

# NRC INSPECTION MANUAL

IOEB

## OPERATING EXPERIENCE SMART SAMPLE (OpESS) 2018/01

### EVALUATION OF LICENSEE ACTIONS TAKEN IN RESPONSE TO 10 CFR PART 21 NOTIFICATION OF THE POTENTIAL EXISTENCE OF DEFECTS RELATED TO CONTROL ROD DRIVE MECHANISM (CRDM) THERMAL SLEEVES

CORNERSTONE:       BARRIER INTEGRITY  
                          MITIGATING SYSTEMS  
                          INITIATING EVENTS

#### APPLICABILITY:

- This voluntary OpESS applies to the domestic Westinghouse designed nuclear steam supply system (NSSS) licensed operating commercial nuclear reactors in Table 1, identified as Tier 1 per Westinghouse Electric Company (Westinghouse) Nuclear Safety Advisory Letter (NSAL) NSAL-18-1, "Thermal Sleeve Flange Wear Leads to Stuck Control Rod."
- These plants are also subject to the Westinghouse 10 CFR Part 21 Notification, dated May 23, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. [ML18143B678](#)), as supplemented by letter dated July 17, 2018 (ADAMS Accession No. [ML18198A275](#)).
- This OpESS supplements sample selection for Inspection Procedure (IP) 71152, "Problem Identification and Resolution."

Table 1. Tier 1 Plants with Original Vessel Heads

Plant/Unit	Region	Unit	Years Operating	Performed NSAL-18-1	Scheduled to Perform NSAL-18-1
A. W. Vogtle	2	1	31	Fall 2018	
		2	29		Yes, Spring 2019
Braidwood	3	1	30		Yes
		2	30	Spring 2017	
Byron	3	1	33	Spring 2017	
		2	31		Yes
Catawba	2	1	33		Yes, Fall 2018
		2	32	Spring 2018	
McGuire	2	1	37		Yes, Spring 2019
		2	34	Fall 2018	
Millstone	1	3	32	Fall 2017	Yes, Fall 2018
Seabrook	1	1	28		Yes

Plant/Unit	Region	Unit	Years Operating	Performed NSAL-18-1	Scheduled to Perform NSAL-18-1
Sequoyah 1 & 2	2	1	37		Yes, Fall 2019
		2	36		Yes, Fall 2018
Shearon Harris	2	1	31	Spring 2018	
Wolf Creek	4	1	33	RFO22	Yes/RFO23
Watts Bar	2	1	22		

OpESS 2018/01-01 OBJECTIVES

01.01 Provide support for initial baseline inspection activities in the area of Problem Identification and Resolution (IP 71152) for Westinghouse plants that were subject to the 10 CFR Part 21 Notification (ADAMS Accession Nos. [ML18143B678](#) and [ML18198A275](#)).

01.02 To verify that licensees are identifying and placing potential 10 CFR 21—REPORTING OF DEFECTS AND NON-COMPLIANCE issues into the Corrective Action Program (CAP) and appropriately evaluating them.

OpESS 2018/01-02 BACKGROUND

02.01 Operating Experience.

Wear on CRDM thermal sleeves was initially noted in 2007 at a Westinghouse designed plant, while performing vessel head penetration J-groove weld examinations (ADAMS Accession No. [ML072010014](#)). Similar wear was noted at other PWRs, consequently Westinghouse issued Technical Bulletin (TB), TB-07-2, “Reactor Vessel Head Adapter Thermal Sleeve Wear.” The bulletin suggested inspections of the outer two concentric rows of the CRDM housing. The wear indications on the thermal sleeves were located in the area where the thermal sleeve exits the CRDM head adapter tube. The wear was attributed to the thermal sleeve contacting the inside diameter of the CRDM head adapter tube due to flow-induced motion of the thermal sleeve. Thermal sleeve wear was also noted during the March 2013, Sequoyah’s License Renewal Aging Management Program Plant Audit (ADAMS Accession No. [ML13141A320](#)), and was further discussed in Sequoyah’s License Renewal Safety Evaluation (ADAMS Accession No. [ML15187A206](#)). Thermal sleeve wear was also noted during Byron and Braidwood license renewal application in 2014. As with the other operating experience the wear was detected while performing vessel head penetration J-groove weld examinations (ADAMS Accession No. [ML14169A026](#)). These early issues relating to CRDM thermal sleeve wear were essentially focused on the wear of the CRDM nozzles by the thermal sleeve centering tabs and wear on the outside diameter of the thermal sleeve.

