



# GENERIC LICENSING TOPICS & POLICY ISSUES RELATED TO SMALL MODULAR REACTORS

September 22 - 23, 2010

# Generic Issues

## NRC Activities

William Reckley  
Advanced Reactor Program  
Office of New Reactors

# SECY 2010-034

- Licensing Process Issues for Small Modular Nuclear Reactors
  - ⊕ License for Prototype Reactors
  - ⊕ License Structure for Multi-Module Facilities (Modularity)
  - ⊕ Manufacturing License Requirements for Future Reactors
- Issues Concerning Design Requirements for Small Modular Nuclear Reactors
  - ⊕ Implementation of the Defense-In-Depth Philosophy for Advanced Reactors
  - ⊕ Use of Probabilistic Risk Assessment in the Licensing Process for SMRs
- Appropriate Source Term, Dose Calculations, and Siting for SMRs
- Key Component and System Design Issues for SMRs

# SECY 2010-034

- Operational Issues for Small Modular Nuclear Reactors
  - ⊕ Appropriate Requirements for Operator Staffing for Small or Multi-Module Facilities
  - ⊕ Operational Programs for Small or Multi-Module Facilities
  - ⊕ Installation of Reactor Modules During Operation for Multi-Module Facilities
  - ⊕ Industrial Facilities Using Nuclear-Generated Process Heat
  - ⊕ Security and Safeguards Requirements for SMRs
  - ⊕ Aircraft Impact Assessments for SMRs
  - ⊕ Offsite Emergency Planning Requirements for SMRs
- Financial Issues for Small Modular Nuclear Reactors
  - ⊕ Annual Fee for Multi-Module Facilities
  - ⊕ Insurance and Liability for SMRs (incl: property)
  - ⊕ Decommissioning Funding for SMRSs

# Source Terms

- Non-LWR mechanistic source terms
  - ⊕ NGNP white paper
- iPWRs
  - ⊕ Question on source term models being used for assessments (e.g., emergency planning requirements)
  - ⊕ Traditional source term or plans to propose modified or mechanistic approaches

# Identify New Issues

- Design Evaluations
- Application Preparations
- Possible Siting Discussions
- Resolution of policy or key technical issues

