

May 15, 2017

MEMORANDUM TO: William M. Dean, Director  
Office of Nuclear Reactor Regulation

FROM: Louise Lund, Director /RA/  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

SUBJECT: RESEARCH AND TEST REACTOR CLOSURE SUMMARY FOR  
GENERIC LETTER 2016-01: "MONITORING OF  
NEUTRON-ABSORBING MATERIALS IN SPENT FUEL POOLS"

This memorandum documents the U.S. Nuclear Regulatory Commission (NRC) staff's closure of Generic Letter (GL) 2016-01, "Monitoring of Neutron-Absorbing Materials in Spent Fuel Pools," responses from the NRC-licensed research and test reactor licensees. The GL issued on April 7, 2016, requested information from addressees licensed under Title 10 of the *Code of Federal Regulations* Part 50, "Domestic Licensing of Production and Utilization Facilities," and requested that licensees submit to the NRC a written response providing information intent on demonstrating compliance with regulatory requirements (technical specifications (TSs)) related to maintaining adequate subcriticality of fuel in spent fuel pools or other onsite wet storage.

The GL requested that each research and test reactor licensee provide information necessary to determine reliance on neutron-absorbing materials (NAM) for criticality control of reactor fuel or spent fuel in wet storage locations. Three questions were included in the GL specific to research and test reactors which asked if NAM was used in wet fuel storage; if used, whether the NAM was credited in the facility licensing or design bases; and if credited, whether any surveillance or monitoring programs confirming continued acceptable performance existed.

The NRC staff evaluated the licensee responses and closed the GL for each research and test reactor licensee. The closure process for research and test reactors uses a two-tier review to assess responses from research and test reactor addressees. In the first-tier review, the NRC staff reviewed individual responses to the GL and verified that the facility is within the scope of the GL, that the licensee response was made under oath and affirmation, and that the information provided appeared to be complete and accurate based on docketed licensing information.

CONTACT: Alexander Adams Jr., NRR/DPR  
301-415-1127

Where the NRC staff confirmed that the facility does not have or credit NAM in its licensing or design basis, that facility screened out of further review and a closure letter was sent to the licensee.

The second-tier review was conducted for those facilities which did not screen out in the first-tier review. It addressed those facilities that credit the use of NAM in their licensing or design basis to prevent criticality in the wet fuel storage. The staff reviewed the information provided in the GL response and other supporting information including, as needed, docketed facility licensing and design information related to wet fuel storage requirements, licensee established surveillance or monitoring programs, the type of NAM used and its known degradation and deformation mechanisms, NAM susceptibility to the facility's chemical or physical environment, and the margin of the storage system  $k_{\text{eff}}$  relative to criticality to ensure that reasonable assurance existed of continued acceptable performance of the NAM relied upon for the prevention of criticality in wet fuel storage.

The NRC staff has completed review of all research and test reactor licensees and their responses to the GL and as of the week ending May 12, 2017, has sent all responding licensees closure letters. The results of the staff review were as follows: five research reactors were out of the GL scope since their specific designs did not include wet fuel storage and appropriately did not provide a response; one research reactor with no wet fuel storage responded unnecessarily and received a closeout letter; three research reactors and one test reactor had specific designs that included NAM, but did not credit its use to meet facility technical specification requirements; 16 research reactors had no NAM in their wet fuel storage; two research reactor facilities credited the use of BORAL as NAM in their specific designs; and three research reactors used cadmium as NAM which the staff reviewed and concluded was not considered in the GL and therefore not within its scope.

For the two research reactors with BORAL credited in their licensing basis, the staff found that one licensee had established an appropriate monitoring program which provides reasonable assurance that NAM degradation and deformation will be identified before exceeding facility technical specification requirements. The second research reactor credited only one percent of the total BORAL provided by the design to meet the facility's technical specification requirements and was able to demonstrate by analysis that even with an incredible total loss of BORAL, criticality would not result in wet fuel storage.

For the three research reactors using cadmium, the staff reviewed the GL development and found that the use of cadmium NAM was not specifically considered. Before the staff reached the conclusion that cadmium was not within the scope of the GL, the staff searched 60 years of research and test reactor operating experience for examples of cadmium failure (degradation or deformation) and reviewed the chemical and physical properties of cadmium in a research reactor water (deionized water) environment. Based on the results of these actions, the staff found no historical examples of cadmium degradation or deformation similar to that observed in the NAM referenced in the GL (e.g., BORAFLEX or BORAL). The Attachment attached provides a table which lists each facility by name and the basis for the closure of GL 2016-01 for their facility.

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GL 2016-01 Research and Test Reactor Closure Basis by Facility

<b>Facility Name</b>	<b>Closure Basis</b>
Aerotest	No NAM
Armed Forces Radiobiological Research Inst.	No NAM
Dow Chemical	No NAM
GE - Vallecitos	No Wet Storage - Not In Scope
Idaho State University	No Wet Storage - Not In Scope
Kansas State University	No NAM
Massachusetts Institute of Technology	Cadmium NAM – Not In Scope
Missouri University of Science and Technology	No NAM
National Institute Standards and Technology	NAM Not Credited
North Carolina State University	No NAM
Ohio State University	Loss of NAM Does Not Result In Criticality
Oregon State University	No NAM
Penn State University	No NAM
Purdue University	NAM Not Credited
Reed College	No NAM
Rensselaer Polytechnic Institute	No Wet Storage - Not In Scope
Rhode Island Atomic Energy Commission	Cadmium NAM – Not In Scope
Texas A&M University (AGN)	No Wet Storage - Not In Scope
Texas A&M University (TRIGA)	No NAM
University California - Davis	No NAM
University California - Irvine	NAM Not Credited
University of Florida	No Wet Storage - Not In Scope
University of Maryland	No NAM
University of Massachusetts at Lowell	NAM Not Credited
University Missouri at Columbia	Acceptable NAM Monitoring Program
University of New Mexico	No Wet Storage - Not In Scope
University of Texas	No NAM
University of Utah	No NAM
University of Wisconsin	Cadmium NAM – Not In Scope
United States Geological Survey	No NAM
Washington State University	No NAM