On December 7, 2015, the Westinghouse vendor technical bulletin TB-07-2, Revision 3, "Reactor Vessel Head Adapter Thermal Sleeve Wear," identified a new thermal sleeve wear mechanism. Specifically, in 2014 two thermal sleeves at partial-length CRDM locations were found to be failed at the flange due to wear. One thermal sleeve fell from the closure head during inservice inspection (ISI) examination of the CRDM nozzle. The thermal sleeve fell due to the upper flange of the thermal sleeve separating and also due to the worn pocket of the CRDM adapter tube. The identified mechanism for this wear is applicable to all Westinghouse designed plants with CRDM thermal sleeves. The vendor recommended inspections of these new areas in conjunction with NRC mandated under head volumetric examinations of the CRDM nozzles.

On December 13, 2017 – Stuck Control Rod - Belleville-sur-Loire power station reactor number 2 caused by blockage of a control cluster caused by loose part from wear of thermal sleeve. Similar thermal sleeve wear observed at another French plant Saint-Alban power station reactor number 2. On February 14, 2018, Electricite de France (EdF) declared to the French Nuclear Safety Authority (ASN) a significant safety event common to two units.

On April 20, 2018, by letter No. MRP 2018-10, the PWR Materials Management Program (PMMP) Executive Committee provided a notification of recent reactor vessel (RV) closure head CRDM thermal sleeve wear operating experience (OpE).

On May 23, 2018, by letter No. LTR-NRC-18-34, Westinghouse provided a notification of the potential existence of defects pursuant to 10 CFR Part 21 (ADAMS Accession No. [ML18143B678](#)). The notification stated that in consideration of the most recent operating experience from EDF in France, the previous Westinghouse guidance may be non-conservative.

On July 17, 2018, by letter No. LTR-NRC-18-53, Westinghouse provided NRC additional information on the issue (ADAMS Accession No. [ML18198A275](#)). The letter provided Westinghouse's Nuclear Safety Advisory Letter (NSAL)-18-1, "Thermal Sleeve Flange Wear Leads to Stuck Control Rod," dated July 9, 2018, which transmitted additional information on the CRDM Thermal Sleeve Flange Wear.

On August 29, 2018, NRC issued Information Notice (IN) 2018-10, "Thermal Sleeve Flange Wear Leads to Stuck Control Rod at Foreign Nuclear Plant," to inform domestic nuclear plants about the recent operating experience related to Westinghouse-designed NPSS plants that have CRDM thermal sleeves (ADAMS Accession No. [ML18214A710](#)).

On August 31, 2018, by letter No. MRP 2018-027, Electric Power Research Institute (EPRI), Materials Reliability Program (MRP), transmitted NEI-03-08, "Guideline for the Management of Materials Issues," "Needed" Interim Guidance for the inspection of CRDM thermal sleeves at affected PWR plants. MRP 2018-027 transmitted interim guidance regarding the inspection of CRDM thermal sleeve flanges, based on the potential for this issue to result in a nuclear safety concern of non-functional control rods, and as discussed in the Westinghouse issued 10 CFR Part 21 Notification.

On September 5, 2018, EPRI MRP, by letter No. MRP 2018-033 (ADAMS Accession No. [ML18253A064](#)), EPRI MRP provided NRC with the most recent NEI-03-08 for information.

On September 27, 2018, NRC staff performed a risk-informed evaluation of the potential safety significance of the CRDM thermal sleeve wear issues at U.S. Westinghouse PWRs (ADAMS

Accession No. ML18249A081), for the plants noted in the Westinghouse 10 CFR Part 21 Notification. This evaluation was performed in accordance with the Office of Nuclear Reactor Regulation (NRR) Instruction LIC-504, Revision 4, "Integrated Risk-Informed Decision-Making Process for Emergent Issues," dated June 2, 2014. As a result of the risk-informed evaluation, the staff recommended to conduct a Smart Sample for a number of domestic Westinghouse PWR plants that were identified as most susceptible to this issue by the Westinghouse NSAL-18-1. This OpESS will allow the NRC staff to evaluate the information from specific plants, to determine whether the analyses presented in the NSAL-18-1 and the LIC-504 have an adequate degree of conservatism. Some of the information needed to make that determination will include: plant specific wear rates, inspection plans, mitigation plans, and supporting analyses.