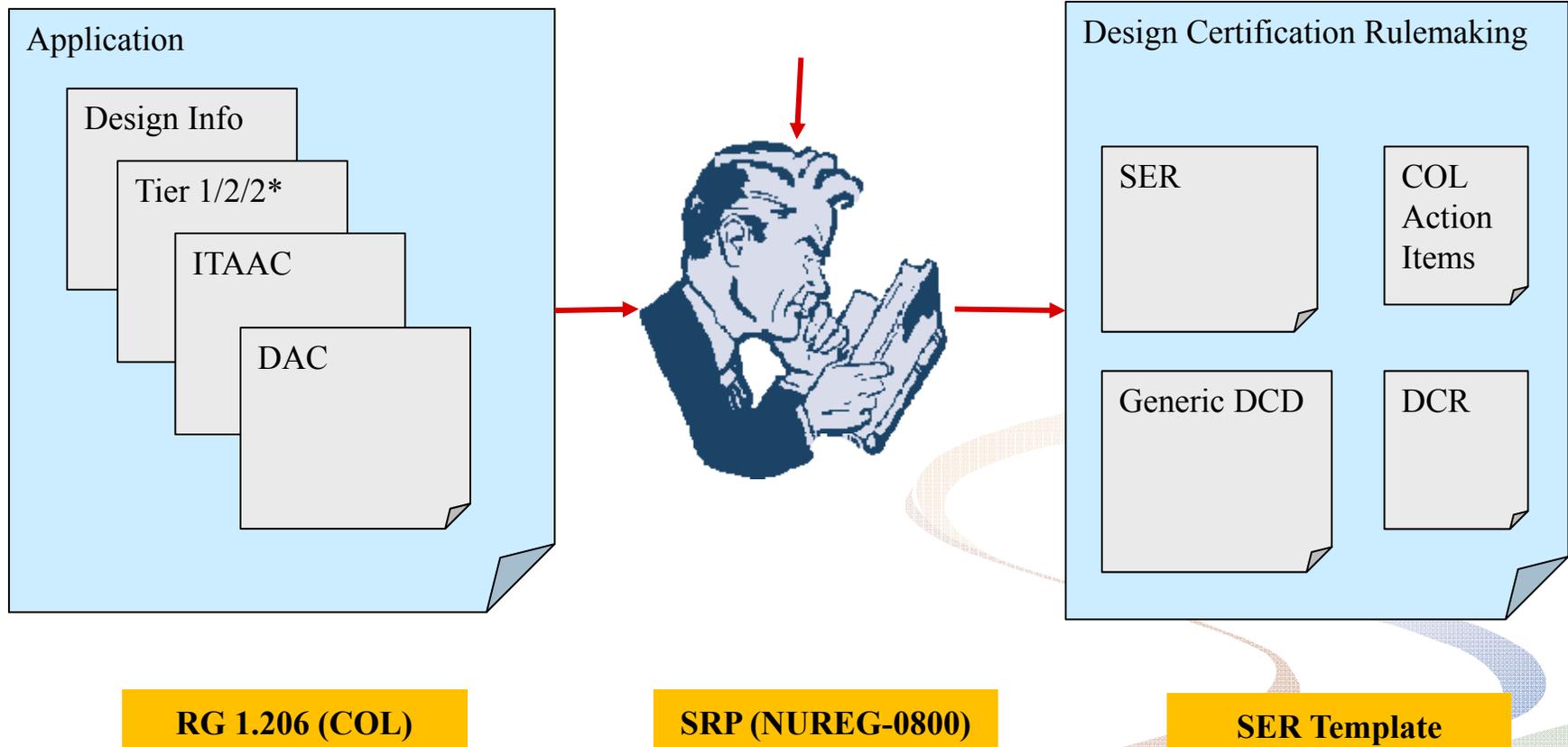
# Risk Insights for SMR Reviews

- Staff building on previous efforts
- General concept – graded approach
  - ⊕ Focus NRC review to safety significant items
  - ⊕ Improve efficiency of NRC review
- Considering more holistic approach
  - ⊕ Possible Considerations:
    - ⊕ Crediting other parts of review process, regulatory requirements (especially for lower risk significant systems)

# Optimizing Application

- Long Standing Challenge
  - ⊕ Matching information provided in application with that sought by NRC staff for performing review
- Information in applications:
  - ⊕ Scope
  - ⊕ Depth (level of detail)

# NRC Review



# Optimizing Application

- NRC staff framework to consider risk insights, improve efficiency for iPWR reviews
- Framework may include factors to guide review
- To improve efficiency of NRC review, application needs to address factors identified in framework
- Information located to support review

# Moving Forward

- Development of framework
  - ⊕ Internal discussions
  - ⊕ Consultation with national laboratories
- Discussions at future generic topics meetings
- Issuance of guidance
  - ⊕ (e.g., revised SRP, RG 1.206)
- Exchange of design and risk insights with designers
- Discussions of format and content during development of application

# Long Term Activities

- Assess lessons learned from efforts with iPWRs
- Continue discussions with NGNP regarding risk-informed licensing approaches
- Interactions with industry efforts
  - ⊕ ANS 53.1
  - ⊕ ANS 54.1
- Assess and develop risk-informed regulatory structure

# NRC Annual Fee Assessment for Small Reactors

*Paul Genoa*

*Director, Policy Development*

*September 22, 2010*

# Overview

- Problem Statement for Small Reactors
- Existing Regulatory Framework
- Proposed Regulatory Changes
- Questions

# Problem Statement

- It is anticipated that small reactors will require oversight that differs from that associated with the current fleet; therefore, appropriate adjustment should be made to annual fee assessment for small reactors to accommodate this difference.
- The NRC published an Advance Notice of Proposed Rulemaking in March 2009 on a “Variable Annual Fee Structure for Power Reactors” and describes the issue in SECY 2010-0034.
- Resolution of this issue is an important component of calculating costs associated with small reactor operation.

# Current Regulatory Framework

- The current annual fee requirements are found in 10 CFR § 171.15 , Annual Fees: Reactor licenses ....
- **Scope:** Requirements apply to any person holding an operating license for a power reactor...under part 50 of this chapter, and to any person holding a combined license issued under part 52....
- Operating reactors today range from 1,500 to 3,990 MWt. They each are assessed the same annual fee.
- Small reactor designs include non-power reactors.

