March 4, 2004

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SUBJECT: MEETING WITH INDUSTRY REPRESENTATIVES AND OTHER INTERESTED STAKEHOLDERS ON OPTIONS FOR NON-LWR CONTAINMENT FUNCTIONAL PERFORMANCE REQUIREMENTS

The staff held a public workshop on January 14, 2004, to discuss and solicit comments on the staff's initial efforts to develop functional performance requirements and criteria for the containment design of new non-light water reactors (LWRs). The meeting was well attended; most of the stakeholders represented the nuclear industry or organizations within the Department of Energy and the national labs supporting non-LWR design activities. Attachment 1 contains the workshop agenda, Attachment 2 contains the list of workshop attendees, Attachment 3 contains the NRC presentation slides, Attachments 4 - 7 contain the stakeholder presentations, and Attachments 8 - 10 contain stakeholder comments.

NRC staff introduced the topic of the workshop and provided a background of the issue. The staff stated that Staff Requirements Memorandum (SRM) on SECY-03-0047 directed the staff to interact with industry experts and other interested stakeholders to develop options for non-LWR containment functional performance requirements and criteria. Stakeholder presentations were given by representatives from PBMR Pty., Westinghouse, Framatome-ANP, and General Atomics. Following the stakeholder presentations, NRC staff led a discussion on non-LWR containment potential functional areas, including:

1. Contain fission products
2. Prevent and mitigate severe core damage accidents
3. Remove heat during accidents
4. Protect safety equipment from natural phenomena, dynamic effects
5. Protect on-site workers from radiation
6. *Physically protect vital equipment (security events)

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RES staff announced at the workshop that a future workshop will be held to discuss the staff's options prior to making recommendations to the Commission on the policy issue. A summary of the workshop discussions is presented below.

Introduction

NRC staff opened the meeting by providing background information on the policy issue (see Attachment 3). The staff noted that the policy issue of the acceptability of non-LWR containment designs emerged from the Pebble Bed Modular Reactor (PBMR) and the Gas Turbine-Modular Helium Reactor (GT-MHR) pre-application reviews. This issue, in the context of future non-LWRs, was brought to the attention of the Commission in SECY-93-092, "Issues Pertaining to the Advanced Reactor (PRISM, MHTGR, and PIUS) and CANDU 3 Designs and their Relationship to Current Regulatory Requirements," SECY-02-0139, "Plan for Resolving Policy Issues Related to Licensing Non-Light Water Reactor Designs," and most recently in SECY-03-0047, "Policy Issues Related to Licensing Non-Light Water Reactor Designs."

The staff recommended in SECY-03-0047 that the Commission approve the use of functional performance requirements to determine the acceptability of non-LWR containment designs, and that if approved, the staff would develop the functional performance requirements. The Commission responded in a Staff Requirements Memorandum (SRM) dated, June 26, 2003, that the staff should first develop options for non-LWR containment functional performance requirements and criteria, accounting for such features as core fuel and cooling system design and interacting with industry experts and other stakeholders, and then to submit options and recommendations to the Commission. NRC staff stated that the Commission will receive a status report on this issue in April, 2004, and that the recommendations on the containment functional performance requirements and criteria would be submitted late in 2004.

The staff noted that the NRC has an ongoing effort to develop a technology-neutral, risk-informed, and performance-based framework to license and regulate new plant designs. A description of 'defense-in-depth' is currently being developed as part of the new framework. The resolution of the containment functional performance policy issue will be consistent with the defense-in-depth description. Additionally, special treatment requirements and generic requirements, such as quality assurance, will be addressed in the framework and will be applied to all containment functions.

Stakeholder Presentations

"*PBMR Containment Design Philosophy*" E. Wallace, PBMR Pty.
This presentation (see Attachment 4) identified the design functions for the PBMR module building and concluded that while a vented, filtered containment structure is necessary for the PBMR, functional requirements and criteria of a containment or confinement structure may vary by plant type and design. In response to questions from workshop participants, the presenter stated that maintaining core geometry is not synonymous with preventing core damage, that the PBMR containment structure is not pressure-retaining, and that venting the containment requires power.