## OpESS 2018/01-03      INSPECTION GUIDANCE

The following inspection guidance may be applied as appropriate to support the annual sample selection for baseline inspection activities under IP 71152, Sections 03.03, Annual Follow-up of Selected Issues and 03.05, Sample Selection Guidance. Inspector judgment should be used when determining the extent to which this OpESS should be used to inform inspection activities.

03.01 NSSS Vendor Guidance NSAL-18-1. The recently revised NEI 03-08 "Needed" Interim Guidance has certain inspection activities regarding the inspection of CRDM Thermal Sleeves for Westinghouse PWRs (ADAMS Accession No. ML18253A064). This interim revised guidance provides inspection for affected PWR plants as defined in Westinghouse's NSAL-18-1. Based on the potential for this issue to result in a nuclear safety concern of non-functional control rods, NEI 03-08 provides guidance to plants dependent on their effective full power year, as to when they should perform dimensional measurement and/or visual inspection as outlined in NSAL-18-1. Prior to performing measurements of flange wear, individual plants should establish measurement acceptance criteria to prevent thermal sleeve flange separation, and may use the acceptance criteria in PWROG-16003-P for assessing flange wear. Plants that are not in the PWROG can establish on a plant-specific acceptance criteria based on available plant design or as built information. The design distance between the thermal sleeve guide funnel and upper guide tube may be different from unit to unit. However, within an individual unit, the design distance, or the as built gap should be the same. Additionally, some licensees may also use a "nominal" value, if an as-built value for the initial reference point is not available. For these plants, subsequent measurements can be used to determine a plant specific wear rates. The Westinghouse NSAL-18-1 is publically available in ADAMS under Accession No. [ML18198A275](#). PWROG-16003-P is not publicly available, however the PWR Owners Group provided this document to NRC with a letter requesting it be withheld from public disclosure in accordance with 10 CFR 2.390b(4) (ADAMS Accession No. ML18283A937). For plants that are part of the PWR Owners Group a copy of this document should be available on site.

The guidance for this inspection follows the flowchart shown in Figure 1. This guidance is provided to help inspectors evaluate the effectiveness of licensee collective actions in response to NSAL-18-1. A description of the inspection and reporting expectations are as follows:

- a. Determine if the licensee performed initial inspections for CRDM thermal sleeve wear
  1. Did the licensee perform measurements of the lowering of all thermal sleeves using a method that is capable of determining the relative distance between a known reference point on the head and the bottom surface of the thermal sleeve guide funnel?

2. Was as-built information used for the reference point in determining the lowering values?
  3. If the following information is available and reviewed as part of the normal inspection sample, it should be appropriately marked (i.e., proprietary or non-proprietary) and provided to the program office (e.g., SharePoint, G: drive, or email), see sample template.
    - a) Acceptance criteria, and as built gap (or as designed gap)
    - b) Re-inspection frequency
    - c) Mitigation/Repair
    - d) CRDM location
    - e) As found wear
    - f) Wear rate
- b. Determine if the licensee's measurements exceed acceptance criteria
    1. Determine if licensee used acceptance criteria in PWROG-16003-P or plant specific criteria was used.
    2. If PWROG-16003-P was used, did licensee measurements from A. exceed acceptance criteria? If plant specific acceptance criteria was used, did licensee measurements from A. exceed the plant specific acceptance criteria?
  - c. Review the licensee developed mitigation or repair plans
    1. Review mitigation or repair plans to determine if licensee considered actions to ensure the plant remains consistent with their license renewal commitments. Specifically, has the licensee initiated actions to evaluate this issue for incorporation into License Renewal Programs that are credited for management of age related degradation that affects vessel internals components?
  - d. Evaluate documentation or deferral
    1. If the licensee did not perform the inspection in A., review the deferral documentation to determine if adequate basis exists for deferral.
    2. Determine if licensee's updated plans for inspection based on the deferral ensure the plant remains consistent with its license renewal commitments.
  - e. Review re-inspection frequency
    1. Did the licensee develop a re-inspection frequency based on the measurements and calculated wear rates from A. and any plant-specific data used to develop plant-specific acceptance criteria (as applicable from B.).
    2. Does the re-inspection frequency ensure the plant remains consistent with its license renewal commitments?
    3. Did the licensee develop a mitigation plan?