# Recommended Path Forward

We believe that the following principles are helpful in determining the most appropriate annual license fee structure under 10 CFR Part 171:

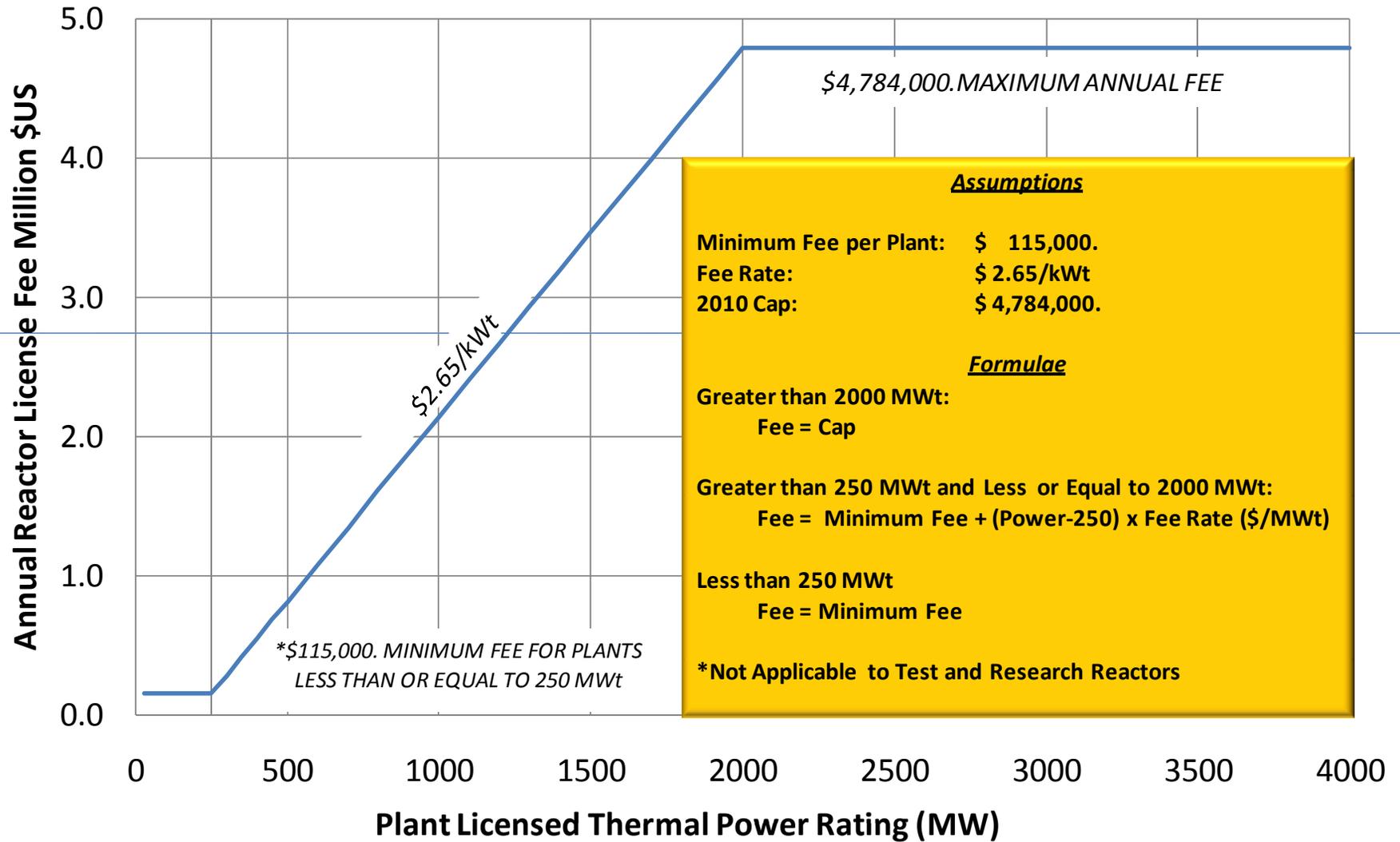
- Ensure protection of public health and safety by reimbursing the NRC adequately for the cost of regulatory oversight;
- Utilize a fee structure that shares regulatory oversight costs equitably among large and smaller-scale generation facilities; and,
- Ensure that the existing fleet of nuclear plants does not bear the regulatory framework development costs associated with deploying new technologies.

# Recommended Path Forward

- In light of these principles, NEI recommends that:
  - NRC implement the annual fee rate setting mechanism for newly licensed commercial reactors based on the combined thermal output of the facility.
  - A floor and ceiling be established for fee collection such that new plants below the floor (250 MWt) all pay one standard fee and all new plants above the ceiling (2,000 MWt) are capped at a higher standard fee.
  - A fee based on a linear scale be assessed for commercial reactors and multi-module plants whose thermal output is between the floor and the ceiling.
  - All currently operating plants pay the same fee as all new large reactors and multi-module plants with outputs above the 2,000 MWt ceiling.



## Annual Reactor License Fee per Plant



**Assumptions**

Minimum Fee per Plant: \$ 115,000.  
 Fee Rate: \$ 2.65/kWt  
 2010 Cap: \$ 4,784,000.

