 Work Order Process and Controls

The inspectors reviewed Section 11.0, "Process Control," Revision 21 of the BWC QAM, which described the control processes at BWC to assure that activities affecting quality are performed in accordance with documented instructions, procedures, or drawings. The Work Order (WO) is the master BWC document for controlling and documenting the performance and status of manufacturing operations. This includes the sequence of operations; the description of each operation; identification of applicable drawings, procedures, and instructions to be followed; identification of all inspections, identification of witness, and hold points; signature or initials or an identification stamp plus date stamp for inspection, witness, documentation, and hold points; and the final completion signature to support documentation of the fabrication history.

The WO is prepared by an individual designated as the WO writer using the Fabrication Outline furnished by the Manufacturing Engineer, the Inspection and Test Plan furnished by the Quality Engineering Coordinator, engineering documents furnished by the Project Engineer, and the computer document control history, which is maintained by the Supervisor Project Services and Document Control. The WO writer is also responsible for determining the applicable Weld Procedure Specifications (WPSs), with input, as required, from the welding engineers. The WO writer inserts the appropriate Authorized Nuclear Inspector (ANI) and customer hold, witness or documentation points identified on the Inspection and Test Plan.

Development of the WO was described in BWC's Operating Procedure, MOP-015, "Creation and Revision of Work Orders." This procedure described what documents are used in creating WOs, including drawings, the Inspection and Test Plan, Shop Instruction Sheets, and the Manufacturing Outline. The manufacturing sequence is established using the Manufacturing Outline. Manufacturing Engineering develops the Manufacturing Outline using the general arrangement drawings. Finally, the WO packages are released for fabrication after the Manager Manufacturing Engineering has determined that the WO has been reviewed for adequacy and independently verified and documented.

b.3 Implementation of RRVCH Working Documents

The inspectors reviewed WO 854852, "Closure Head Initial Machining for the Palisades RRVCH," and its associated design drawing number, 142JE101. The inspectors also

sampled personnel entries in the WO, "Inspection and Test Plan (Nuclear) for the Palisades Closure Head Initial Machining and Assembly," dated November 13, 2006, and the Palisades "Fabrication Outline for Closure Head," dated September 21, 2006.

The inspectors reviewed specific WO actions related to operation 0490, "Prepare, Clean, and Butter," for the Palisades RRVCH. The inspectors verified that various levels of weld buttering activities for the 53 pockets on the Palisades RRVCH had been documented, via initials of the welding operator, for each specific control rod drive mechanism (CRDM) pocket. Nonconformance Reports, NR 29875, NR 29882, and NR 29905 and their accompanying Shop Instruction Sheets (SISs) were reviewed and the inspectors determined that all identified actions had been performed, including the appropriate documentation of the inspections and hold points.

Revision 1 of SIS 259657, "Visual Examination Standard for Welds," Revision 1, dated June 6, 2005, defined the requirements and methods used to perform visual examinations of welds. Section 10.0, "Reporting," of the SIS required the results of visual examinations be documented on the WO at the operation describing the welds to be examined. The acceptability of the welds, date of examination, and the inspector's stamp or signature was recorded for the WO operation. However, the ASME Code does not require this formal visual examination of each buttering layer for J-groove welds. The Palisades WO does reference SIS 259657. However, SIS 259657 was not implemented for the Palisades RRVCH buttering layers, since it was not required by the ASME Code.

c. Conclusions

Through review of the Palisades WO 854852, and the supporting documents and records, the inspectors concluded that quality activities performed to support the various work practices reviewed for the fabrication of the Palisades RRVCH were performed in accordance with the BWC QAM and applicable implementing procedures and instructions. However, the inspectors identified a failure to revise the Palisades CIS to reflect an approved change. This issue was one example of Nonconformance 99900067/2007-201-02.

3.4 CONTROL OF SPECIAL PROCESSES – RRVCH WELDING

a. Inspection Scope

The inspectors reviewed information related to BWC's contracted duties in the production of the RRVCH welds for Calvert Cliffs and Palisades. The materials reviewed included WOs, SISs, welder logs, nonconformance reports and training check lists. The inspectors also conducted interviews with BWC personnel. Additionally, BWC staff and management provided presentations of their activities associated with RRVCH welds.