"*PBMR Adapted for INEEL Co-Generation NGNP*" S. Caspersson, Westinghouse
This presentation (see Attachment 5) emphasized that the PBMR containment system takes advantage of the characteristics of the particle fuel and also concluded that a vented containment concept is best for the adapted PBMR but that functional requirements for containment/confinement structures would vary between plant designs. The workshop participants had questions about the severe accident considerations when co-siting nuclear plants and Hydrogen plants, to which the presenter responded that the interface is not yet

completely defined, but that this issue would most likely turn out not to be a large concern. The workshop participants questioned what the term “severe accident” means for newer plants. NRC staff responded that the new framework will address the categorization of events and accidents.

“*The Framatome-ANP Indirect Cycle VHTR*” S. Mazurkiewicz, Framatome-ANP
This presentation (see Attachment 6) described the VHTR safety design approach, identified reactor building safety functions, and stressed the importance of fuel performance and a highly reliable pressure boundary in its approach to a containment system. The reactor building is a filtered, low-pressure structure that serves as a containment building for the Indirect Cycle VHTR.

“*Gas Turbine-Modular Helium Reactor* [GT-MHR] *Safety Approach*” T. Quinn, General Atomics
This presentation (see Attachment 7) emphasized that the design has a minimal reliance on active systems. Workshop participants asked whether studies were done on different containment designs; the presenter stated that extensive studies and cost-benefit analyses could not make the case for using a leak-tight containment structure for a GT-MHR, and that it was a political decision to use a leak-tight containment on the plutonium-production plant in Russia.

Potential Containment Functional Performance Areas
NRC staff presented the list of potential functional performance areas for non-LWR containments (see Attachment 3):

1. Contain fission products
2. Prevent and mitigate severe core damage accidents
3. Remove heat during accidents
4. Protect safety equipment from natural phenomena, dynamic effects
5. Protect on-site workers from radiation
6. *Physically protect vital equipment (security events)

and asked the workshop if there was anything to add to and/or change on the list. The workshop participants stated that there needed to be a clarification between reactor safety functions, containment safety functions, and where the two overlap. Stakeholders also voiced that the NRC should look at how to apply these safety functions to radiation sources outside of the core.

Many stakeholders agreed that specific aspects of the containment building can only be addressed in the consideration of a specific technology and design, and that generic requirements are not very practical at a low level. Stakeholders also generally agreed that the NRC should make functional performance requirements technology-neutral (within the non-LWR arena), but that functional performance criteria should be done on a design-specific basis, and that for now, the NRC should focus on high-temperature, gas-cooled reactors (HTGRs) while developing functional performance criteria.

The workshop participants generally agreed that functional performance areas 1 and 2 should be combined and modified to an area such as “manage the release of fission products during accidents.” There was significant uncertainty expressed among stakeholders on the meaning of “core damage” for non-LWRs. None of the stakeholders knew what core damage or severe accidents meant for non-LWRs as these terms are not well defined outside of the LWR arena. The staff stated that a definition for core damage, applicable to non-LWRs, had not yet been

*Outside of meeting scope.

established, but would be, as part of the new regulatory framework.

Some stakeholders stated that only areas 1, 2, and 3 are primarily functions of the containment, and that the other areas are really supportive functions. Additionally, the workshop participants noted that some of the functional performance areas are not exclusive functions of the containment and can be accomplished or shared by other systems or structures.

Much discussion centered on the meaning of 'containment,' and whether the word was being used to talk about the function of containing radionuclides or a physical containment structure. The workshop participants generally agreed that for the purposes of the discussions, 'containment' would refer to a structure and that 'containment building' and 'reactor building' could be used interchangeably; i.e. that the use of the word 'containment' did not necessarily imply a building with pressure-retaining capability. It was suggested that the title of the slide be changed to "Potential Containment Building Functional Performance Areas" to emphasize that the listed functions refer to an actual building rather than to the function of containing radionuclides.

Stakeholders were asked if any functional performance areas needed to be added to the list, there were no suggestions.

