

NRC Presentations to AECL and CNSC Regarding Design Certification Process



August 17, 2004

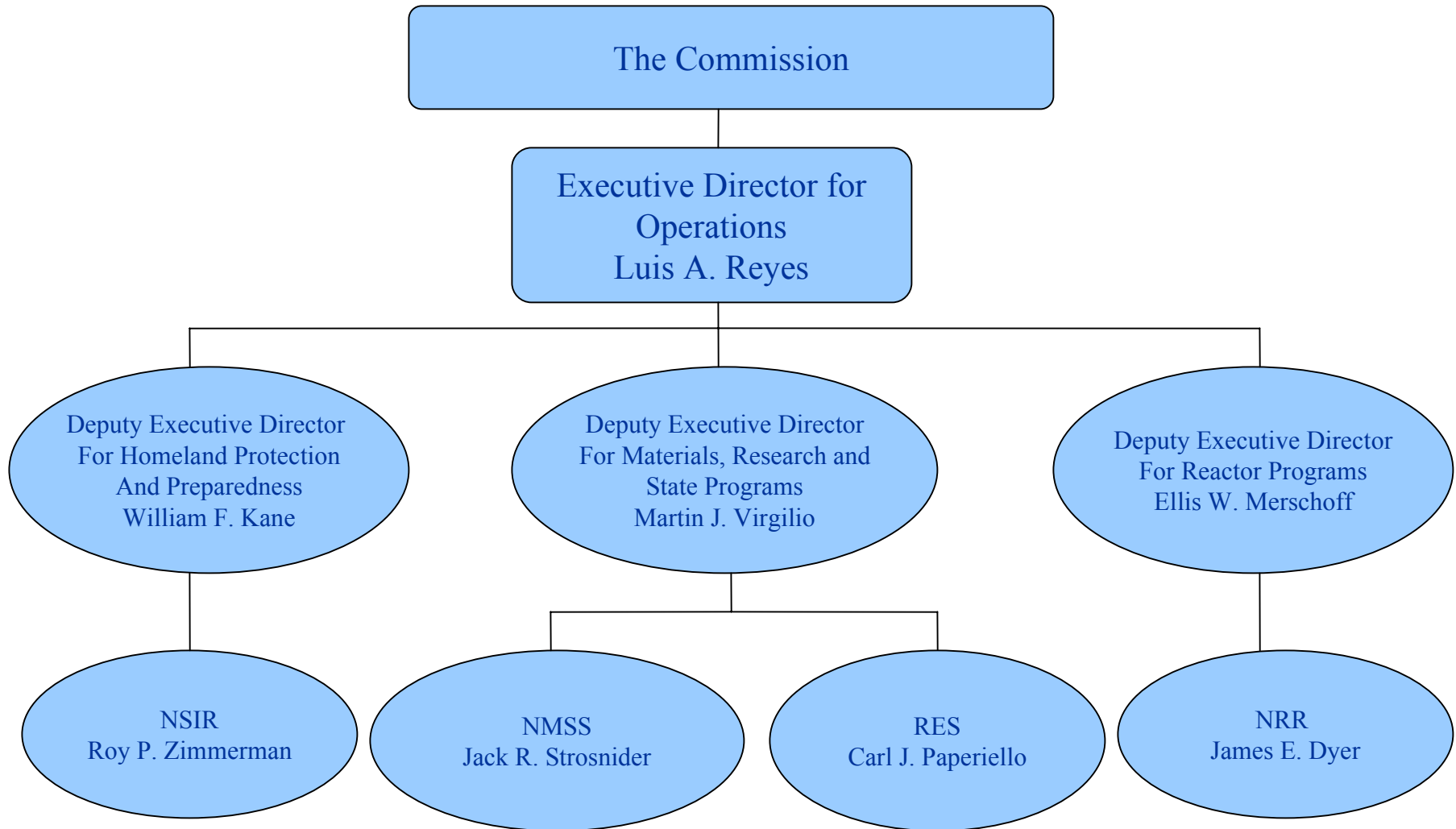


Meeting Agenda

- Opening Remarks
- 10 CFR Part 52 Process
- Design Certification Process
- Contents of DC Application
- Role of the Office of Research
- Role of the Advisory Committee for Reactor Safeguards
- Review Schedule Considerations/Impacts
- Determination of Applicability of Regulations
- Applicability and Resolution of Technical and Regulatory Issues
- Lessons Learned from Previous Design Certifications
- Discussion and Questions