**Formulae**

Greater than 2000 MWt:  
 Fee = Cap

Greater than 250 MWt and Less or Equal to 2000 MWt:  
 Fee = Minimum Fee + (Power-250) x Fee Rate (\$/MWt)

Less than 250 MWt  
 Fee = Minimum Fee

**\*Not Applicable to Test and Research Reactors**

# Summary

- No intent to change relative fee structure for
  - current operating power reactors
  - test reactors
  - research reactors
- Fee for new large LWRs should be the same as for existing operating power reactors
- Formula should be adjusted accordingly as NRC makes regular fee adjustments
- SMRs will pay an equitable portion of the fees based on proposed structure
- Industry requests decision and action on this proposed structure



# Decommissioning Funding Assurance for Small Reactors

*Paul Genoa*

*Director, Policy Development*

*September 22, 2010*

# Overview

- Problem Statement for Small Reactors
- Existing Regulatory Framework
- Proposed Regulatory Changes
- Questions

## Problem Statement

- Current minimum funding requirements are designed to address current large reactors.
- The new generation of small reactors, particularly those that will use multi-module installations, will require additional guidance and flexibility to allow decommissioning funding levels to be based on design and site-specific estimates, rather than the funding formulas that are currently used for large LWRs (see 10 C.F.R. § 50.75(c)).

# Range of Reactor Type and Siting Issues for Small Reactors

Reactor Type	Siting	Issues
Small LWR	Single unit	<ul style="list-style-type: none"> <li>• Need exemption from current minimum funding level required for large LWR</li> </ul>
Small LWR	Multiple modules	<ul style="list-style-type: none"> <li>• Need exemption from current minimum funding levels designed for large LWR</li> <li>• Funding requirements should be specifically timed with the start-up of additional modules</li> <li>• Interim removal strategies for modules reaching the end of licensed life should be incorporated</li> </ul>
Non-LWR	Single unit	<ul style="list-style-type: none"> <li>• Requires design-specific decommissioning funding estimate</li> </ul>
Non-LWR	Multiple modules	<ul style="list-style-type: none"> <li>• Requires design-specific decommissioning funding estimate</li> <li>• Funding requirements should be specifically timed with the start-up of additional modules</li> <li>• Interim removal strategies for modules reaching the end of licensed life should be incorporated</li> </ul>

# Current Regulatory Framework

- 10 CFR § 50.75 in combination with § 50.33(k) provide the regulatory framework for decommissioning funding assurance.
- Regulatory Guide 1.159 provides further details on the methodology for calculating minimum decommissioning funding amounts and describes acceptable funding mechanisms.
- Formulas in 10 CFR § 50.75 (c) apply to LWRs but are designed for the current large LWR fleet
- No mention of non-LWR technology
- No mention or guidance on how to address multi-module facilities

# Current Regulatory Framework (continued)

- In August 2007 a revised rule (10 CFR § 20.1406) titled “Minimization of Contamination” provided guidance for all future applicants on how to minimize radiological contamination and generation of radioactive waste through design and operations.

# Current Regulatory Framework (continued)

- NRC staff considered decommissioning funding assurance requirements for non-LWR technology through reviews of PBMR and indicated design-specific minimum decommissioning cost estimate with a standard amount per module may be acceptable
  - SECY-01-0207, *Legal and Financial Issues Related to Exelon's Pebble Bed Modular Reactor (PBMR)*
  - SECY-02-0180, *Legal and Financial Policy Issues Associated with Licensing New Nuclear Power Plants*
- SECY-10-0034, *Potential Policy, Licensing, and Key Technical Issues for Small Modular Nuclear Reactor Designs*, item 5.3 describes a similar approach

# Current Regulatory Framework (continued)

- NUREG-1827, *Safety Evaluation Report for the National Enrichment Facility in Lea County, New Mexico* provides guidance on the changing decommissioning liability associated with multiple modules:

*"If the applicant reduces the amount of funding for the facility because of a change in module phase-in, the revisions will be submitted prior to the operation of each facility module. This will allow the applicant to modify its initial facility decommissioning funding approach to reflect changes in future enrichment module phase-in schedules."*

