STATE OF MAINE
OFFICE OF THE GOVERNOR
1 STATE HOUSE STATION
AUGUSTA, MAINE
04333-0001

(4)

DOCKETED

April 4, 2000

ANGUS S. KING, JR.
GOVERNOR

'00 APR 10 P5:07

Mr. Richard A. Meserve, Esq.
Chair
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Attn: Rulemaking and Adjudications Staff

DOCKET NUMBER PROPOSED RULE PR 72 (65FR 3397)

Dear Chair Meserve:

On behalf of the State of Maine (the "State"), I submit the enclosed comments on the Commission's proposed rule, 65 Fed. Reg. 3397, January 21, 2000, that would amend 10 CFR § 72.214 to approve the NAC-UMS Universal Storage System for spent nuclear fuel (Certificate No. 1015). The State has an acute interest in the Commission's evaluation of this application because Maine Yankee Atomic Power Company intends to use this system for long-term storage of its spent fuel following decommissioning. Based on the United State's commitments in the Nuclear Waste Policy Act, 42 U.S.C. § 10222, et seq., the State expected the Department of Energy ("DOE") to remove all spent fuel from Maine in a timely manner, thus obviating the need for any extensive storage after Maine Yankee's shutdown. Instead, it now appears that DOE may not complete removal of all Maine Yankee's spent fuel for 20 to 30 years, or perhaps much longer. Thus, whatever storage system is chosen must assure the public's safety for an extended period and must ensure that the fuel will be acceptable for removal when the DOE is finally prepared to take it years in the future.

Based on its consultation with leading experts, the State has serious concerns about long-term spent fuel storage. The Commission's proposed Certificate of Compliance (Appendix A at A1-1) and NAC's Preliminary Safety Analysis Report (Table 1-1 at 1-4) permit fuel with pinholes or hairline cracks in the cladding to be treated as if it were "intact," without analyzing the impact of those defects over the 20-year license period much less over the likely storage duration. Emerging research shows that incomplete drying of the spent fuel before storage, combined with demonstrated physical processes, can enlarge those defects and "unzip" the cladding thus breaching a primary containment barrier for the fuel. The absence of any mechanism in the NAC-UMS system to verify the condition of the fuel during storage and prior to transport intensifies the State's concerns.

Because of these concerns, the State of Maine hereby requests that, as a prerequisite to approving the proposed rule, the NRC acquire binding assurances from the DOE that DOE will accept spent fuel for transport and disposal that has been stored in accordance with NRC-approved procedures. Those procedures, in turn, must ensure that stored spent fuel will remain in a condition that DOE can accept. These considerations and the Commission's regulations, 10 CFR § 72.236, preclude approval of the proposed certification until the Commission and the applicant have thoroughly analyzed and resolved critical outstanding issues.

PHONE: (207) 287-3531(Voice)
PRINTED ON RECYCLED PAPER
FAX: (207) 287-1034
(207) 287-6548 (TTY)

TEMPLATE = SECY-067

SECY-02

The State recognizes that resolution of these issues has industry-wide implications. Most current dry storage systems permit fuel with small defects to be treated as fully intact and those systems may be susceptible to the same long-term cladding failures as the NAC-UMS system. Nevertheless, in light of emerging studies and the anticipated decades-long delay in DOE's removal of spent fuel from reactor sites, the Commission and DOE must act in concert so that Maine does not rely on potentially flawed and inadequate storage systems. Failure to provide concerted answers now based on rigorous, scientific analysis may create additional, more serious problems for future generations. I urge the Commission to take whatever steps are required to provide reliable, incontrovertible evidence that the NAC-UMS system will store spent fuel safely for the reasonably expected storage period and that DOE will accept it for transport and permanent disposal. I look forward to the Commission's response to the State's comments.

Sincerely,

Angus S. King, Jr.
Governor

cc: Bill Richardson
Secretary, Department of Energy

Annette L. Vietti-Cook
Secretary, Nuclear Regulatory Commission

Honorable Olympia J. Snowe
U.S. Senate

Honorable Susan M. Collins
U.S. Senate

Honorable Thomas H. Allen
U.S. House of Representatives

Honorable John E. Baldacci
U.S. House of Representatives

John Tewhey, Esq.
Chair, Maine Board of Environmental Protection

Eric Howes
Maine Yankee Atomic Power Company

STATE OF MAINE COMMENTS ON NAC-UMS SPENT FUEL STORAGE SYSTEM

April 4, 2000

General Comments

The State of Maine (the "State") offers these comments based on its detailed review of the Preliminary Safety Evaluation Report ("PSER," ML993230106), relevant portions of the Preliminary Safety Analysis Report ("PSAR," ML003683264), and proposed Certificate of Compliance ("CoC," ML993230106) No.1015, including Appendices A and B for the NAC-UMS. The State's comments rely on analysis conducted by Deist Associates, Inc. and by John A. Nevshemal. Dr. Charles Hess and Dr. George Chabot, members of the State's Technical Advisory Panel on nuclear power issues, reviewed the analysis and these comments.