NRC ORGANIZATION



Design Certification



Jerry N. Wilson, PE
New, Research, and Test Reactors
Office of Nuclear Reactor Regulation

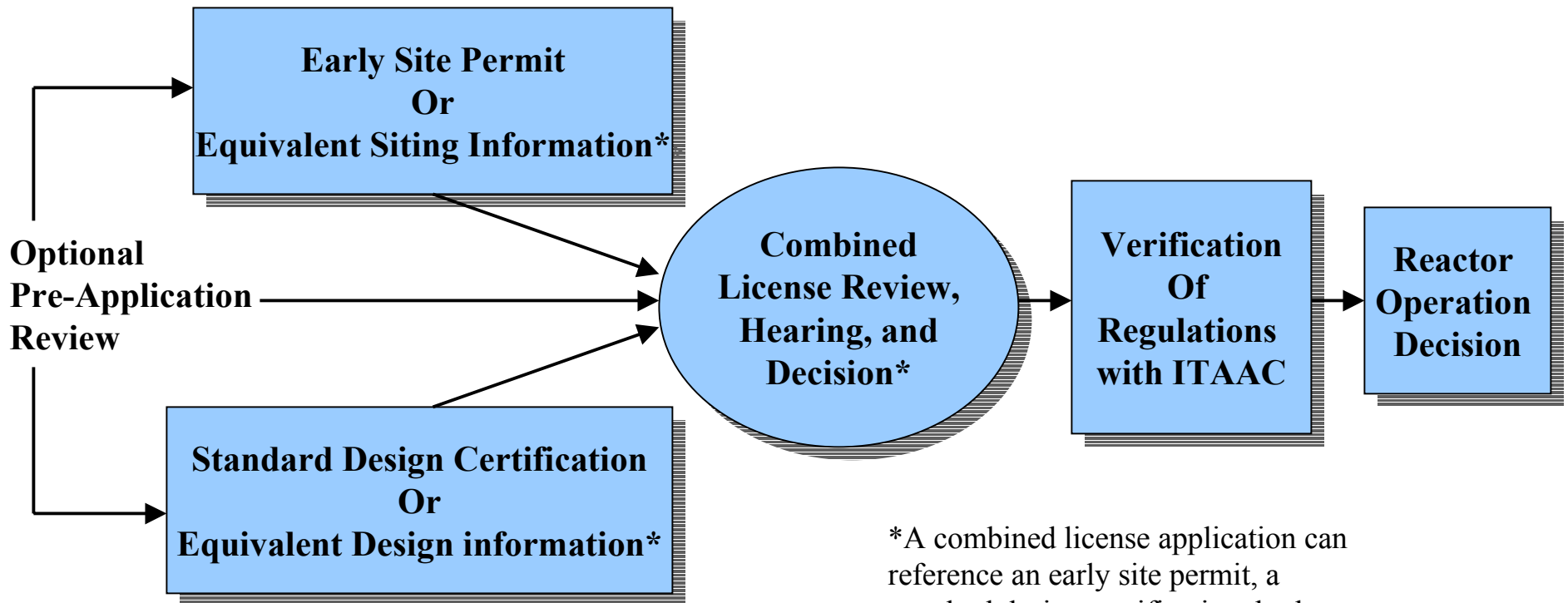


10 CFR Part 52

- Early Site Permits [ESPs]
- Design Certifications [DCRs]
- Combined Licenses [COLs]
- Appendices M, N, O, & Q



Part 52 Licensing Process



*A combined license application can reference an early site permit, a standard design certification, both, or neither. If an early site permit and/or a standard design certification is not referenced, the applicant must provide an equivalent level of information in the combined license application.