# 10 CFR 50.75(c) Formulae

	<i>Millions</i>
(i) For a PWR: greater than or equal to 3400 Mwt	\$105
between 1200 Mwt and 3400 Mwt (For a PWR of less than 1200 Mwt, use P=1200 Mwt)	\$(75+0.0088P)
(ii) For a BWR: greater than or equal to 3400 Mwt	\$135
between 1200 Mwt and 3400 Mwt (For a BWR of less than 1200 Mwt, use P=1200 Mwt)	\$(104+0.009P)

$$\text{Adjustment Factor} = 0.65 L + 0.13 E + 0.22 B$$

L: Labor escalation factor

E: Energy escalation factor

B: Waste burial escalation factor



## Recommended Path Forward

- Funding mechanisms described in current rule and guidance are adequate – no changes needed at this time
- Allow design-specific and site-specific minimum decommissioning cost estimates for non-LWR technologies. Existing guidance provides tools for creating these estimates.
- If using the formulas in 10 CFR § 50.75 (c), LWR SMRs will need to be allowed to provide design-specific and/or site specific estimates that are less than the minimum decommissioning funding amounts provided in the rule.

## Recommended Path Forward

- Update the guidance in RG 1.159 to allow multi-modular reactors to provide funding for liabilities associated with the additional modules as fuel load commences in each new module to ensure the minimum decommissioning funding amount is commensurate with the current site cost estimate.
- 10 CFR § 50.82 and associated guidance contemplates only the full site remediation and does not provide for partial decommissioning using the decommissioning trust during operation of the facility. This rule and associated guidance requires revisions to address the gradual decommissioning of modules over time.

# SMR Problem Statement

## Emergency Planning

Andrea Sterdis

# Overview

- White paper based on NEI template:
  - Issue scope
  - Current regulatory framework
  - Special considerations for SMRs
  - Supporting analyses/discussions (legal, technical, financial)
  - Recommended framework & path forward

# EP “Sub-Issues”

- Source term impact
- Credit for release timing
- Adjustments to EPZ Requirements
  - Siren requirements
  - Evacuation requirements
  - EP Facilities
- Interactions with other federal agencies
- State and local impact

# Emergency Planning - Schedule

- White paper outline currently in development
- Expected to be submitted to NRC by year end
- Discuss at November 4 public meeting

# SMR Problem Statement

## Modularity

Peter Hastings

# Modularity White Paper - Introduction

- White paper based on NEI template (including existing regulatory framework and proposed changes for SMRs)
- Four “sub-issues” identified to date
- Key interfaces (including existing/in progress efforts)
- Schedule

# Modularity “Sub-Issues”

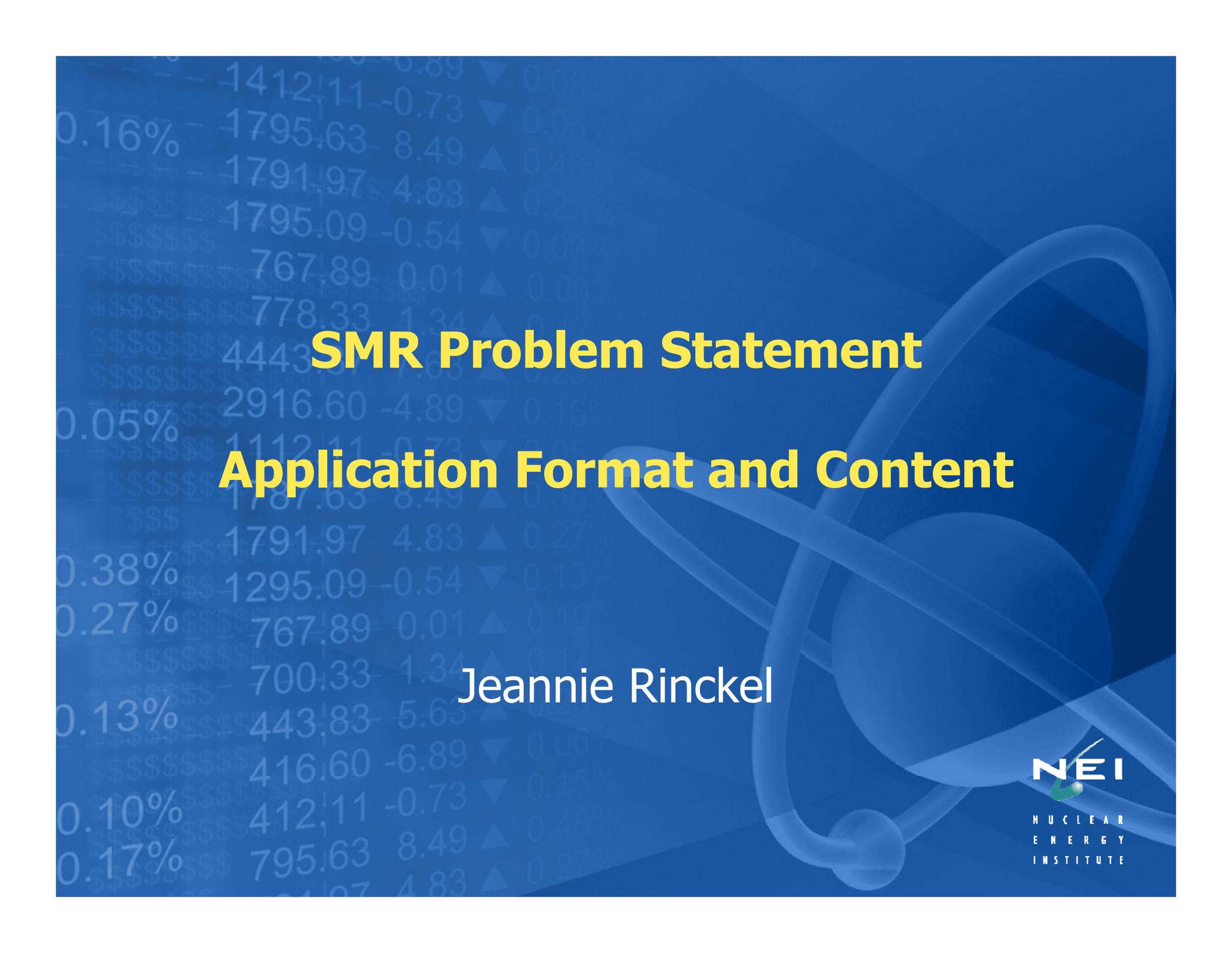
- Number of licenses
- Accident analysis/PRA considerations
- Construction adjacent to operating unit
- Construction access requirements