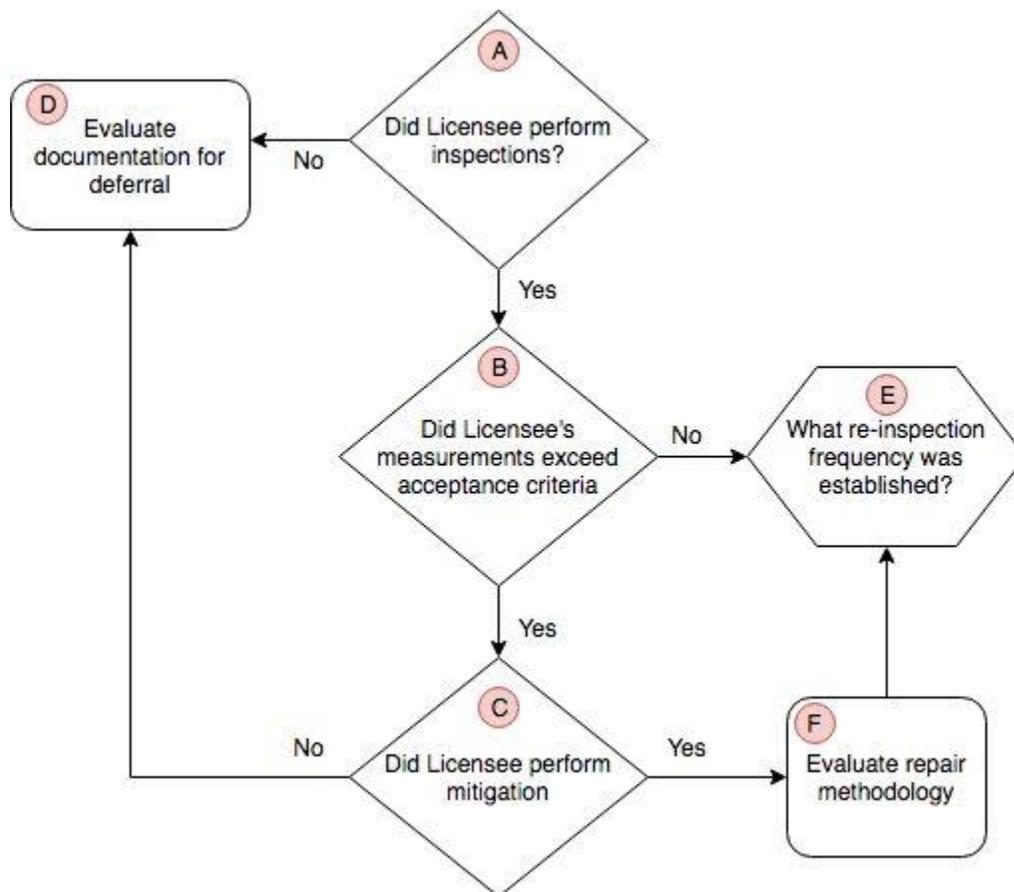


Figure 1.

Non-conservative decision-making and/or improper application of NSAL-18-1 and action requirements or deviations from the established interim Nuclear Energy Institute (NEI) guidance (ADAMS Accession No. ML18253A064) that may rise to the level of a performance deficiency should be documented in the report.

OpESS 2018/01-04 REFERENCES

These references may include pre-decisional information contained on NRC internal websites. Once the agency has formally evaluated an OpE issue and has determined that it meets the criteria for agency action, the NRC communicates the issue to the public and the industry through one or more appropriate methods (e.g., generic communication, rulemaking public comment periods, etc.).

04.01 Inspection Manual Chapters and Procedures

IP 71152, "Program Identification and Resolution."

04.02 Correspondence

NRC IN 2018-10, "Thermal Sleeve Flange Wear Leads to Stuck Control Rod at Foreign Nuclear

Plant,” August 29, 2018 (ADAMS Accession No. [ML18214A710](#)).

July 2007, Dominion Nuclear Connecticut, Millstone Power Station Unit 3, Results of the Reactor Pressure Vessel Head Inspections Required by NRC Order EA-03-009 (ADAMS Accession No. [ML072010014](#)).

June 2013, NRC “Aging Management Programs Audit Report Regarding the Sequoyah Nuclear Plant, Units 1 and 2” (ADAMS Accession No. [ML13141A320](#)), and SE Related to License Renewal of Sequoyah Nuclear Plant, Units 1 and 2, (ADAMS Accession No. [ML15187A206](#)).

