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March 26, 2010  
10-029

U.S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
Washington, D.C. 20555

References: (1) License SNM-42, Docket 70-27  
(2) Letter dated February 25, 2010, Silva (NRC) to Cochrane (B&W), NRC  
Inspection Report No. 70-27/2010-201 and Notice of Violation

Subject: Reply to a Notice of Violation

Dear Sir:

Pursuant to the provisions of 10 CFR 2.201, Babcock & Wilcox Nuclear Operations Group, Inc. (B&W NOG), Lynchburg facility, is providing this written statement of explanation to the U.S. Nuclear Regulatory Commission (NRC) in reply to the Notice of Violation that was received by letter dated February 25, 2010 (Reference 2). B&W NOG's reply is provided as an enclosure.

If there are any questions in this regard, please contact Barry Cole at (434) 522-5665.

Sincerely,

Roger Cochrane  
General Manager  
B&W NOG, Inc., Lynchburg

Enclosure

cc: NRC, Regional Administrator, Region II  
NRC, Chief, Technical Support Branch, Division of Fuel Cycle Safety and Safeguards  
NRC, Senior Resident Inspector  
NRC, M. Baker

IED7  
NMSS

**ENCLOSURE**

**Reply To Notice of Violation 70-27/2010-201 March 26, 2010****Violation: 70-27/2010-201-02**

Per the notice of violation dated February 25, 2010:

During a Nuclear Regulatory Commission (NRC) inspection conducted January 25 – 29, 2010 a violation of NRC requirements was identified. In accordance with NRC Enforcement Policy, the violation is listed below:

Safety Condition No. S-1 of Special Nuclear Material License No. 42 requires that material be used in accordance with the statements, representations, and conditions in the license application dated June 29, 2007, and supplements thereto.

License Application Section 5.2.3 states, in part, that the limiting condition for operation (LCO) for all high-enriched systems (other than those involving A1B clusters) will be  $k_{\text{eff}} \leq 0.92$ , and that a Routine Operating Limit shall be established from the LCO to account for measurement uncertainties and normal process variability, which is not to exceed the LCO.

License Application Section 5.2.5 states, in part, that calculations are to be based on optimum moderation unless moderating materials are restricted or carefully controlled. Section 5.2.5.3 states, in part, that when calculations indicate that license conditions would be violated at a degree of interstitial moderation other than 100%, all degrees of moderation exceeding any allowed H/X limit must be controlled.

Contrary to the above, on and before December 14, 2009, using a less than optimal degree of interstitial moderation, the licensee performed a safety concern analysis for bowed fuel on a vertical fuel cart without controlling or restricting moderation. Specifically, the analysis was performed for a fuel cart in the Research, Test Reactor and Target (RTRT) area using an interstitial moderation value of 5%, when the LCO limit of  $k_{\text{eff}} \leq 0.92$  would have been exceeded with optimum interstitial moderation and fuel closer than the allowed spacing of 0.1 inches.

**Reason For The Violation:**

The inspectors reviewed a licensee Safety Concern Analysis (SCA) for an incident involving the bowing of fuel stored on a vertical fuel cart in RTRT. The current analysis (NCS-1986-024) requires the fuel to be stored at least 0.1" apart, but bowing allowed the fuel to be closer than 0.1" at the ends. The SCA determined that the spacing restriction was not necessary, as the allowed number of elements would be subcritical with any degree of interstitial moderation, even if they were in contact (i.e., spacing reduced to zero). The inspectors determined that the licensee had extrapolated to a spacing of zero from four prior calculations performed with spacing from 0.1 to 0.4". The inspectors note that the prior calculations were performed at an interstitial moderation of 5%. The inspectors noted that the licensee extrapolation range was approximately 1/3 of the total range covered by the data, that the equation of the linear fit was not provided, and that the uncertainty in the extrapolation or the linear correlation coefficient of the regression

fit was not discussed. The licensee stated that it had not extrapolated the data rigorously because it expected that  $k_{\text{eff}}$  will decrease as spacing is reduced to zero. While this is likely, it is also possible that  $k_{\text{eff}}$  reaches a maximum at some nonzero value less than 0.1".

With regard to interstitial moderation, the licensee stated that it had originally believed that 5% was bounding, but upon further examination, an optimum value of 7 -10% should have been used. Based on the prior analysis; an increase in interstitial moderation from 5 to 7% results in an increase in  $k_{\text{eff}}$  of ~3%. The limiting condition for operation (LCO) as specified in the license application, for this high-enriched system, is:

$$k_{\text{calc}} + 2\sigma + (\text{bias}) \leq 0.92 \text{ (LCO)}$$

The licensee's extrapolation at 5% interstitial moderation, the corresponding curve at 7% interstitial moderation, and the LCO value are shown in the figure contained in NRC inspection report (Reference 2).

Because there were no controls to limit the maximum amount of interstitial moderation, an optimum value should have been chosen for the extrapolation. The Safety Concern Analysis failed to adequately demonstrate sub-criticality under bounding moderation and spacing conditions for bowed fuel on the RTRT vertical spacing cart.

It should be noted, however, the LCO license limit of  $k_{\text{eff}} \leq 0.92$  defines the limit for a *normal operating condition*. License Application Section 5.2.3 states:

*"The LCO value is set such that any single failure (contingency) in the controlled parameter will not exceed the Safety Limit value for that parameter."*

Section 5.2.3 also states:

*"For a controlled parameter to exceed its LCO value, a contingency would have to occur. After this contingency, the k-effective of the system would have to be less than the Safety Limit. In other words, no single contingency will take a system critical or even above its safety limit. Calculated k-effective values shall include appropriate allowances for any bias in data and calculation methods used."*

Furthermore, License Application Section 5.2.3 states, in part:

*The k-effective for the Safety Limit shall not exceed 0.95 for all high-enriched systems (other than those involving A1B clusters).*

In other words, for the single contingency of the fuel plate spacing of less than 0.1", the calculated  $k_{\text{eff}}$  value should be evaluated relative to the Safety Limit of 0.95, not the LCO limit of 0.92. Although, this clarification does not change the results of the violation, it does indicate the Safety Limit is only slightly exceeded relative to the data portrayed in the figure contained in the NRC inspection report (Reference 2).

**Corrective Steps Which Have Been Taken and the Results Achieved:**

The Safety Concern Analysis of this incident was revised. Additional calculations were completed using the same assumptions of the original analysis that defined the LCO of 0.1" for minimum plate-to-plate spacing. The calculations were an extension of the original analysis; the cart was modeled using the original model inputs as much as possible. Some fuel plate dimensions were updated to those of the current design. The revised Safety Concern Analysis demonstrated the Safety Limit was not exceeded for any value of plate-to-plate spacing based on optimum interspersed moderation, which meets the requirements of License Application Section 5.2.3. Complete as of February 3, 2010

**Corrective Steps Taken To Avoid Future Violations:**

- 1) A Nuclear Criticality Safety (NCS) Analysis was completed to establish a new safety basis for the vertical fuel plate cart. The analysis demonstrated that by taking credit for other physical attributes of the cart the LCO license limit was met for any degree of interspersed moderation and plate-to-plate spacing. The LCO for plate-to-plate spacing was subsequently removed from the safety basis and replaced with limits on other cart attributes. Complete as of March 4, 2010
- 2) The specifics of this violation were reviewed within the NCS organization. The organization was retrained on the relevant areas of the license application that were violated and the portion of the NCS procedure that addresses the completion of Safety Concern Analyses. Complete as of March 23, 2010

**Date When Full Compliance Will Be Achieved:**

Full compliance was achieved on March 23, 2010.