# Key Interfaces

- ANS papers in development (will be integrated into NEI paper)
  - Modularity
  - Licensing Process
- Related NEI topics
  - License application format and content
  - Organizational/staffing issues (to the extent modularity plays a role)
  - Control room layout

## Modularity - Schedule

- White paper currently in development
- Expected to be submitted to NRC by year end
- Discuss at November 4 public meeting

The background is a solid blue color. On the left side, there is a faint, semi-transparent grid of financial data, including numbers like 1412.11, 1795.63, 1791.97, 1795.09, 767.89, 778.33, 4443.83, 2916.60, 1112.11, 1787.65, 1791.97, 1295.09, 767.89, 700.33, 443.83, 416.60, 412.11, 795.63, and percentages like 0.16%, 0.05%, 0.38%, 0.27%, 0.13%, 0.10%, and 0.17%. On the right side, there is a large, semi-transparent blue graphic of a ring, similar to the rings of Saturn, with a sphere in the center.

# **SMR Problem Statement**

## **Application Format and Content**

Jeannie Rinckel

# Application Format and Content White Paper - Introduction

- Overview of issue description
- Work scope
- Schedule

# Issue Description

- Goal is to assure efficient application and review process
- Need well-defined expectations for
  - Application completeness
  - Level of detail
  - Content and format
- Emergence of SMR designs may result in a need for different/additional elements
- Pre-application process will be near-term focus

# Work Scope

- Review 10 CFR Parts 50, 52 application requirements (specifically 52.47 (c)(2) and (3))
  - Review application and guidance (i.e., RG 1.206, SRP, ISGs)
    - Evaluate need for documenting exceptions with NRC
    - Consider lessons learned from the new large LWR reviews
    - Evaluate standard content to support diverse technology applications

# Work Scope

- Re-confirm and re-focus pre-application engagement with the NRC
  - Role of white papers, topical and technical reports
  - Public meetings
  - Technology familiarization
- Application content changes
  - Including small LWR and non-LWR technologies
  - Adaptive to single and/or multi-module approach

# Work Scope

- Format considerations
  - Retain chapter numbering consistent with Standard Review Plan
  - Confirm SMR-unique information in an agreed upon section, i.e., multi-module configurations, integrated design features, departure from existing design features, concurrent operations and construction
  - Non-standard Technical Specifications

# Work Scope

- Potential level of detail and acceptable standards for:
  - FSAR content changes/additions
  - Identification of DAC issues in DCD (e.g., control room design)
  - Establishing ITAAC
  - Reference documents (topical reports, technical reports, etc.)

