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From: Joseph Williams  
To: NRR\_NRLPO  
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Subject: Commission Meeting Materials

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The attached files provide the staff's slides and background materials which are going to be used at the May 29 Commission meeting.

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*TAB 055*

**Status of New Reactor Licensing Activities**

**Commission Briefing, May 29, 2002**

**Background Material for "Status of New Reactor Licensing Activities"**

**Presented by James Lyons, Director  
New Reactor Licensing Project Office, NRR**

1. Presentation Overview (Slide 2)
  - a. recent products
  - b. current activities
  - c. stakeholder interactions
  - d. schedule and workload uncertainty
  - e. technical and policy issues
  - f. upcoming products

2. Recent products (since July 19, 2001 Commission briefing) (Slides 3 - 6)
  - a. SECY-01-0188, "Future Licensing and Inspection Readiness Assessment," October 12, 2001
  - b. SECY-01-0207, "Legal and Financial Issues Related to Exelon's Pebble Bed Modular Reactor," November 20, 2001
  - c. SECY-02-0059, "Use of Design Acceptance Criteria for the AP1000 Standard Plant Design" April 1, 2002
  - d. SECY-02-0067, "Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for Operational Programs (Programmatic ITAAC)," April 15, 2002
  - e. SECY-02-0076, "Semi-annual Update to the Future Licensing and Inspection Readiness Assessment," May 8, 2002
  - f. SECY-02-0077, "Proposed Rule to Update 10 CFR Part 52," May 8, 2002

3. Current activities (Slide 7)

a. PBMR pre-application (Slide 8)

- i. Exelon announced on April 16 that it will not be proceeding with the PBMR project beyond the current phase
- ii. planning for logical conclusion
  - (1) May 16 planning meeting
  - (2) Exelon and staff will document review so that information is easily retrievable by any future applicant
  - (3) Exelon submittals
    - (a) paper containment issues
    - (b) response to Powers' trip report
    - (c) summary of German fuel testing
    - (d) summary of pre-application review and correspondence in June 2002
  - (4) staff documenting questions on technical issues, no response from Exelon expected
- iii. modular and merchant plant legal and financial issues, SECY-01-0207 November 20, 2001
  - (1) topics
    - (a) operator staffing
    - (b) fuel cycle impacts
    - (c) financial qualifications
    - (d) decommissioning costs and funding
    - (e) antitrust review
    - (f) number of licenses
    - (g) annual fees
    - (h) financial protection
    - (i) COL testing requirements
  - (2) March 27, 2002 public workshop
  - (3) May 22 meeting with NEI
  - (4) NEI white paper addressing issues for modular and merchant plants expected in June 2002
  - (5) staff recommendations August 2002

b. AP1000 design certification (Slide 9)

- i. acceptance review to be completed shortly
- ii. SECY-02-0059 (April 1, 2002) informed the Commission of staff views on use of design acceptance criteria (DAC)
  - (1) paper for information only, no decision requested
  - (2) DAC: a set of prescribed limits, parameters, procedures, and attributes upon which the NRC relies, in limited technical areas, in making a final safety determination to support a design certification
  - (3) instrumentation and controls

- (4) control room
  - (5) piping design
- c. GT-MHR pre-application (Slide 10)
  - i. General Atomics submitted a pre-application licensing plan on February 18, 2002
  - ii. staff response May 14, 2002
    - (1) similar to PBMR pre-application plan
    - (2) familiarize the staff with GT-MHR design and technology
    - (3) assess analytical tools and establish an independent staff capability to quantitatively assess HTGR safety performance
    - (4) identify key technology issues and safety implications, including research needs to address these issues
    - (5) requested realistic schedule
- d. Early site permit preparation (Slide 11)
  - i. 3 sites identified
    - (1) Exelon - Clinton, June 2003
    - (2) Entergy - Grand Gulf, June 2003
    - (3) Dominion - North Anna, Fall 2003
  - ii. Review areas
    - (1) environmental impact
    - (2) site emergency plan
    - (3) site suitability
  - iii. pre-application activities
    - (1) meetings with applicants
      - (a) May 28 kick-off meeting
      - (b) future meetings on each review area
    - (2) local public meetings
    - (3) staff review of applicant data gathering and site walkdown
    - (4) resolution of NEI issues
      - (a) ESP Inspection Guidance
      - (b) Nature and timing of NRC activities prior to ESP application submittal
      - (c) QA requirements of ESP information
      - (d) Guidance for seismic evaluations required by 10 CFR 50, Appendix S
      - (e) Nominal NRC review timeline
- e. Infrastructure development (Slide 12)
  - i. rulemaking
    - (1) Part 52 update
      - (a) proposed rule, policy issues
      - (b) NEI petitions