1. Contain Fission Products

NRC staff opened the discussion on this topic by presenting the preliminary potential performance requirements the staff had generated (see Attachment 3). The workshop participants generally agreed that this functional area should be combined with the "Prevent and Mitigate Severe Core Damage Accidents" area, with some changes to the wording. It was pointed out that some of the requirements listed on the slide may be accomplished by means other than the containment.

The question: "Is it reasonable to expect to be able to seal off the building" was posed to the workshop audience. Workshop participants responded that the pressure-retaining capability should not be forced through the regulations. Many workshop participants thought that the NRC should not require a containment building to be pressure-retaining, or to have the capability to filter fission products, but that the regulations should focus on what dose acceptance criteria need to be met outside of the reactor/containment building.

Workshop participants questioned whether imposing a system (such as a filter system) through the regulations would add more uncertainty to a reactor design. They also commented that the NRC should give credit to design features that enhance operator recovery. Workshop participants generally agreed that functional performance requirements need to account for the role of the time in assessing functional performance requirements, and to consider time available for taking mitigative actions.

Workshop participants urged the NRC to take into consideration the thinking that went into writing the LWR regulations rather than prescribing certain performance requirements simply because that was what had been done in the past. Additionally, workshop participants encouraged the NRC to understand the design philosophy of the new reactors and to take that, along with how to deal with very low core damage numbers, into consideration while determining the functional performance requirements.

The questions: "Is this the right time to look at this policy issue? Should the NRC wait to look at this issue until it has an applicant to work with?" were posed to the workshop participants. It

was generally agreed that this policy issue should be looked at now, but at a higher level than what was being presented (see Attachment 3). The workshop participants generally agreed that the NRC should develop functional performance requirements now and to develop the associated criteria on a design-specific basis.

2. Prevent and Mitigate Severe Core Damage Accidents.
NRC staff opened the discussion on this topic by presenting the slide in Attachment 3. Workshop participants were again uncertain of what "severe core damage" means for new reactors, and again suggested that this functional area be combined with "Contain Fission Products." The workshop participants generally agreed that the combined functional performance area should focus on the end results and include all accidents, and should be worded similarly to: "Manage the release of fission products during accidents."

Workshop participants generally agreed that the NRC should allow the designers to have flexibility in dealing with uncertainties, and not to assume that the prevention of severe core damage (however it is defined) is a function of the containment building. The workshop participants did not agree that fission product "retention" should be necessarily assigned to the containment building.

A discussion ensued regarding how much defense-in-depth (DID) is needed in a plant design, and how that DID should be achieved. If there is reasonable assurance of fuel quality, is a containment building a necessary element of DID? How should the NRC ensure that the designers have enough diversity, and not just less uncertainty, as part of their DID strategy? Is a containment building with the capability to be pressure-retaining necessary just in case the fuel integrity is not as good as it was thought to be?

NRC staff voiced a concern that designers may pay too much attention to prevention and not enough attention to mitigation. Prevention and mitigation have to be balanced to have appropriate levels of DID. Mitigation is necessary for accounting for the unknown. Workshop participants responded by saying that there is no clear separation between prevention and mitigation, that new reactor designs are not relying on just one thing to prevent accidents.

The question: "Should there be an independent means of controlling fission products beyond the reactor coolant boundary?" was posed to the workshop. Workshop participants responded by saying that the NRC should focus on putting requirements on the conditions of an area immediately outside of the containment (or reactor) building, and not to look at how those conditions are achieved.

NRC staff stated that new reactors need to account for completeness uncertainties, that safety margins need to be in place for adverse phenomena or events that are not accounted for in the safety analysis or the PRA. Workshop participants responded by saying that there needs to be a balance of accounting for completeness uncertainties with the integrated cost of the plant, and again stressed that the NRC should establish basic dose criteria that needs to be met under accident conditions while allowing the designer flexibility in how to meet that criteria.

3. Remove Heat During Accidents
NRC staff opened the discussion on this topic by presenting the slide in Attachment 3. An industry representative stated that for the MHTGR, assuming that structural issues are taken care of by the containment, the containment doesn't need to have a role in heat removal. It was generally agreed that having the capability to remove heat is important as it adds to the time available for recovery actions.