# Application Format and Content-Schedule

- Industry group actively drafting detailed white paper
- Expected to be submitted to NRC by year end
- Discuss at December 15 public meeting

# SMR Problem Statement

Price Anderson

Victoria Anderson

# Price Anderson White Paper - Introduction

- Overview of issue description
- Work scope
- Schedule

## Issue Description

- Liabilities associated with SMRs may be different than those for current reactors
  - Appropriate evaluation necessary
  - Reviewing 10 CFR 140 requirements relative to SMR designs and deployment strategies

## Work Scope

- Propose appropriately-scaled insurance requirements for primary, secondary and property insurance
- Using basis for current requirements, examine effects of different deployment strategies

## Price Anderson - Schedule

- Industry group currently engaged in discussions
- Discuss at December 15 public meeting
- Paper expected to be submitted to NRC by year end

# Interactions Between Design Certification and Combined License Activities

*Eddie Grant*

*Excel Services*

*September 22, 2010*

# SMR DC-COL Interactions

- Problem – How to keep DC applications and COL applications in sync
- Solution – Communication

# DC Applicants During Preparation

- Clearly identify COL information requirements  
- no hidden actions
- Clearly identify conceptual design information
- State criteria for what should be an ITAAC
- Separate the SAMDA ER information from DCD
- Utilize SRP section/subsection numbering to extent practical

# DC Applicants During NRC review

- Keep COL applicants informed of new COL info items
- Keep COL applicants informed of changes to existing COL info items
- Make COL applicants part of review team for submittals, e.g., RAI responses, new TRs
  - Identify potential COL application difficulties
  - Early ID of potential new and revised COL items
  - Listen to your COL applicants

# DC Applicants (Not for DC Submittal)

- Prepare information necessary for COL applicants
- Considerable additional information needed for ERs

# COL Applicants

- Consider options/advantages for incorporating DCD text (e.g., IBR)
- Consider use of electronic links
- Consider use of LMAs for identification of standard content, departures, COL items
- Participate in the DC team
  - Understand the vendor's situation
  - Would COL item help with issue timing
- Update COL item information content promptly – coordinate with DCD revisions

# NRC Reviewers

- Consider where you consistently need to ask for more – use ISG process for these areas
- Careful consideration of whether RAIs go to DC applicant or COL applicant
- Use IBR to your advantage...
  - Tech Specs from COL applicants (just the bracketed info initially)
  - Full set after the DC application is “final”
- Same for ITAAC – use IBR
  - Only new plant specific ITAAC from COL applicants (for initial application)
  - Full set after the DC application is “final”



# All Participants

- Regular status and schedule discussions between applicant and NRC project managers
- What has been issued
- What is being worked, “real” estimated completion dates
- What is being discussed – tracking for awareness

# NEI Early Site Permit Task Force

## *Small Reactor Participation*

Rod McCullum  
September 22, 2010

# Topics

- Relevance of Early Site Permits to small reactors
- NEI ESP Task Force
- NEI 10-01 – Plant Parameter Envelope Guidance
- Path Forward – Need for additional dialogue

# ESPs for Small Reactors

- Possible point of entry to regulatory process
- Potential opportunity to apply bounding analysis to developing designs through use of a Plant Parameter Envelope (PPE)
  - Address siting issues early
  - Include both small and large reactor designs in a single PPE
  - Demonstrate potential siting advantages of small reactors
  - Make licensing progress in parallel to design certification
- Need additional dialogue on required level of information to support this option

## ESP Task Force

- Formed in fall 2009 to support ESP applications expected in 2010 and beyond
- Focused on developing tools to help standardize ESP applications
- Consists of Broad Membership
  - Utilities planning to file ESPs
  - Utilities with approved ESPs
  - Vendors
    - Conventional Light Water Reactors
    - Small Modular Reactors