Based on the State's analysis, NAC International has not yet provided reasonable assurance that its NAC-UMS transfer and storage system will maintain the required level of confinement integrity in the proposed dry storage installation under the known, normal conditions. NAC has not provided the required assurance that the single failure-proof confinement requirements for cladding and cask integrity will be unimpaired during the expected storage interval. In particular, NAC has not provided assurance that the integrity of the primary confinement barrier (i.e., the cladding) will be maintained during the licensed period from cask closure until relicensing or shipment. Until NAC provides that assurance, the NAC-UMS spent fuel storage system should not be approved. To the extent that the NRC approves the NAC-UMS application without a further empirical demonstration of such assurance, the NRC should provide a demonstrable scientific basis to justify its approval.

Specific Comments

Comment 1

The CoC defines "Intact Fuel Assembly" and "Intact Fuel Rod" as "a fuel assembly [or rod] without known or suspected cladding defects greater than a pinhole leak or hairline crack." (CoC, App. A at A1-1) Such cladding penetrations indicate cracks in the cladding, and the pinhole is merely the first point of penetration. Thus, it is inappropriate to rely on the partially breached cladding to provide the necessary confinement barrier during long-term storage. Fuel rods with cladding that has been compromised by pinhole leaks or hairline cracks may "unzip" during dry storage due to the known, expected fuel pellet expansion caused by oxidation. Test data compiled by the Pacific Northwest National Laboratory ("PNNL") suggest that small defects -- perhaps at the location of permissible cladding defects in "intact" fuel -- may open up during dry storage, creating a loss of primary confinement. See "Spent Nuclear Fuel Integrity During Dry Storage – Performance Tests and Demonstrations," Pacific Northwest National Laboratory, June 1997. The PNNL study was based on data covering only seven years of dry storage, and cladding degradation over a 20-year licensed life would be expected to be greater. NAC and the Commission have not analyzed the long-term implications of pinholes and hairline cracks.

Moreover, the PSER does not provide a rationale to explain scientifically why permitted cladding defects in the form of pinholes and hairline cracks do not compromise the cladding as a confinement barrier. Neither the PSER nor the PSAR specify a cause for the pinhole or hairline crack, but necessarily assume that they were created by mechanisms external to the fuel rod (i.e., that there is no ongoing mechanism that would exacerbate the defect over time). It is equally plausible, however, that these defects stem from ***internal*** rod (cladding) stress corrosion cracking. If so, that mechanism may persist through the dry storage period, further compromising the cladding. Neither Interim Staff Guidance - 1, Damaged Fuel, nor the Nuclear Energy Institute's June 30, 1999 fuel classification protocol address the scientific (i.e., physical cause) rationale for classifying fuel with cladding pinholes and hairline cracks as "intact fuel". Without this analysis, the application does not satisfy the requirements of 10 CFR § 72.236(b), (e), and (l), and the Commission may not approve the proposed rule

Comment 2

Neither the PSER nor the PSAR explains how consolidated fuel assemblies that have been canned will maintain confinement in the NAC-UMS system. (See PSAR Section 6.6.1.3.1.) For such assemblies, the primary confinement barrier (i.e., cladding), has been compromised and has been replaced by a can. The can is not a true confinement barrier, however, because the top and bottom are merely screens that will not confine the powder form of the fuel, U_3O_8. (See PSAR, App. 12A at 12A1-6.) Furthermore, the process of consolidation itself (as defined by ANSI/ANS-57.10, Design Criteria for Consolidation of LWR Spent Fuel) is expected (Design Event II) to produce broken/damaged rods (i.e., cladding penetrations). Therefore, the requirement for a primary confinement barrier will not be met if the can in which the individual rods are loaded has screens. This absence of a primary barrier -- especially when damaged fuel rods are loaded in the can – violates the single failure requirement in 10 CFR § 72.236(e) for confinement of the radioactive material (fuel).