June 2014, Exelon Generation Company, “Response to NRC Request for Additional Information, related to the Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2, License Renewal Application” (ADAMS Accession No. [ML14169A026](#)).

May 2018, Public Meeting with EPRI MRP “Materials Information Exchange,” Presentation describing recent operating experience for CRDM Thermal Sleeve Wear (ADAMS Accession No. [ML18142A395](#))

May 23, 2018, Westinghouse 10 CFR Part 21 Notification of the Potential Existence of Defects (ADAMS Accession No. [ML18143B678](#)).

July 17, 2018, Westinghouse Provides Additional Information not included in Part 21 Notification Dated May 23, 2018 (ADAMS Accession No. [ML18198A275](#)).

September 5, 2018, MRP 2018-033, Materials Reliability Program, Transmittal of NEI-03-08 “Needed” Interim Guidance for PWR CRDM Thermal Sleeve (ADAMS Accession No. ML18253A064), adjusts the initial inspection requirement from 25 to 20 EFPY, provides inspection guidance applicable to units with CRDM thermal sleeves installed in either original or replacement heads.

Westinghouse Technical Bulletin –TB-07-02, Revision 3, “Reactor Vessel Head Thermal Sleeve Wear,” December 7, 2015.

WCAP-16911-P, Revision 0, July 2008, “Reactor Vessel Head Thermal Sleeve Wear Evaluation for Westinghouse Domestic Plants,” provides disposition and prediction of Thermal Sleeve ID/OD wear.

PWROG-16003-P, Revision 1, August 2017, “Evaluation of Potential Thermal Sleeve Flange Wear,” provides acceptance criteria for thermal sleeve lowering due to wear and flange wear Prediction (ADAMS Accession No. ML18283A937).

#### OpESS 2018/01-05      REPORTING RESULTS/TIME CHARGES/ADDITIONAL ISSUES

If information from this OpESS is used to inform a baseline inspection sample, reference the OpESS number in the scope section of the report.

In addition, if any findings or violations are identified in conjunction with this OpESS, include a statement similar to the following in the description section of the finding write-up:

“This finding was identified in connection with a review of Operating Experience Smart Sample (OpESS) 2018/03.”

Inspection time for this OpESS is to be charged to the normal baseline procedure under which it is being used and the level of effort is expected to be within normal baseline inspection sample resource estimates.

Additional guidance: If licensee plant specific measurement data is collected and is reviewed in order to complete the inspection sample as noted in Section 03.03 of this OpESS, it should not be included in the IR. However the data should be appropriately labeled (i.e., Official Use Only and Proprietary Information) and provided to the Program Office on the [NRR/DMLR/MPHB Sharepoint Site](#).

The template below is provided for reference only. When sufficient data is available it will be used to update NRC’s [Reactor Operational Experience public website](#), under “CRDM Thermal Sleeve Wear.”

Template

Plant: _____		Unit No: _____			
Date/Refueling Outage Flange Wear Measurements Were Taken Per Westinghouse NSAL-18-01					
CRMD Location	As Found Wear	Acceptance Criteria	Wear Rate	Mitigated (M) Replaced (R)	Next Inspection

OpESS 2018/01-06 CONTACTS

For technical support regarding the performance of this OpESS and emergent issues, contact: Roger Kalikian (NRR/DMLR/MPHB) at 301-415-5590 or [Roger.Kalikian@nrc.gov](mailto:Roger.Kalikian@nrc.gov), or John Thompson (NRR/DIRS/IOEB) at 301-415-1011 or [John.Thompson@nrc.gov](mailto:John.Thompson@nrc.gov)

For administrative, reporting, or documentation questions, contact: Bridget Curran (NRR/DIRS/IRGB) at 301-415-1003 or [Bridget.Curran@nrc.gov](mailto:Bridget.Curran@nrc.gov).

Revision History for OpESS 2018/01

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional, Non-Public Information )
N/A	ML18263A261 11/19/18 CN 18-040	Initial issuance to provide support for initial baseline inspection activities in the area of Problem Identification and Resolution (IP 71152) for Westinghouse plants that were subject to the 10 CFR Part 21 Notification (ADAMS Accession Nos. <a href="#">ML18143B678</a> and <a href="#">ML18198A275</a> ).	N/A	ML18276A018