UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 2, 1996

MEMORANDUM TO: Chairman Jackson
Commissioner Rogers
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan

FROM: James M. Taylor
Executive Director for Operations

SUBJECT: RESPONSE TO STAFF REQUIREMENTS MEMORANDUM DATED AUGUST 27, 1996 - BRIEFING ON SPENT FUEL POOL COOLING ISSUES

On August 1, 1996, the staff briefed the Commission on spent fuel pool cooling issues. On August 27, 1996, the Commission requested additional information on these issues and asked the staff to provide information on schedules or completion dates for certain spent fuel related activities. These requests are being tracked on the Chairman's Tracking List, Items II.M.5 and II.M.6. This memorandum addresses those questions and provides the schedular information requested by the Commission.

1. **How much of the reactivity margins depends on Boraflex and degradation of Boraflex as opposed to other factors?**

A 5 percent subcriticality margin (i.e., an effective neutron multiplication factor, k_{eff}, no greater than 0.95) is required for both BWR and PWR spent fuel pools. For pools which contain Boraflex, this margin is typically determined assuming a small amount of Boraflex degradation and no credit for soluble boron in the pool water. The amount of Boraflex loss which can be accommodated varies from plant to plant and depends on items such as the spacing between the fuel assemblies and the remaining reactivity of the fuel assemblies after irradiation in the reactor. In a PWR pool, soluble boron is present in the water. The total reactivity worth of the soluble boron and the Boraflex is about 30 percent delta-k and, in fact, there is normally sufficient soluble boron to meet the 0.95 k_{eff} limit even with complete loss of Boraflex. Because soluble boron is not used in a BWR pool, the 0.95 k_{eff} limit would be challenged with a limited amount of Boraflex degradation. Substantial Boraflex degradation in a BWR would be required to result in criticality.

The staff has recently issued Generic letter 96-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks." requesting all licensees that use Boraflex in their fuel storage racks to assess the capability of the Boraflex to maintain a 5 percent subcriticality margin and describe proposed actions if this

CONTACT: Steve Jones, NRR
415-2833

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subcriticality margin cannot be maintained because of current or projected future Boraflex degradation. Potential actions to compensate for the reactivity increase due to Boraflex degradation are increasing the spacing between stored fuel assemblies (e.g., "checkerboarding"), crediting the reactivity decrease associated with fuel burnup, crediting soluble boron, or inserting additional neutron absorber materials into the storage racks. Responses to the generic letter are due by October 25, 1996.

2. **Have any of the utilities had to replace the Boraflex or part of it? Does it require replacing the whole rack?**

The staff is not aware of any utility that had to replace the Boraflex or part of it. However, licensees for several utilities have reracked their pools and have chosen to use other neutron poisons instead of Boraflex. Because the Boraflex used in most fuel storage racks is held in place by a stainless steel cover that is tack welded at several locations along its length to the structural portion of the rack that forms a wall of the storage cell, the Boraflex cannot be easily replaced. Therefore, if the neutron-absorbing material degrades to the extent that replacement is necessary, rack replacement would likely be the least complicated and most economical means of resolving the degraded condition.

3. **Does the generic letter allow you to deal adequately with all of the remaining fuel activity concerns?**

Yes, the generic letter is adequate. However, the staff will continue to monitor operating experience to assure that spent fuel pool reactivity issues are understood and appropriately addressed.

4. **How are non-power reactors affected?**

Non-Power Reactors (NPRs) have small amounts of spent fuel on site in storage racks. This is because most NPRs consume small amounts of fuel during operation (many NPRs have lifetime or near lifetime cores). Because all licensed NPRs have agreements with the U.S. Department of Energy (DOE) for disposal of spent fuel, fuel is returned periodically to DOE for those few facilities that produce spent fuel on a regular basis and from all NPRs at the end of facility life. Consequently, NPRs do not have the large fuel inventories of commercial power reactors, and NPRs do not generally require the high-density storage and the attendant neutron absorbing materials, such as Boraflex, that have become common at commercial power reactors. At most non-power reactors (NPRs), fuel is stored in racks along the sides of the same pool that houses the reactor. A few NPRs (e.g., Georgia Tech, the National Institute of Standards and Technology (NIST), and the Massachusetts Institute of Technology) have separate pools with fuel storage racks.

Fuel at most NPRs can be cooled in air immediately after shutdown. For higher power NPRs (more than 2 megawatts (MW) of licensed thermal power level), the fuel must be kept covered with water for a relatively short period of time after reactor shutdown so that the melting temperature of the fuel cladding cannot be reached. For example, NIST fuel requires only about two-and-a-half

hours of water coverage to preclude reaching the melting temperature of the aluminum cladding, about 1100° F (note that the NIST NPR at 20 MW is the highest powered NPR that is currently licensed by the NRC). The low decay heat rate that permits air cooling also prevents significant heating of the pool water.