Comment 3

Since the inception of the dry storage concept, designers and regulators have been concerned about oxidation of the radioactive fuel (initially UO_2) due to moisture that remains in the canister after fuel has been loaded from the pool. Because of this concern, extraordinary attention must be given to removal of the pool water from the loaded canister. The proposed NAC-UMS canister drying process (CoC, Table A3-1; SER Section 8.1.3) calls for producing and holding a vacuum of 3 torr (3 mm Mercury) for 30 minutes through two cycles. Upon completion of the drying process the fuel canister is backfilled with an inert gas (helium) and sealed. This proposed drying process will not remove the water completely. Ideal gas law theory alone indicates that this proposed vacuum drying process cannot remove all of the water, even if the fuel rods do not have cladding penetrations (i.e., pinholes and/or hairline cracks). In addition, it is a fact that the water inside those rods with allowed cladding penetrations (i.e., "intact" fuel rods) will not be removed by the vacuum drying process, thus adding to the amount of water available to react with the fuel material (UO_2) during storage.

Water will react with UO_2 based fuel to form bonded hydrated phases (UO_3-H_2O), which cannot be removed by vacuum drying. The oxygen will cause continued oxidation of the fuel, resulting in U_3O_8 phase, which is highly expansionary (i.e., low density). This phase is able to "unzip" the cladding at already damaged cladding points (stress corrosion cracking) that extend inside the cladding from a pinhole. Because U_3O_8 is essentially a powder, it is highly dispersible. The oxidation reaction is a time-at-temperature process that will proceed based on the temperature of the fuel pellets. Moreover, hydrated phases can increase the oxidation rate of the fuel, typically by a factor of five. For these reasons, it is highly doubtful that the NAC-UMS dry storage system will be able to maintain the necessary condition of the fuel rods over the 20-year license period, and the application does not satisfy the requirements of 10 CFR § 72.236(b), (e), and (l).

Comment 4

The NAC-UMS system does not provide for a capability to verify periodically whether or not the storage conditions have changed, thus requiring canning or other remedial measures for fuel that has developed further damage during storage. Due to the highly dispersible nature of U_3O_8, verification inspection cannot take place in a pool but requires a hot cell with remote handling capabilities. The only available non-destructive verification process would be an assay approach similar to gamma scanning, but gamma scanning is not adequate to determine whether storage conditions have changed. In any case, the NAC-UMS storage system is not amenable to such a scanning technique. Thus, the fuel-containing canisters may need to be opened periodically in a hot cell and visually inspected. An ISFSI site using the NAC-UMS system may require such a facility because the canisters may not be shipped under Part 71 without verification of fuel rod integrity. The PSER inappropriately accepts verification based solely on the lack of external events -- not on the actual condition of cladding -- even though there is an established potential for in-storage cladding degradation. The PSER should define verification requirements for the NAC-UMS system prior to shipment under Part 71 and evaluate the applicant's verification methods. Without such an analysis, the application does not satisfy the requirements of 10 CFR § 72.236(g), (j), and (m).

Comment 5

The NAC-UMS system proposes to use a borated polymer (NS-4-FR) as a neutron slowing/absorbing material for the storage cask (PSER Section 9.1.3). This raises a concern because of problems with radiation hardening experienced with a similar material, Boraflex. See NRC Generic Letter 96-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks," June 26, 1996. There is no evidence -- and the PSER does no analysis -- to establish NS-4-FR's ability to maintain form over the expected lifetime integrated neutron flux. The analysis does not satisfy 10 CFR § 72.236(c), (d), and (g).

Comment 6

The heavy load lifting ability of the transfer and storage systems (described in PSER Section 3.2.3) appears to be inadequately supported. The systems are not redundant, either for attachment or lift capability, and, therefore, do not satisfy the requirements for single failure of the lifting equipment. Similarly, the transfer and storage cask lifting trunnions are not redundant and do not satisfy the requirements for single failure or the requirements of 10 CFR § 72.236(h).

Comment 7

The NAC-UMS system dissipates heat via conduction from the center of the fuel assembly-filled canister to the canister walls and away from the canister through the natural convection via air circulation over the canister's outer surface. The analysis of the expected configuration described in the PSER Section 4.4.1.2 is based on an unrealistic physical model that assumes concentrically centered fuel assemblies. In fact, conduction is radial (not axial) and is based solely on the physical contact of the fuel assembly with the basket holding the assemblies. Because the NAC-UMS system is a vertical storage system, there is a potential for non-uniform physical contact between the basket and the fuel assembly (i.e., the heat source). For this reason, hot spots may develop along the axial direction of the fuel rod. The PSER does not analyze the degradation effects of these hot spots to assure cladding integrity throughout the license storage period. Thus, the application does not satisfy the requirements of 10 CFR § 72.236(b), (e), (f), and (l).