An RRVCH is essentially comprised of one main forged piece with various fixtures attached. Within the reactor coolant pressure boundary, holes are drilled for various penetration nozzles to be installed for control rod drive mechanisms, reactor instrumentation and head vents. These penetration nozzles are cold shrink fit, inserted through the holes in the RRVCH, and then welded with a partial penetration J-groove

weld to establish the reactor coolant pressure boundary. Prior to the installation of the penetration nozzles, each hole is bored out of the head on the inside surface to support application of the weld. A buttered layer of weld material is deposited on the bored out head surface to act as an interface between the weld and the low alloy steel material of the RRVCH.

b. Observations and Findings

b.1. Buttering Weld Layer of Reactor Vessel Closure Heads

The inspectors' interviews and review of materials identified the following information associated with the identification of flaws in the buttering weld layer of RRVCHs for Calvert Cliffs and Palisades.

By NR 27449, dated February 18, 2004, BWC identified transverse cracking found in welds during buttering operations for the Calvert Cliffs Unit 1 RRVCH. The corrective action for NR 27449 was to modify the RRVCH weld buttering sequence. Upon completing an entire machine buttering layer, the layer was to be visually examined by the weld operator for any transverse cracking. If any transverse cracking was observed, the operator was to log the pocket number in the daily log book, inform the shop supervision, and flag that pocket as not to be buttered any further until observed by Weld Development. If no transverse cracking was visually observed by the weld operator, the entire layer was to be aggressively ground and again visually inspected by the weld operator for transverse cracking. If no visual transverse cracking was observed by the weld operator either on the "as welded surface" or after aggressive grinding, machine buttering of the next layer may proceed. If Weld Development was contacted, they would have recorded all, if any, visually observed transverse cracking. After Weld Development had recorded any visually observed transverse cracking, the transverse crack(s) would have been ground removed suitable for machine buttering and a PT performed and accepted prior to proceeding to the next machine buttering layer.

The NR 27449 was documented during the welding of the second layer of buttering on the first Calvert Cliffs RRVCH under WO 842184 for Project Number 104JRV1710MA. Revision 8 of the WO, issued on February 18, 2004, included a visual observation requirement to resolve NR 27449. The NR 27449 was resolved on May 17, 2004, and signed off complete by the licensee. The inspectors identified no discrepancies in this process and found no issues with the welding of the Calvert Cliffs Unit 1 RRVCH. The second Calvert Cliffs RRVCH was done under WO 843498 and Project Task Number 104JRV2710MA. The WO 843498 referenced use of SIS 259174, "ICI [Incore Instrumentation] and CRDM to RPV [Reactor Pressure Vessel] Reactor Head Welding and Repairs," Revision 0, dated December 12, 2003. Revision 1 of SIS 259174, dated March 16, 2004, was issued in part, to address NR 27449. Specifically, Section 6.2.6 was updated to state that upon completion of an entire machine buttering layer, the layer is to be ground and visually examined by the weld operator for any transverse cracking. If no transverse cracking is observed by the weld operator, machine buttering of the next layer may proceed. If any transverse cracking is observed, the weld operator was to log the pocket number in the daily log book, inform shop supervision and flag that pocket as not to be buttered until the cracking has been ground removed and PT inspected to verify removal. After any transverse cracks have been ground removed and PT



inspected to verify their removal, machine buttering of the next layer may proceed. Revision 2 of SIS 259174 was issued on June 30, 2004, with no changes for Section 6.2.6.

On March 31, 2004, WO 843498 (Calvert Cliffs Unit 2) was revised to require a second weld operator or shift weld supervisor to inspect each layer, as an independent check, with a magnifying glass (2 or 5 times magnification) after grinding to ensure no more cracks are present. The independent checker was to progressively sign the data sheet upon each layer inspection along with the original weld operator sign off. The inspectors identified no discrepancies in this process and found no issues with the welding of the Calvert Cliffs Unit 2 RRVCH.

Revision 0 of SIS 259695, "ICI and CRDM to RPV Reactor Head Welding and Repairs," dated February 23, 2006, for the Palisades RRVCH was the procedure for butter layer deposition. Revision 0 of SIS 259695 contained the same butter weld layer visual inspection requirements (Sections 6.2.6 and 6.3.1) as used in the procedure for Calvert Cliffs Unit 2, (Revision 2 of SIS 259174). However, unlike the WO for Calvert Cliffs Unit 2, the Palisades WO was not revised to include this visual inspection requirement until March 30, 2006. By request of the licensee, Revision 1 of SIS 259695, dated February 24, 2006, changed the requirement for the weld operator to visually examine the layer for any visually identified cracking. Revision 2 of SIS 259695, dated April 4, 2006, had no changes from Section 6.2.6 of Revision 1. Section 6.3.1 called for the repeating of the procedure step 6.2.6 for each new layer.