All NPR fuel storage pools ensure that adequate water level is maintained by alerting operators to level problems through alarms (e.g., level and radiation) and design features to prevent water loss. Because the decay heat generation within the fuel is low enough to preclude cladding damage if water level falls below the top of the fuel, the main purpose of maintaining the water level is to ensure that enough water remains to serve as a radiation shielding. Generally, NPR pools were designed to comply with the local uniform building code. Some of the higher power NPRs were designed to higher seismic standards. The staff concludes that these standards provide adequate protection from water loss at NPRs.

All NPRs are designed to prevent stored fuel from reaching criticality. The configuration of the storage racks and the number of fuel elements needed to reach a critical condition make this accident highly unlikely (i.e., more than four to seven fuel elements falling together from the fuel storage racks into a nearly optimum configuration is not considered credible). The use of solid poison materials is not common at NPRs. For those few that utilize solid poison material, the staff verified that material other than Boraflex is used.

On the basis of this information, the staff concludes that the issues investigated for fuel storage at operating commercial power reactors have been acceptably addressed for NPRs.

5. **Provide schedules or completion dates for the following activities:**

a) <u>Revise the Standard Review Plan: October 1998</u>

The staff intends to revise the fuel storage pool design guidance documents (Regulatory Guide 1.13 and Sections 9.1.2 and 9.1.3 of the Standard Review Plan) with the benefit of insights from the proposed rulemaking for shutdown and fuel storage pool operations and from the plant-specific regulatory analyses involving fuel pool related design features. The content of the fuel pool operations rule will affect revisions to these guidance documents because of the interface between operational capability and design. The rule is currently scheduled to be published for comment in early 1997. The staff expects the regulatory analyses to provide a clear perspective of the safety significance of specific design attributes. As described in paragraph (b) below, we plan on completing the regulatory analyses in May 1997. Additionally, the priority given to the rulemaking and regulatory analyses is supported by the safety benefits of these actions because of their effect on currently operating reactors. The staff plans to complete draft revisions to the guidance documents in the fourth quarter of 1997. The staff selected the final completion date of October 1998 to allow for public comment and review by the Advisory Committee on Reactor Safeguards and the Committee to Review Generic Requirements (CRGR).

b) Complete regulatory analysis: May 1997

The staff proposed plant-specific evaluations and regulatory analyses to examine the potential for safety-enhancement backfits at plants with low values of design fuel pool decay heat removal capability or rare fuel pool related design features. Completion of this examination in the scheduled period will require assembly of a multi-disciplinary team, including individuals familiar with fuel pool design features, probabilistic risk assessment, and instrumentation, to investigate seven sites (Dresden, Hatch, Indian Point 2, Oconee, Robinson, Salem, and Surry). These seven sites have extreme examples of the design features that require further evaluation and which may necessitate a plant-specific backfit. Therefore, the staff expects to quickly identify those design features, if any, for which a backfit may be justified. For design features where backfits are supported, additional facilities with that design feature will be evaluated. The end product in May 1997 will be a regulatory analysis for each supported plant-specific backfit and a summary report describing the basis for no regulatory action for the remaining areas.

c) Complete enhancements at 22 affected sites: August 1997

The staff based the implementation date of August 1997 on review of the plant-specific backfits applicable to multiple plants by CRGR, issuance of letters to the affected licensees, the potential for appeal of the backfit by the affected licensees, and potential issuance of an order to implement the backfit. Completion may be reached much earlier if the regulatory analyses fail to support implementation of the proposed backfits or if licensees voluntarily implement changes to design or operation that alleviate the concern. This completion date does not include the time necessary for physical implementation of backfits by the licensee nor any staff action to verify implementation of the backfit. These schedules will be determined at the time the letters are drafted to affected licensees, and the schedules will be affected by the safety significance and extent of the changes.

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c) Complete enhancements at 22 affected sites: August 29, 1997

The staff plans to complete staff actions related to implementation of the plant-specific backfits by issuing letters to licensee's by August 29, 1997. The staff based this implementation date on review of the plant-specific backfits applicable to multiple plants by CRGR, issuance of letters to the affected licensees, the potential for appeal of the backfit by the affected licensees, and potential issuance of an order to implement the backfit. Completion may be reached much earlier if the regulatory analyses fail to support implementation of the backfit or if licensees voluntarily implement changes to design or operation. This completion date does not include the time necessary for physical implementation of backfits by the licensee nor any staff action to verify implementation of the backfit. These schedules will be determined at the time the letters are drafted to affected licensees, and the schedules will be affected by the safety significance and extent of the changes.

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c) <u>Complete enhancements at 22 affected sites: January 31, 1998</u>

The staff plans to complete staff actions related to implementation of the plant-specific backfits by January 31, 1998. The staff based this implementation date on review of the plant-specific backfits applicable to multiple plants by CRGR, issuance of notification letters to the affected licensees, the potential for appeal of the backfit by the affected licensees, and potential issuance of an order to implement the backfit. Completion may be reached much earlier should the regulatory analyses fail to support implementation of the backfit or should licensees voluntarily implement changes to design or operation. This completion date does not include the time necessary for physical implementation of justified backfits by the licensee nor any staff action to verify implementation of the backfit.

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