# ESP Task Force Path Forward

Existing ESPs



Standardized Tools



ESP Task Force

ESP Task Force



Refined Tools

Lessons Learned



NEI Guidance



Approved Guidance



Exelon



PSEG



ESP Applications



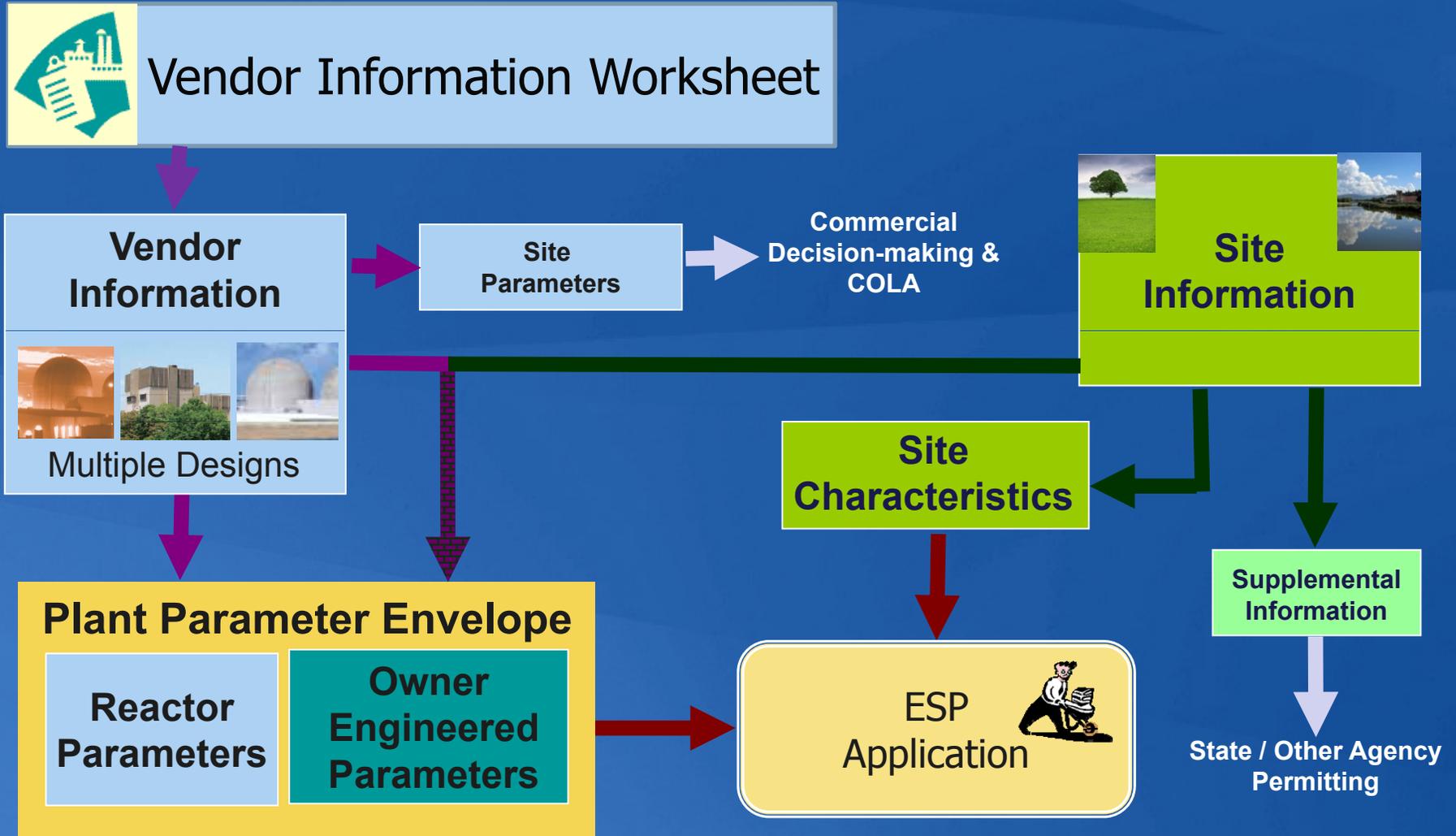
Approved ESPs



Future Applications



# PPE Concept – NEI 10-01\*



\*NEI 10-01, Revision 0, Industry Guideline for Developing a Plant Parameter Envelope in Support of an Early Site Permit, submitted to NRC on 3/26/2010

## NEI 10-01 is...

- Industry Guidance for Process to Develop a PPE
  - PSEG and Exelon cooperated on development and utilization of a common Vendor Information Worksheet
  - Reviewed with other NEI members and experienced ESP applicants
  - Vendor reviews conducted
  - Process for using Vendor Information Worksheet to construct a PPE in support of an ESP application described in NEI 10-01
  - Industry is seeking NRC endorsement of NEI 10-01 to assure that the process outlined will support NRC's review needs
- Based on the idea that a PPE is developed to bound potential designs



## NEI 10-01 is NOT...

- A substitute for NRC requirements/guidance
- A fully assembled PPE
- A compilation of specific PPE values
- A roadmap to everything that must be done to construct an ESP
- Based on the idea that a PPE must be constructed from actual design details

## PPE Guidance – Conclusion

- In asking NRC to endorse NEI 10-01 we are looking for agreement that the process described and vendor information worksheet constitute a logical, consistent, and workable framework for developing a PPE
- Task Force exploring opportunities to make NEI 10-01 more useful to small reactors
  - Additional dialogue on level of detail between NRC and ESP task force welcome on this issue