By a letter dated February 24, 2006, the licensee reviewed and accepted for use without comments Revision 1 of SIS 259695. This SIS at the time contained the only requirements for the inspection of buttered weld layers for the Palisades RRVCH, as the WO had not been revised. The inspectors noted that the SIS and WO contained fewer requirements than those pertaining to Calvert Cliff's RRVCH buttered weld layers.

On March 30, 2006, due to concerns raised by Palisades personnel, NR 29905 was issued and included in the Palisades WO 854852 to require that all remaining layers of weld buttering on the balance of the RRVCH have a visual examination performed at five times magnification by an independent welder or shop supervisor. If any linear indications were identified, work on the area was to be stopped and shop supervision notified. Work would not be allowed to continue without additional instruction.

Initial work stopped on the welding of the buttering layer for the Palisades RRVCH on May 12, 2006 and restarted on November 22, 2006 and then stopped again on December 5, 2006.

The inspectors found through review of materials and interviews with BWC personnel that the visual inspection implemented for the buttering weld layer process on the Palisades RRVCH was adequate to identify transverse cracking. However, as detailed below, BWC's expectations of verification by the weld operator to perform an inspection and document the inspection results in accordance with the procedure were not as clear.

b.2 Implementation of the Welding Procedures

The inspectors reviewed BWC implementation of the visual inspection requirements of Section 6.2.6 of SIS 259695 by BWC personnel. The inspectors focused on whether sufficient records were maintained to furnish evidence of activities affecting quality.

Section 6.2.6 of SIS 259695, states in part that, the weld buttering layer is to be ground and visually examined by the operator for any cracking, and if any transverse cracking is observed, the operator is to log the pocket number in the daily log book, inform shop supervision and flag that pocket as not to be buttered until the cracking has been removed by grinding and PT inspected to verify removal.

The Daily Log Book for Job 142J, WO 854852, for the Palisades RRVCH contains records of welder comments starting on February 26, 2006 through December 5, 2006. Through this time period, approximately 390 log entries were made. Only one log entry was made concerning cracking found by visual examination. A BWC Shop Supervisor that worked on the Palisades head project recalled in an interview verifying butter weld layer cracks in accordance with Section 6.2.6. He estimated that he verified more than 20 such flaws. In accordance with Section 6.2.6, once a weld operator identified a butter weld layer crack, along with notifying the Shop Supervisor the weld operator should log the pocket number in the Daily Log Book and that pocket is not to be buttered until the cracking has been removed by grinding and PT inspected to verify removal.

The inspectors identified a failure to update the Daily Log Book with all visually identified flaws found by inspection as required by Section 6.2.6 of SIS 259695. Further, the inspectors noted that BWC was unable to produce PT reports to verify flaw removal for all identified flaws. This issue is identified as Nonconformance 99900067/2007-201-03.

The inspectors interviewed the BWC Welding Technologist that developed Section 6.2.6 to gather information about the performance expectation of the procedural step. However, in another interview with a BWC Shop Supervisor, the inspector noted discrepancies about when a visual inspection would be performed and how it would be logged in the Daily Log Book between the two individuals. Section 6.2.6 requirements were not as specific when compared to previous visual inspection requirements documented in the WO for Calvert Cliff's RRVCH.

The inspectors interviewed a BWC Weld Operator who worked on the Palisades RRVCH. The weld operator described that the Section 6.2.6 visual inspection was to be performed after all grinding was complete on a weld layer. The weld operator noted surface defects were visually identifiable on many welds before grinding. The weld operator would then grind the surface of the weld layer to remove all visual indications. On average, the weld operator stated that he is required to remove approximately 30 percent of the weld layer. The weld operator stated that he would go beyond the estimated 30 percent material removal if a flaw was still visible. Once he had completed all grinding, he would do a visual inspection with a magnifying glass to look for any cracks in accordance with Section 6.2.6 of SIS 259695. The weld operator noted when he performed this visual inspection that no cracks were identified on any weld layer he inspected.

The inspectors identified a failure of BWC weld operators to follow the requirements of Section 6.2.6 of SIS 295695. If, as performed by weld operators working on the Palisades head, grinding was performed until all visual evidence of cracking was removed from the weld layer surface to any depth, then the visual examination for cracking after the grinding operation was complete would find no flaws. Section 6.2.6 stated the layer was to be ground and visually examined by the operator for any cracking. This issue is identified as one example of Nonconformance 99900067/2007-201-02.