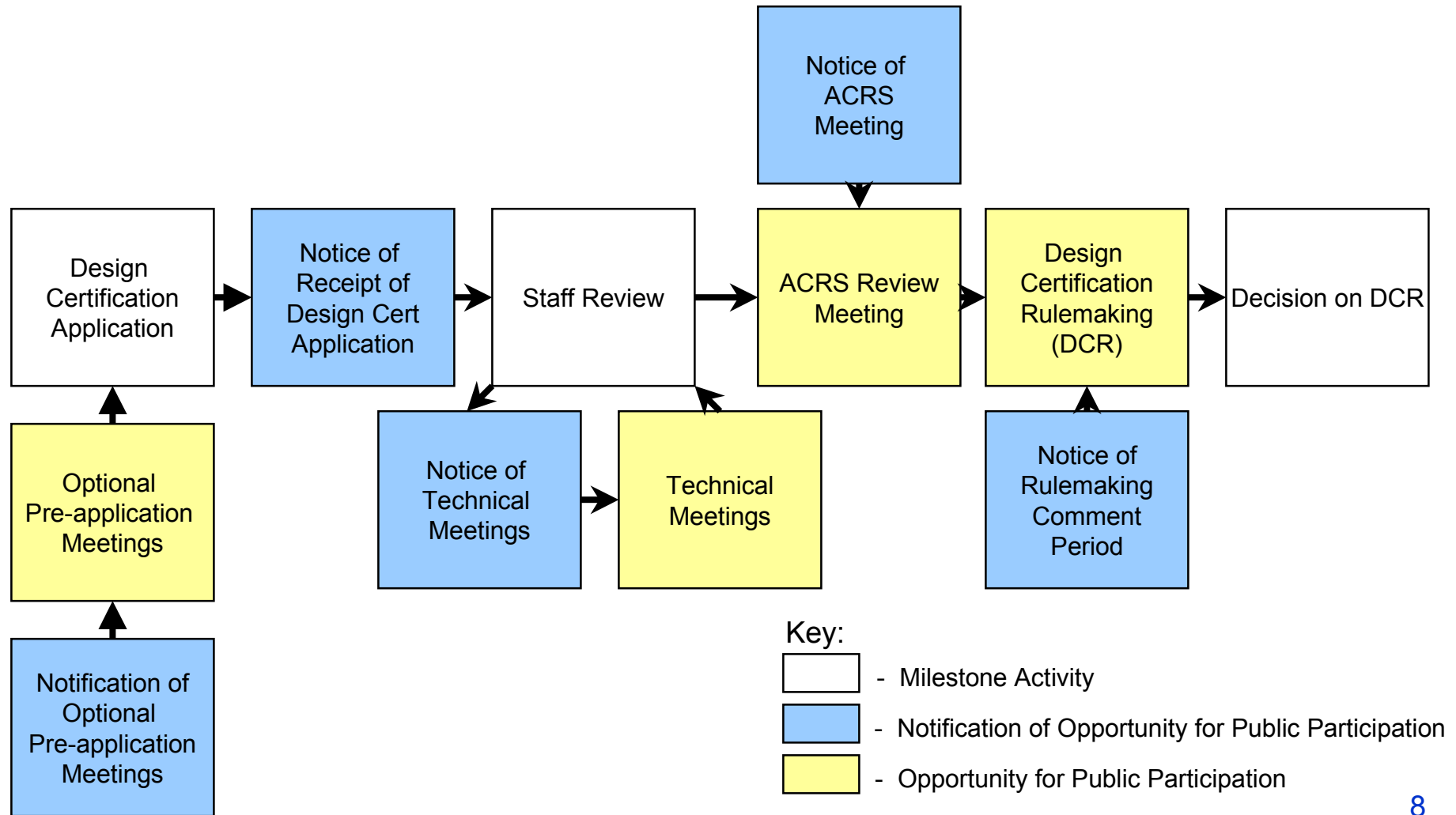


Design Certification

- Allows an applicant to obtain pre-approval of an essentially complete plant design
- Requires final design information
- Reduces licensing uncertainty by resolving all design issues
- Facilitates standardization



Design Certification Process





Pre-application reviews

- Not mandatory and scope chosen by the applicant based on what it wants resolved prior to application
- AP1000 pre-application review
 - ◆ Applicability of AP600 test programs
 - ◆ Applicability of AP600 analysis codes
 - ◆ Use of design acceptance criteria
 - ◆ Use of AP600 exemptions
- Identify technical/policy issues that need to be resolved during design certification review

