

February 1, 2016

MEMORANDUM TO: Kevin Hsueh, Chief  
Licensing Processes Branch  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

FROM: Victor G. Cusumano, Chief */RA/*  
Safety Issue Resolution Branch  
Division of Safety Systems  
Office of Nuclear Reactor Regulation

SUBJECT: AUDIT PLAN – PRESSURIZED WATER REACTORS OWNERS  
GROUP (PWROG) – AUDIT TO REVIEW THERMAL  
HYDRAULIC CODE CASES IN WCAP-17788-P (TAC NO.  
MF6536)

By letter dated July 17, 2015, PWR Owners Group (PWROG) submitted a licensing Topical Report intended for Generic Safety Issue (GSI)-191 closure, "Comprehensive Analysis and Test Program for GSI-191 Closure" (Agencywide Document Access and Management System (ADAMS) Accession No. ML15210A668). The TR is an approach to define an in-vessel fibrous debris limit and provides a means for increasing the approved fibrous debris limit used by licensees to resolve GSI-191.

The staff has proposed to conduct a regulatory audit at this point in the review process in an effort to increase efficiency in the review, and has therefore enclosed an audit plan. This audit will focus on the thermal hydraulic models and methodologies in Volume 4, specifically, analyzing code runs and sensitivity studies and evaluating input variable calculations.

The Safety Issues Resolution Branch staff expects the audit to increase their level of knowledge and understanding of the topic and associated methodologies. The enclosure provides the audit plan in accordance with LIC-111, "Regulatory Audits," for conveyance to PWROG.

Enclosure:  
Audit Plan

CONTACT: Ashley S. Smith, NRR/DSS  
301-415-3201

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NRR-106

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NAME	ASmith	VCusumano
DATE	2/01/2016	2/01/2016

**OFFICIAL RECORD COPY**

**AUDIT PLAN**  
**EVALUATION OF THERMAL HYDRAULIC MODELS**  
**AND METHODOLOGIES USED IN WCAP-17788-P**  
**PRESSURIZED WATER REACTOR OWNERS GROUP**

Purpose and Scope

By letter dated July 17, 2015, PWR Owners Group (PWROG) submitted a licensing Topical Report (TR) intended for Generic Safety Issue (GSI)-191 closure "Comprehensive Analysis and Test Program for GSI-191 Closure" (Agencywide Document Access and Management System (ADAMS) Accession No. ML15210A668). The TR is an approach to define an in-vessel fibrous debris limit and provides a means for increasing the approved fibrous debris limit used by licensees to resolve GSI-191.

The thermal hydraulic analysis in TR WCAP-17788-P uses various codes and methodologies to simulate core inlet blockage caused by debris. This audit will allow the U.S. Nuclear Regulatory Commission (NRC) staff to determine the validity and consistency between the thermal hydraulic models and methodologies presented in Volume 4 by analyzing code runs and sensitivity studies and evaluating input variable calculations.

Audit Agenda

The audit is expected to last a total of three days to ensure enough time for both opening and exit meetings. The audit will take place at the Westinghouse facilities in Rockville, Maryland.

The agenda will include:

- An introduction presentation by the PWROG to outline:
  - Code used for the analyses including any modification
  - Plant models used for the analyses including any modification
  - Analysis approach and major points of the analyses (i.e. what it was meant to achieve)
  - Results of the analysis
  - Key elements available for NRC staff review during the audit
  
- Run and analyze results for cases including, but not limited to:
  - Cases in Appendix A
  - Additional cases possible after discussions about inputs and assumptions

**ENCLOSURE**

- Review calculation notes for barrel/baffle and Upper Head Spray Nozzle (UHSN) resistances for all four plant categories
- Examine validity of major assumptions
- Investigate the  $t_{\text{block}}$  error in SRELAP5 reporting for the CE cases in Volume 4 Section 10
- Review results of the code-to-code comparison for the Westinghouse downflow plant category as described in Volume 4, Section 5.4
- Understand conservatism in the fluid volume entering the fuel as described in Volume 3, Section 3.3
- Review the quality assurance process for the models used in the analyses as it relates to the regulatory requirements in 10 CFR Appendix B

### Audit Team

The audit team will consist of:

- Ashley Smith, Team Leader, Safety Issues Resolution Branch Technical Reviewer, NRR
- Steve Smith, Safety Issues Resolution Branch Technical Reviewer, NRR
- Andrea Russell, Safety Issues Resolution Branch Technical Reviewer, NRR
- Victor Cusumano, Chief, Safety Issues Resolution Branch, NRR
- Vesselin Palazov, Contractor, Information Systems Laboratories
- Jonathan Rowley, Project Manager, Licensing Processes Branch, NRR