The inspectors found that the grinding step described in Section 6.2.6 would be reasonably interpreted to be grinding to a sufficient depth to remove the oxide layer and prep for welding. Removal of 30 percent or more of the weld layer necessary for the removal of all visible flaws goes beyond a general grinding procedure to prep a weld surface for the next layer to be applied. Further, the statement in Section 6.2.6 to "ground remove" flaws, if identified, implied a difference in intended grinding operations. The inspectors found the weld operator's definition of grinding to go beyond oxide layer removal, to a point of flaw removal was incorrect given the wording of Section 6.2.6. Grinding to remove a flaw should reasonably imply, as stated in Section 6.2.6, a step to perform a PT inspection to verify flaw removal.

c. Conclusions

The inspectors determined through a review of welding and inspection activities associated with the production of the butter weld layers for the Calvert Cliffs and Palisades RRVCHs that BWC is in accordance with the requirements of ASME Code.

However, the inspectors identified that BWC personnel did not adequately maintain the Daily Log Book by recording inspection results for visually identified weld flaws, as required by Section 6.2.6 of SIS 295695. This issue is identified as Nonconformance 99900067/2007-201-03.

The inspectors also identified that weld operators did not properly conduct grinding activities prior to visual inspections in accordance with the requirements of Section 6.2.6 of SIS 295695. This issue is identified as one example of Nonconformance 99900067/2007-201-02.

3.5 CORRECTIVE ACTION PROGRAM

a. Inspection Scope

The inspectors reviewed the policies and procedures governing the implementation of BWC's corrective action program, and reviewed a sample of corrective actions. Specifically, the inspectors reviewed the procedures governing the implementation of BWC's corrective action process to assure that those procedures provided an adequate description of the corrective action process and implementation of program requirements and that they were consistent with the requirements of Appendix B to 10 CFR Part 50, Criterion XVI, "Corrective Action."

b. Observations and Findings

b.1 Policies and Procedures Governing Corrective Actions

Section 18.6, "Corrective Action," of the BWC QAM described the requirements for the implementation of a corrective action system. Section 18.6 of the QAM contained provisions for the identification of conditions adverse to quality, evaluation and resolution of such conditions, and development of supporting documentation. The QAM stated that any personnel detecting conditions adverse to quality shall notify the Manager Nuclear Quality Programs or the Manager Nuclear Services Quality Programs or the Director Operational Excellence & Quality. These managers are responsible for evaluating the condition and initiating any necessary corrective action by issuing a QA CAR. The CAR should identify the condition adverse to quality, the cause of the condition, action to be taken to correct the condition, action taken to prevent recurrence, and estimated completion date. Upon completion of the approved corrective action plan, the QAM stated that the responsible manager provides documentation demonstrating the completed action to the QA department. The Manager Nuclear Quality Programs or the Manager Nuclear Services Quality Programs is the contact for receipt of CARs from external sources (customers, regulatory authorities). These managers maintain a log of CARs received from external sources and track their receipt, follow-up, reply and closeout to verify the effectiveness of the corrective action.

The inspectors reviewed selected CARs generated as a result of activities associated with BWC's fabrication processes. All of the sampled corrective actions were in the process of being evaluated at the time of the inspection, and documented as required in Section 18.6 of the QAM. The inspectors did not identify any outstanding issues with the open CARs.

The inspectors requested the implementing procedure governing BWC's corrective action program. After conversations with the Director of Operational Excellence and Quality and the Manager Nuclear Quality Programs, the inspectors learned that BWC does not have a procedure to implement the requirements of Section 18.6 of the QAM. The inspectors learned that specific requirements for the BWC corrective/preventive action system are described and implemented directly from the QA Manual. The NRC inspectors determined that, although guidance was provided in Section 18.6 of the QAM for the identification of conditions adverse to quality and corrective actions taken to prevent recurrence, in accordance with Criterion V of Appendix B to 10 CFR Part 50, these activities were not prescribed and accomplished in accordance with documented procedures.

To verify adequate implementation of the corrective action system, the inspectors discussed with BWC the process for tracking issues and concerns raised as a result of external audits. This is an activity required to be implemented as stated in Section 18.6 of the QAM. After discussions with BWC's management, the inspectors learned that BWC does not enter issues or deviations identified by external sources into the corrective action system. As an example, the inspectors discussed with the Director Operational Excellence and Quality and with the Manager Nuclear Quality Programs the corrective actions taken as a result of the March 2007 Palisades audit. The managers

stated that audit findings resulting from external audits are not currently captured into the existing CAR system.