Comment 8

The operator testing and training exercises described in CoC Section A5.0 do not require training in the importance of sequence. The CoC implies that training will be conducted solely on an activity basis. Thus, the planned training loses the importance of the various interface requirements between activities that follow each other. This omission permits operator mistakes at activity intersections and may contribute to missing parameter values or conditions that must be met for safe loading and transfer of the assembly canister from the spent fuel pool to the storage cask. Individual procedures should include stated pre-conditions that must be satisfied by the previous sequential procedure and are necessary for safely performing the subsequent activity. Without such procedures, the application does not satisfy the requirements of 10 CFR § 72.236(l).

Comment 9

The radiological dose to adjacent controlled or non-controlled site areas is based on 20 loaded vertical storage modules (PSER Sections 10.3 and 10.4). The prototypical modules are arranged in two rows with ten storage modules per row. This assumption is unrealistic in ISFSIs that support the complete decommissioning of an operating nuclear power plant, where there may be 50 or more modules. The more storage modules, the greater the sky shine interaction that is available at the boundary of the site control area and the greater the on-site occupational dose. The PSER does not analyze the more typical module configurations and, thus, does not meet the requirements of 10 CFR § 72.236(d).

Comment 10

The PSER structural analysis (Sections 3.1 and 3.4) discusses three types of tornado generated missiles, two of which are of different mass (i.e., a "deformable missile of 3980 lbs." and a "penetration missile of 275 lbs."). There is no analysis, however, of an event similar to a tornado generated missile -- a terrorist attack in the form of a fired missile. Foreign regulatory agencies are now requiring such an analysis. The need for the analysis is further driven by a common location of the ISFSI (e.g., near international waters). The recent introduction of high penetrating depleted uranium missile shells adds to the concern of a terrorist event at an ISFSI. An analysis of the vulnerability of an ISFSI to such an attack may identify the need for sturdier storage module surfaces, an expanded site security area, or a storage enclosure (including appropriately designed heat removal systems). Without such an analysis, the application does not satisfy the requirements of 10 CFR § 72.236(l).

Comment 11

The criticality analyses as discussed in PSER Section 6.4 does not provide a listing of the fissile material in the spent fuel assemblies, without which the analysis is questionable and does not satisfy the requirements of 10 CFR § 72.236(c). Of particular concern is the concentration of Pu-239 which continues to undergo spontaneous fission and, therefore, increased neutron flux.

Comment 12

The process of placing the spent fuel in the canister is not adequately justified, as required by 10 CFR § 72.236(l). The spent fuel handling equipment removes the fuel assembly from either the transfer basket or the spent fuel storage rack. The assembly is raised until the bottom is above the rack, and then horizontally translated to the canister at which point the assembly is vertically lowered into the canister basket. The entire procedure is manual. The industry consensus standard, ANSI/ANS-57.1, Design Requirements for Light Water Reactor Fuel Handling Systems, requires a Translation Inhibit, i.e., "[a]n interlock to prevent bridge or trolley movement unless its associated hoist is at or above a predetermined operational up-position." The "up-position" is defined as being above the aforementioned restricted areas. The basic reason is to assure that horizontal motion translation does not occur when a fuel assembly is partially inserted into the canister basket, which could cause major damage to the fuel assembly and, thereby, disperse highly radioactive fuel pellets. While the standard permits an allowed bypass for this interlock, the bypass is limited to a jogging function that confines travel to increments of 1/16 of an inch. The NAC-UMS procedures do not make it clear that installed bypasses must be step-by-step, as required by the standard, not continuous motion. The handling equipment of a plant applying for approval to load dry storage canisters should be checked for continuous translation bypass in sensitive areas in order to eliminate the potential for a major radioactive dispersing accident.

Comment 13

The PSER does not address the impact of the NAC-UMS cask storage system on stormwater quality.

Comment 14

The PSER does not address the necessary financial capability of a license holder to operate and maintain the NAC-UMS cask storage system over the 20-year license period.

Comment 15

The PSER does not address the necessary technical capability of the license holder to operate and maintain the NAC-UMS cask storage system