Workshop participants voiced that this function should not be assigned to the containment building as heat removal can be accomplished with other systems. Workshop participants stated that the NRC should clarify whether this function is necessary for maintaining structural integrity of the containment building or if it is important for the retention of fission products in the fuel. Another participant posed the question of how much redundancy and diversity should be required for passive components.

Workshop participants were in general agreement that the reactor/containment building, no matter what it looks like, must accommodate and not interfere with heat removal and recovery actions for the purposes of maintaining fuel integrity, terminating fuel damage if such damage is underway, ensuring building and structural integrity, and facilitating recovery actions after an accident.

4. Protect Safety Equipment from Natural Phenomena, Dynamic Effects
NRC staff opened the discussion on this topic by presenting the slide in Attachment 3. NRC staff stated that while this function may be shared with other barriers, there is a role for containment. Workshop participants stated that they would prefer this requirement not be assigned specifically to containment, and that the NRC would only require that provisions are provided within the system structures and components to protect against the adverse effects of natural phenomena.

5. Protect on-site workers from radiation
NRC staff opened the discussion on this topic by presenting the slide in Attachment 3. NRC staff stated that this function is new and does not currently exist for off-normal conditions in the regulations outside of control room habitability. The staff noted that this function is not directed at worker protection under normal operating conditions since that is well covered in 10 CFR 20.

Workshop participants commented that there need not be additional regulations for worker protection under accident conditions as the existing regulations were adequate, and suggested that new plants use something similar to Severe Accident Management Guidelines (SAMGs). NRC staff pointed out that the SAMGs were created as an afterthought for LWRs, and that the NRC is trying to develop worker protection in accident scenarios as part of the regulatory framework for new reactors.

The workshop participants generally agreed that this functional performance requirement should require the reactor (or containment) building to accommodate and not to interfere with recovery actions.

6. Physically protect vital equipment (security events)
This topic was not discussed at the workshop.

Containment Structures, Systems, and Components Functionality
NRC staff opened the discussion on this topic by presenting the slide in Attachment 3. NRC staff stated that this performance requirement ensures that the containment building is able to perform its functions under the conditions it is expected to perform in; and that this requirement, along with other special treatment requirements, may be addressed instead via the new reactor framework rather than in the context of containment functional performance requirements.

Workshop participants questioned why the containment would be singled out in this performance requirement when this is something that would apply to all structures, systems, and components (SSCs) for any new reactor. A workshop participant suggested that if the

NRC keep this requirement, that the wording be changed to: “Like all other SSCs in the plant, the containment SSCs will be subject to the special treatment requirements of the new reactor framework.” The NRC staff responded that this functional performance requirement was included for completeness and not to suggest that the containment SSCs were unique in this regard.

Potential Evaluation Metrics
NRC staff opened the discussion on this topic by presenting the slide in Attachment 3. Workshop participants suggested adding the following evaluation metrics to the list: cost benefit considerations, burden reduction, and consistency with the designers plans.

NRC staff responded that those items would be taken into consideration while weighing the pros and cons for the options developed for each performance requirement, but that the list presented (see Attachment 3) represented the factors that a safety regulator should consider first and foremost (see Attachment 3).

General Discussion, Summary, and Wrap-up
NRC staff opened the floor for general comments and other points. Workshop participants indicated that they would like to have future opportunities to interact with the NRC on this topic prior to the staff providing recommendations to the Commission. NRC staff agreed that future interactions would add much to the discussion and encouraged designers of HTGRs, liquid metal reactors (LMRs), sodium-cooled reactors, and other non-LWRs to plan for a future workshop with the NRC.

The meeting concluded with the general agreement that the workshop was very productive and had provided for a good exchange of information. NRC staff presented the key points raised during the workshop; participants agreed that the list was complete.

Attachments:
1. Agenda
2. Attendance List
3. NRC Presentation
4. PBMR Presentation
5. Westinghouse Presentation
6. Framatome-ANP Presentation
7. General Atomics Presentation
8. Written comments from Nuclear Energy Institute
9. Written comments from PBMR (Pty), Ltd.
10. Written comments from Westinghouse

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Memo dated: 03/04/04

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