The inspectors determined that the corrective action system implemented by BWC is not prescribed by documented procedures as required in Criterion V of Appendix B to 10 CFR Part 50. In addition, the inspectors determined that the lack of an adequate procedure prevents BWC from implementing its corrective action system in a way that ensures prompt identification and correction of significant conditions adverse to quality in order to preclude recurrence. This issue has been identified as one example of Nonconformance 99900067/2007-201-04.

The inspectors also reviewed Section 16, "Nonconformance Control," of the QAM. The guidance provided in Section 16 of the QAM included the basic activities associated with identification of nonconformances for deficiencies in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. The QAM provided specific guidance for the receipt of material without adequate documentation, and provided controls for the identification and disposition of nonconformances. However, the inspectors noted that, as with the case of the corrective action system, BWC does not have procedural guidance to implement the requirements of Section 16 of the QAM. Specific requirements for the BWC nonconformance control system are described and implemented directly from the QA Manual. The inspectors determined that this is an activity affecting quality that, per Criterion V of Appendix B to 10 CFR Part 50, shall be prescribed and accomplished in accordance with documented procedures. This issue has been identified as one example of Nonconformance 99900067/2007-201-04.

The inspectors noted that the CAR form and the NR form do not include provisions to identify and screen for Part 21 applicability and evaluation. This issue is documented in Section 3.1 of this Inspection Report.

The inspectors were informed during this inspection that the corrective action system is in the process of being replaced with an electronic process. In addition, the inspectors learned that BWC management will conduct procedural revisions to reflect such changes.

## b.2 Management Review of Corrective Actions

Section 18.7, "Trend Evaluation and Management Assessment," of the BWC QAM required that management should perform monthly reviews of NRs to identify any adverse trends, and provided for the generation of corrective action reports to address such adverse trends as deemed necessary. Specifically, the QAM stated that the Manager Nuclear Quality Programs or the Manager Nuclear Services Quality Programs is responsible for reviewing nonconformance reports, rework reports, internal audit reports, (performed by ASME or customers), and QA corrective action reports monthly to determine any major problem areas and trends of conditions adverse to quality. Monthly reports are issued to the General Manager and responsible managers.

The inspectors reviewed the 2004, 2005, and 2006 Monthly Management Meeting Reports to gain an understanding of how BWC's management review of the NRs was

implemented, and to confirm that BWC was performing an analysis of NRs as required by Section 18.7 of the QAM. The BWC management reviews are conducted monthly as a means of identifying areas for continued improvement and assessing the current adequacy of the NR, Rework Reports, internal audit reports, and CAR programs. The reports were assembled by the Manager Nuclear Quality Programs and sources of information used in the report included, but were not limited to, analysis of NR data, internal audits, and individual observations. The inspectors noted that each report contained an analysis of current NRs and recommendations for addressing any identified adverse trends. The inspectors found this to be a comprehensive document that provided adequate insight for management performance trending. No issues were identified.

b.3 Corrective Actions Associated with RRVCH Weld Buttering

The inspectors performed a review of BWC's corrective action activities for the fabrication of the RRVCHs for Calvert Cliffs and Palisades. The inspectors focused on the J-groove weld pocket buttering activities. Specifically, the inspectors reviewed BWC's response to transverse cracks in the buttering that were first observed in the Calvert Cliff's RRVCH. No evidence of transverse cracks was observed during the fabrication of the first four RRVCHs (Oconee and Ginna). The inspectors reviewed the potential safety significance of the transverse cracks.

Weld buttering is done to replace material removed from the RRVCH in order to accurately place a CRDM or ICI penetration prior to the J-groove weld and replacement of any cladding. Depending on the location for the CRDM/ICI penetration on the RRVCH more or less material may have to be removed. The slope of the RRVCH had a major effect on material removal. For the Calvert Cliffs RRVCH, BWC and the licensee conducted a joint review of the problem. The suspected mechanism for the occurrence of the cracks was that thermal strain in the weld metal exceeded the material property limit during the cooling process. However, no definitive welding variable could be specifically attributed to the cracking.