The following support personnel are requested:

- Code developers who contributed to modifications and analysts for the Westinghouse upflow, Westinghouse downflow, CE, and B&W cases and sensitivity studies run for WCAP-17788-P
- Engineers with expertise in the cold leg break and hot leg break methodologies in WCAP-17788-P (specifically the developers)

### Documents Requested for NRC Staff Examination

The NRC staff requests that documentation pertaining to the agenda items listed above be made available including:

- Input decks and output results for the following cases:
  - All cases that have been used for the hot leg break analysis
  - Cases in Appendix A
- Results of existing sensitivity studies performed to support the hot leg break results
- Documentation of all plant models including modifications to support the hot leg break methodology
- Theory, input, and user manuals for WCOBRA/TRAC version MOD7A, S-RELAP5, and RELAP5/MOD2-B&W
- Calculation notes for barrel/baffle and UHSN resistances

- References 6-2, 6-3, and 6-4 of Volume 4
- NSAL-95-001
- Quality assurance process documents as it relates to 10 CFR Appendix B

#### Logistical Considerations

The following logistics are also requested:

- Telephone available to call NRC Headquarters if necessary
- Private space for internal NRC staff discussion separate from the PWROG staff
- A white board in the conference room to assist in discussion
- A projector and screen for presentations
- 

#### Documentation of Audit

Within 45 days of the audit, the NRC staff will prepare a detailed audit report documenting the information reviewed during the audit, and any open items identified as a result of the audit. The NRC staff will also document its understanding of the proposed resolution of any identified open items. The audit report will be provided to PWROG in draft form for proprietary markup.

Appendix A – Code cases to rerun and analyze results

Run #	Plant Category	Table	Case	Modification	Action
1	Westinghouse Upflow	8-1	1B	Change timestep to 0.001 s	Compare to Table 8-3
2				Multiply convergence criteria by 0.5	
3				Impose a resistance to axial nodes that have spacer grids to simulate crossflow is partially blocked	
4			2B	Change timestep to 0.001 s	
5				Multiply convergence criteria by 0.5	
6			3B	Change timestep to 0.001 s	
7				Multiply convergence criteria by 0.5	
8		8-2	3	Change timestep to 0.001 s	Compare to Table 8-4, Figure 8-4, and Figure 8-5
9				Multiply convergence criteria by 0.5	
10				Impose a resistance to axial nodes that have spacer grids to simulate crossflow is partially blocked	
11			5	Change timestep to 0.001 s	
12				Multiply convergence criteria by 0.5	
13				Impose a resistance to axial nodes that have spacer grids to simulate crossflow is partially blocked	
14		6-1, V1	NA	Change tblock to 113, 133, 153, and 173 minutes	Compare heatup results

Run #	Plant Category	Table	Case	Modification	Action
15	Westinghouse downflow	9-1	1A	Change timestep to 0.001 s	Compare to Table 9-3
16				Multiply convergence criteria by 0.5	
17				Impose a resistance to axial nodes that have spacer grids to simulate crossflow is partially blocked	
18			2B	Change timestep to 0.001 s	
19				Multiply convergence criteria by 0.5	
20					
21		9-2	3	Change timestep to 0.001 s	Compare to Table 9-4, Figure 9-3, and Figure 9-4
22				Multiply convergence criteria by 0.5	
23				Impose a resistance to axial nodes that have spacer grids to simulate crossflow is partially blocked	
24			5	Change timestep to 0.001 s	
25				Multiply convergence criteria by 0.5	
26				Impose a resistance to axial nodes that have spacer grids to simulate crossflow is partially blocked	
26		6-1, V1	NA	Change tblock to 230, 240, 270, and 290 minutes	Compare heatup results

Nodalization sensitivities

Run #	Plant Category	Table	Case	Modification	Action
1	Westinghouse Upflow	8-1, 8-2	All	Double number of core channels	Compare to Tables 8-3. Table 8-4, Figure 8-3, and Figure 8-4
2				Quadruple number of core channels	
3				Double number of axial nodes	
4	Westinghouse downflow	9-1, 9-2	All	Double number of core channels	Compare to Tables 9-3. Table 9-4, Figure 9-3, and Figure 9-4
5				Quadruple number of core channels	
6				Double number of axial nodes	