- (2) others
  - (a) Part 51 changes
    - (i) Tables S3 & S4
    - (ii) alternate site review
  - (b) 10 CFR 50 Appendix I ALARA requirements
  - (c) 10 CFR 50.54 operator staffing
- ii. construction inspection program
  - (1) Programmatic ITAAC, SECY-02-0067, April 15, 2002
    - (a) staff: ITAAC needed
    - (b) NEI: ITAAC not necessary
  - (2) ITAAC implementation
    - (a) NEI position
    - (b) staff working on comments
  - (3) inspection guidance updates
    - (a) team formed
    - (b) initial focus on guidance for ESP applications
- iii. advanced reactor research plan
  - (1) confirmation of applicant's safety basis
  - (2) develop analytical tools and data
  - (3) technical basis for regulatory changes
  - (4) identification of long lead time items
  - (5) paper planned for September 2002
- iv. integration with overall risk-informed framework activities
  - (1) staff development of a common set of risk-informed initiatives applicable to both operating and new reactors
  - (2) May 7, 2002 NEI white paper proposing improvements applicable to all reactors
  - (3) to be discussed in more detail in the June 2002 update to the Risk-informed Regulation Implementation Plan

- 4. Stakeholder interactions (Slide 13)
  - a. public
    - i. workshops
      - (1) June 4 - 5, 2001: ACRS
      - (2) July 25 - 26, 2001: future licensing
      - (3) March 27, 2002: legal/financial issues
    - ii. opportunity for comment at meetings
    - iii. plan to conduct meetings in vicinity of sites designated for early site permits
  - b. industry
    - i. workshops as discussed above
    - ii. meetings
      - (1) early site permit process
      - (2) ITAAC implementation
      - (3) pre-application reviews
      - (4) design certification review
  - c. ACRS
    - i. briefings
      - (1) October 4, 2001, FLIRA
      - (2) November 9, 2001, PBMR licensing approach
      - (3) March 8, 2002, AP1000 pre-application
      - (4) April 11, 2002, advanced reactor research plan
    - ii. June 4-5, 2001 workshop
    - iii. will continue to keep ACRS informed on activities and staff positions
  - d. inter-office (NRR, RES, NMSS, OGC, Regions, et al.)
    - i. internal workshop July 24, 2001
    - ii. regional counterparts meetings
    - iii. DRS/DRP meetings
  - e. interagency (DOE)
    - i. interagency funding agreements
    - ii. coordinated research



- f. international
  - i. overseas visits focused on HTGR issues (Germany, Japan, China, South Africa, and the United Kingdom)
  - ii. international research cooperation

5. Schedule and workload uncertainty (Slide 14)
  - a. PBMR decision - large impact on resources planned for combined license review
  - b. 3 simultaneous ESP reviews
    - i. environmental review resource availability
    - ii. site safety review resource availability (skills and amount)
  - c. ESBWR
    - i. 4000 MWt, 1380 MWe boiling water reactor incorporating passive safety features
    - ii. derived from ABWR (certified design) and SBWR (some NRC review)
    - iii. April 18 GE letter
      - (1) proposed 12-month pre-application review
      - (2) expect to reach agreement on scope and schedule later this summer
      - (3) design certification application after completion of pre-application review
  - d. SWR 1000
    - i. 2778 MWt, 1000 MWe boiling water reactor incorporating passive safety features
    - ii. In presentation to the staff on March 13, 2002 and subsequent telephone calls, Framatome indicated pre-application review could begin in early 2003
  - e. GT-MHR
    - i. Per February 18, 2002 letter, General Atomics is seeking a sponsor for this design
  - f. staff will apply planning, budgeting, and performance monitoring (PBPM) to allocate resources