The transverse cracks were observed only on the sloped CRDM/ICI locations where partial weld beads were deposited. Metallurgical examinations were done from four samples, as follows:

- One material sample from 2 RRVCH buttered pockets,
- One material sample from a mock-up, and
- One material sample where a weld layer was deposited over a transverse crack.

Metallurgical examinations showed that the surface transverse cracks stopped at a grain boundary. Crack depths of 0.021", 0.022", 0.048", and 0.037" were measured based on the material samples. A visual examination was sensitive enough to detect transverse cracks to a depth of 0.021" or deeper. To address the transverse cracks, several actions were taken. Surface grinding prior to the next weld buttering pass was performed. Industry experience had shown that removal of the oxide layer was required to ensure a good weld in multi-pass welds with Inconel filler metals. The welder performed a visual examination for transverse cracks. Any identified cracks were removed by grinding and verified by PT examination. The next weld buttering pass would remelt part of the

previously deposited weld layer. Machining of the final buttering layer was followed by a PT examination, as required by Section III of the ASME Code.

In the case of Palisades, the RRVCH pocket buttering was stopped by the licensee after the buttering was complete on 46 of 53 pockets and the first buttering layer was complete or partially complete on the remaining seven pockets. The inspectors noted that the SIS included visual inspections to detect transverse cracks and grinding for removal of visually detected transverse cracks and final verification of removal by PT.

Liquid penetrant indications on a buttering layer that was acceptable to the visual examinations performed to SIS requirements led to licensee concerns that the weld process may leave embedded transverse cracks in the buttering. As a note, the PT process is more sensitive to detect an indication in a weld than a visual examination.

BWC did not issue a nonconformance report (NCR). BWC management stated that an NCR was not issued for the Palisades buttering weld issue. BWC management believed the issue was addressed by the NCR for Calvert Cliffs. However, BWC determined to perform another evaluation to address the licensee's concerns. The evaluation involved a review of previous RRVCH experience on transverse cracks, a buttering mock-up block, and if compliance to ASME Code Section III welding and examination requirements were met. The buttering mock-up block was sectioned and metallurgical examinations were conducted at locations identified by PT indications. No embedded cracks were identified at sections of identified PT indications. The metallurgical examination identified defects that included lack of fusion which was not detected by the PT examination and intergranular microfissures. The defects were documented and characterized for orientation and size. All defects were determined to be acceptable for the service life of the RRVCH. BWC from the mockup block examination determined the following:

- No embedded cracks at the surface transverse crack location were found.
- Other volumetric defects not detected by the PT were identified by metallurgical examination. The lack of fusion and grain boundary microfissures were found to be acceptable by engineering evaluation.
- No microfissures penetrated the base material.
- The weld process and associated inspections for buttering welds were determined to be in compliance with ASME Section III.
- The buttering weld process and associated inspections were found to result in acceptable welds.

c. Conclusions

The inspectors determined that BWC, in concert with the licensees, had proposed multiple corrective actions to address weld buttering layer cracking. However, the inspectors identified two examples of a failure to implement procedures. The examples were for the corrective action and nonconformance reporting systems. These examples

were identified as Nonconformance 99900067/2007-201-04. Implementation of the proposed corrective action is addressed in other sections of this inspection report.

#### **4.0 MANAGEMENT MEETINGS AND PERSONNEL CONTACTED**

##### **4.1 ENTRANCE AND EXIT MEETINGS**

In the entrance meeting on August 27, 2007, the inspectors discussed the scope of the inspection, outlined the areas to be inspected, and established interfaces with BWC's Director of Operational Excellence and Quality and several staff personnel. During the exit meeting on August 30, 2007, the inspectors discussed the inspection findings and observations with BWC's President and staff.

##### **4.2 PERSONNEL CONTACTED**

M. Lees	President, BWC
J. MacQuarrie	General Manager, BWC
L. Nielson	General Manager, Operations, BWC
C. Wilson	Director, Operational Excellence and Quality, BWC
W. Huson	Manager Nuclear Quality Programs, BWC
J. Bloomaert	Manager, Quality Control, BWC
M. Ajmani	Manager, Projects, Nuclear Equipment, BWC
D. Lee	Manager, Nuclear Engineering, BWC
D. Allingham	Factory Focus Manager, BWC

##### **4.3 OBSERVERS**

Members of the Canadian Nuclear Safety Commission (CNSC) requested and were allowed to participate as observers on the BWC inspection team. The CNSC members also attended the entrance and exit meetings.

P. Wong	Quality Management Specialist, CNSC
D. Papaz	Quality Management Specialist, CNSC