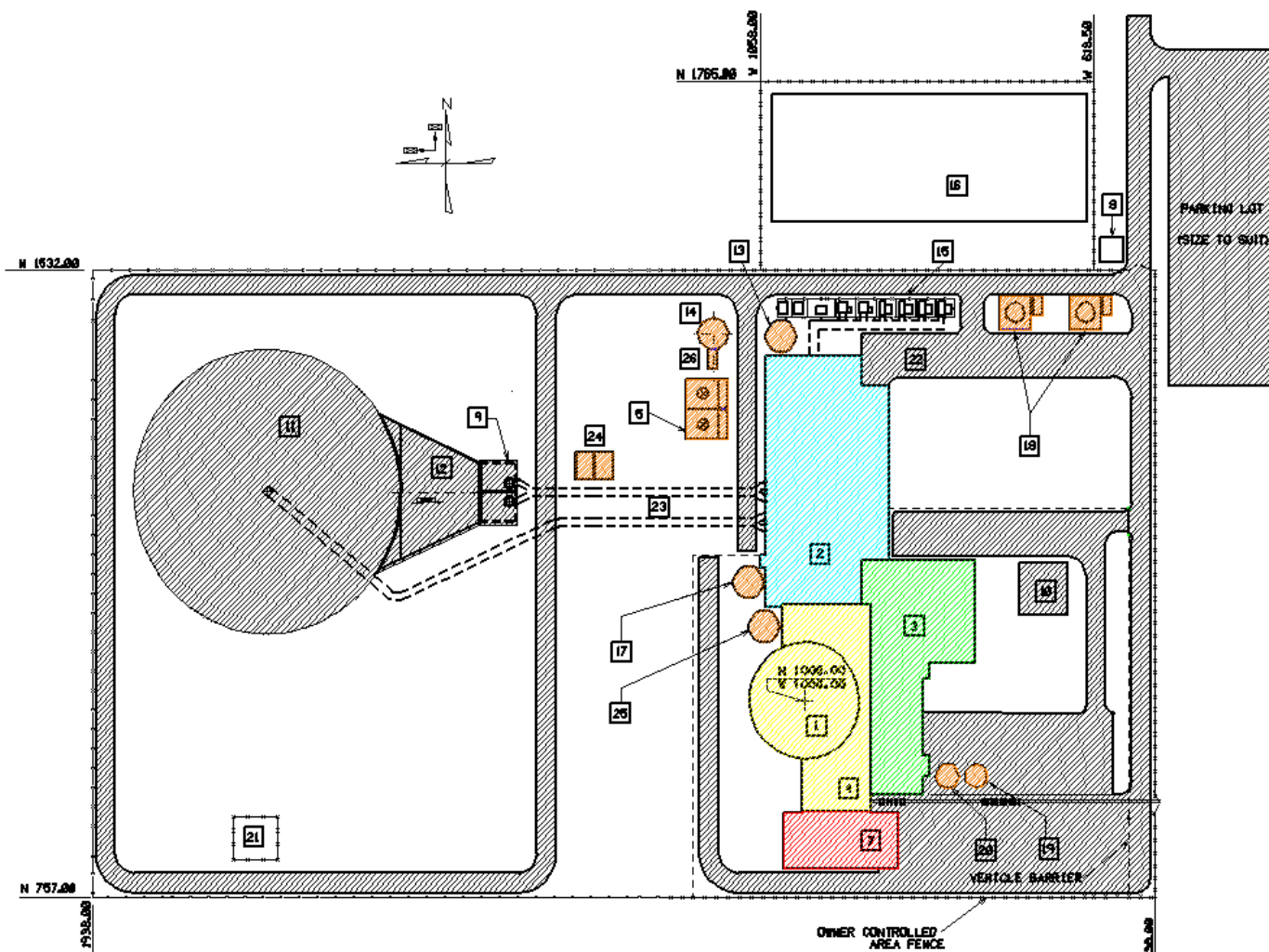


Contents of Application

- Design scope and level of detail
- Conceptual design for out-of-scope portions of plant
- Interface requirements
- Site parameters assumed for design and analyses
- Testing to demonstrate performance of safety features



AP1000 Plot Plan





Contents of Application

- Applicable TMI requirements in 50.34(f)
- Proposed resolutions of USIs/GSIs in NUREG-0933
- Design-specific probabilistic risk assessment (PRA)
- Inspections, tests, analyses, and acceptance criteria (ensure facility will be built as designed)
- Design Acceptance Criteria (policy issue)



Format of Application

- Two-tiered documentation
- Proprietary & Safeguards information
- Probabilistic Risk Assessment
- Design Control Document with additional chapters



Review Process

- Standard Review Plan (NUREG-0800)
- Issue-specific NUREGs and RGs
- Office Instructions (OI LIC-101 on RAIs, etc.)
- Commission guidance (SECYs + SRMs)
 - ◆ Severe accident design features
 - ◆ Regulatory treatment of non-safety systems