# **New Reactor Licensing Activities**

**James Lyons, NRR**

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# **Presentation Overview**

- **Recent products**
- **Current activities**
- **Stakeholder interactions**
- **Schedule and workload uncertainty**
- **Technical and policy issues**
- **Upcoming products**

## **Recent Products**

- **SECY-01-0188, “Future Licensing and Inspection Readiness Assessment,” October 12, 2001**
- **SECY-01-0207, “Legal and Financial Issues Related to Exelon’s Pebble Bed Modular Reactor,” November 20, 2001**

## **Recent Products, cont.**

- **SECY-02-0059, “Use of Design Acceptance Criteria for the AP1000 Standard Plant Design,”  
April 1, 2002**

## **Recent Products, cont.**

- **SECY-02-0067, “Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for Operational Programs (Programmatic ITAAC),” April 15, 2002**

## **Recent Products, cont.**

- **SECY-02-0076, “Semi-annual Update to the Future Licensing and Inspection Readiness Assessment,” May 8, 2002**
- **SECY-02-0077, “Proposed Rule to Update 10 CFR Part 52,” May 8, 2002**



# **Current Activities**

- **PBMR pre-application**
- **AP1000 design certification**
- **GT-MHR pre-application**
- **Early site permit application preparation**
- **Infrastructure development**

# **PBMR Pre-application**

- **On April 16, Exelon withdrew from the PBMR project**
- **Plans for closing out pre-application activities**
- **Recommendations on modular and merchant plant issues - August 2002**

# **AP1000 Design Certification**

- **March 28, 2002 application**
- **Acceptance review to be completed shortly**
- **SECY-02-0059 on the use of design acceptance criteria**
  - **Instrumentation and controls**
  - **Control room**
  - **Piping design**

# **GT-MHR Pre-application**

- **General Atomics licensing plan submitted February 18, 2002**
- **Staff response May 14, 2002**

# **Early Site Permits**

- **Three sites identified**
  - **Clinton (Exelon), June 2003**
  - **Grand Gulf (Entergy), June 2003**
  - **North Anna (Dominion), Fall 2003**
- **Staff review areas**
- **Pre-application activities**

# **Infrastructure Development**

- **Rulemaking**
- **Construction inspection program**
- **Advanced reactor research plan**
- **Related activity**
  - **Risk-informed framework**

# Stakeholder Interactions

- **Public**
- **Industry**
- **ACRS**
- **Within NRC**
- **Interagency**
- **International**

# **Schedule and Workload Uncertainty**

- **Impact of PBMR decision**
- **Simultaneous ESP reviews**
- **ESBWR**
- **SWR 1000**
- **GT-MHR**



# **Technical & Policy Issues**

- **Key LWR policy and technical issues**
- **Plan to address gas cooled reactor technical and policy issues**
- **Regulatory framework**
- **Upcoming products**

# AP1000

- **NRC and DOE collaborating on integral testing for the AP1000 at the Oregon State University APEX facility**
- **NRC beyond design basis tests will start in October 2002**

# **ESBWR & SWR 1000**

- **Build upon existing LWR technology**
  - **Design basis accidents and acceptance criteria**
  - **Severe accidents and requirements**

# **ESBWR & SWR 1000**

- **Incorporate passive safety features**
- **Passive safety systems reliability**
  - **Perform beyond design basis accident tests to establish margins**

# **ESBWR & SWR 1000**

- **In-vessel melt retention**
- **Drywell flooding for core melt accident**
- **Acceptance of Codes and Standards not endorsed by NRC**

# **ESBWR & SWR 1000**

- **Upgrade NRC PUMA facility**
  - **Perform scenario-specific tests**
- **TRAC-M code validation and improvements**

# **Gas Cooled Reactors**

- **Potential policy issues**
  - **Event selection and safety classifications**
  - **Fuel performance and qualifications**
  - **Source term**

# **Gas Cooled Reactors**

- **Potential policy issues, cont.**
  - **Containment performance**
  - **Emergency evacuation**
- **Stakeholder engagement**
- **Recommendation to Commission –  
Fall 2002**



# Framework

- **Develop risk-informed, performance based criteria for advanced reactors**
- **Criteria could be**
  - **Generic**
  - **Design-specific**
  - **Combination of the above**

# Framework

- **For gas cooled reactors**
  - **Need to develop Core Damage Frequency (CDF) and Large Early Release Frequency (LERF) as surrogates to the Commission Safety Goals**

## **Selected Technical Issues**

- **Status paper on key gas cooled reactor technical issues – June 2002**
  - **Fuel quality and performance**
  - **Fission products release**
  - **High temperature materials and design**

# **Upcoming Products**

- **Key policy issues on High Temperature Gas Cooled Reactor (HTGR), June 2002**
- **Key HTGR technical issues, June 2002**
- **Risk-informed Regulation Implementation Plan Update, June 2002**

## **Upcoming Products, cont.**

- **Recommendations on modular and merchant plants, August 2002**
- **NEI petitions recommendations, September 2002**
- **Recommendations on HTGR policy, Fall 2002**
- **Advanced Reactor Research Plan, Fall 2002**

# RES Supporting Information

## **Advanced Reactor Briefing**

# Safety Goals

- Need to consider the following policy issues
  - Increase level of safety
  - Defense-in- depth, safety margins
  - additional cornerstones
    - radiation safety (worker), security, safeguards
    - environmental risk metrics (land contamination)

## Key Technical and Policy Issues for Gas Cooled Reactors

- **Event selection and safety classifications** -- An approach is proposed that establishes three frequency categories
  - Anticipated Operational Occurrences (AOO) –  $2.5 \times 10^{-2}$  ~ ALARA
  - Design Basis Events (DBE) – Encompasses releases not expected during the lifetime of one plant --  $10^{-4}$  per plant year
  - Emergency Planning Basis Events (EPBE)–improbable vents--not expected to occur during the life of several hundred nuclear power plants –  $5 \times 10^{-7}$
- **Questions – Impact on containment and emergency evacuation**
  - What are the implication of using PRA information to establish the licensing basis for GCR? – Issues Large uncertainties (i.e., limited experience)
  - What criteria should be used – risk metrics, confidence level, cost benefit
  - How should defense-in-depth be applied
    - Prevention vs. mitigation; reliability, redundancy, diversity independence;
  - How should defense-in-depth be applied considering long response time
  - What should be the role of engineering judgment in event selection?
  - Should higher level of safety be a criterion for new plant design so as:
    - Maintain low cumulative risk as more plants become operational?
    - Compensate for limited operational experience



## Key Technical and Policy Issues for Gas Cooled Reactors

- **Fuel Performance and Qualification**
  - Designed to achieve burnup of 80,000 MWd/t
  - Withstand high temperature (1600°C) without release of fission products
- **Questions**
  - What scope of fuel qualification testing will be completed to support application and when and how will the remainder be obtained?
  - How will the analytical tools be validated to ensure reliable prediction of fuel temperatures?
  - How will experimental data beyond DBE be used by the staff in the licensing process?
- **Policy Issues**
  - Should the fuel qualification test program be completed prior to granting COL, or can it be consider a condition of the license verified during or after plant construction?
  - Should the scope of the test include beyond DBE to establish margin?
  - Who should pay for beyond DBE?

## Key Technical and Policy Issues for Gas Cooled Reactors

- **Licensing Source Term** –TID-14844, NUREG-1465 are used to determine LWR containment effectiveness and site suitability
- **Questions**
  - Under what conditions,if any, should the Commission accept the use of scenario specific source terms for licensing decisions regarding containment and site suitability?
  - How to account for uncertainties?
- **Containment vs. Confinement**
- **Question**
  - Under what conditions,if any, should the Commission accept the use of non-pressure retaining containment building?
- – The role of containment vs. confinement in protecting the plant from external threats, sabotage, and maintaining public confidence?

## Key Technical and Policy Issues for Gas Cooled Reactors

- **Metallic Components Performance**
  - S Maintain structural integrity under high temperatures and impure environments
- **Questions**
- Do impurities in the helium lower the fatigue and creep lives, and increase susceptibility to cracking?
- Do high temperature design codes and standards take into account effects of impurities?
- The connecting pipe has been designated a vessel. As such, there is no break analysis conducted and no mitigation steps/equipment provided. Since the pipe is relatively thin, and cracks could grow through wall relatively quickly, what is the basis for treating the pipe as a vessel?
- Are inspection intervals and extent of inspection adequate?
- **Policy Issue**
- Can reactor design and licensing proceed in the absence of acceptable national codes and standards that take into account the detrimental effects of the reactor environment?
- Is it acceptable to treat the connecting pipe as a vessel?
- Since inservice inspections can only be conducted infrequently, and important components may be inaccessible, should continuous monitoring for structural integrity of reactor components be required?

## Key Technical and Policy Issues for Gas Cooled Reactors

### !Graphite Performance -

- Very high temperatures, in excess of 1200 °C; Helium gas atmosphere; Neutron fluences ranging from 0.02 to 0.59 X 10<sup>22</sup> n/cm<sup>2</sup>.
- Maintain structural integrity under irradiation and environmental conditions

### !Questions

- How do the mechanical and physical properties change as a function of irradiation for different graphite?
- How does irradiation affect core geometry as a function of fluence?
- Are codes and standards available for the design of graphite components for AGR service?

### !Policy Issues

- Since different graphite behave differently, should irradiation data, for the specific graphite, be required prior to design of graphite components and licensing of AGRs?
- Can reactor design and licensing proceed in the absence of nationally-accepted codes and standards that take into account the behavior of graphite under operating conditions?

## Key Technical Issues for Advanced Light Water Reactors

- Applicability of existing data and analysis tools to advanced reactors

### AP1000

- Extensive AP600 (NRC, Westinghouse, and DOE) data have been demonstrated to be applicable to AP1000. Supplemental AP1000 tests are being conducted

### ESBWR

- Extensive SBWR (General Electric—Panda, Giraffe, GIST)
  - NRC independent data is limited, but can be generated expeditiously
- Scaling Analysis to demonstrate applicability of tests to ESBWR
- Qualification of NRC TRAC-M code to model important ESBWR phenomena
- Role of operators and man machine interface
- Reliability of Passive Components
  - Non-condensable gas distribution in the containment and its effect on the Passive Containment Cooling System (PCCS)

## Regulatory Framework

- Linked to other agency work to improve coherence of regulation
- Develop a plan to obtain criteria which can be used to address technical issues
- Criteria will be an expansion of the Option 3 "Framework" for risk-informing current regulations - to allow application to gas cooled reactors
- Need to consider a number of policy and technical issues
- Examples of technical issues:
  - Develop appropriate core damage frequency (CDF) and large early release frequency (LERF) for gas cooled reactors as surrogate to the Commission Safety Goals
  - For the surrogates chosen, determine the appropriate quantitative guidelines
  - Define what is the appropriate level of defense-in-depth, safety margin, etc.
    - Considerations will differ from those of current reactors where margins, defense-in-depth layers are well established
- Criteria could be established at various levels
  - Generic – applicable to all currently envisioned advanced designs
  - Design Specific – applicable to one design or a group of similar designs
  - Combination of the above

## Regulatory Framework

- Examples of Policy Issues
  - Should higher level of safety be a criterion for gas cooled reactors
  - Should criteria apply to single units or entire sites (what about mixed sites – current reactors and advanced reactors on same site)
- Plan would outline a path for generating decision-making criteria that:
  - Are consistent (coherent) with other agency activities
  - are suitable for developing design and operating requirements for gas cooled reactors in a consistent, systematic and structured manner.
  - allow direct linkage of advanced reactor regulations to high level safety goals and principles
  - can be used to demonstrated that the safety goals are met (or exceeded)
  - are performance based.
  - outlines the process a licensee and NRC will go through to ensure high level goals are met

# Regulatory Framework

- Plan will describe approach that:
  - adheres to the hierarchical structure of the Option 3 Framework
    - Safety goals – additional goals?-policy
    - Cornerstones - additional cornerstones ?-policy
    - Strategies – policy, technical
      - balance of prevention vs. mitigation in terms of quantitative guidelines and/or qualitative guidance (defense-in-depth)
      - surrogates or complete consequence analysis
    - Tactics – changes in margins, redundancy, SSC treatment from current practice? – policy, technical
- Decision Criteria will be a combination of quantitative and qualitative criteria – consistent with Option 3 Framework