Not reviewed for DCR

- Site Safety (seismology, meteorology, etc.)
- Environmental protection
- Site-specific design features (cooling tower)
- Licensee information (operational programs)
- Rapidly evolving technology (NRC policy)



Summary

- Essentially complete nuclear power plant design
- Final design information
- Resolve all safety issues
- Finality for resolutions in subsequent proceedings

Role of the Office of Nuclear Regulatory Research



Marsha Gamberoni

Acting Branch Chief

Advanced Reactors and Regulatory Effectiveness Branch

Office of Nuclear Regulatory Research



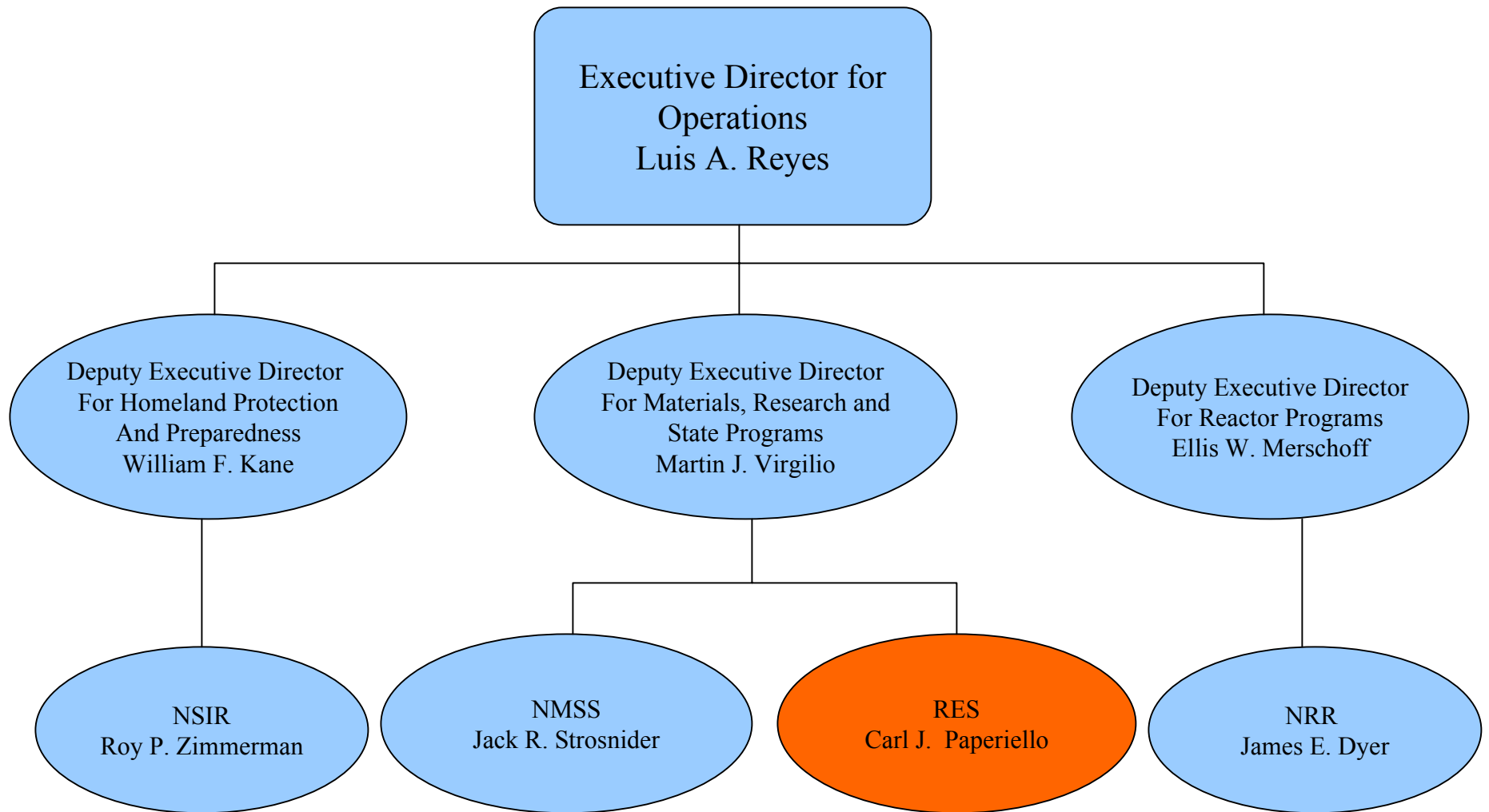
Office of Nuclear Regulatory Research

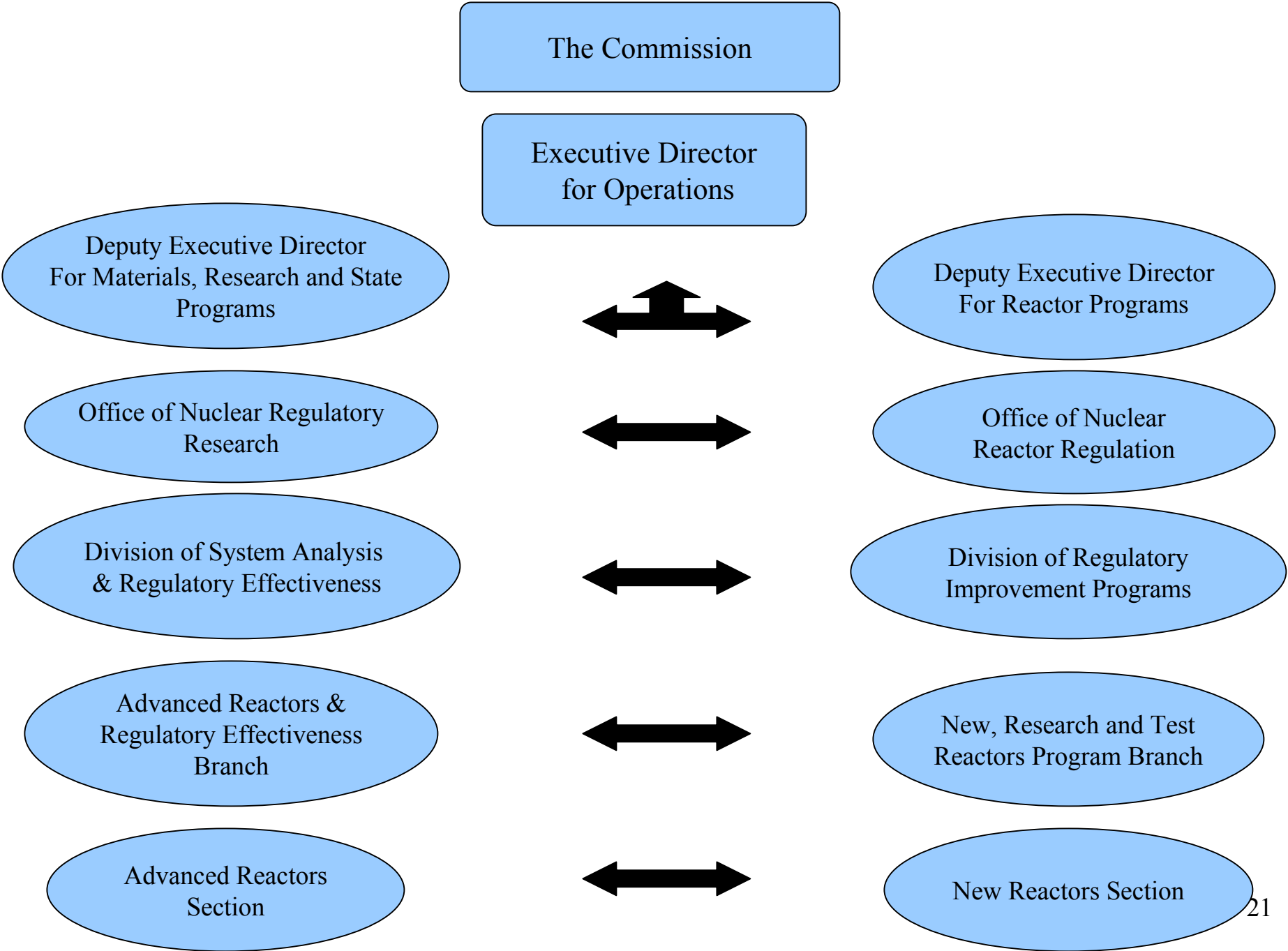
- Program Office explicitly identified in the Atomic Energy Act
- Functions
 - Conduct research to improve knowledge
 - Coordinate risk-informed efforts
 - Conduct evaluations of regulatory requirements
 - Conduct technical assessments to identify safety issues

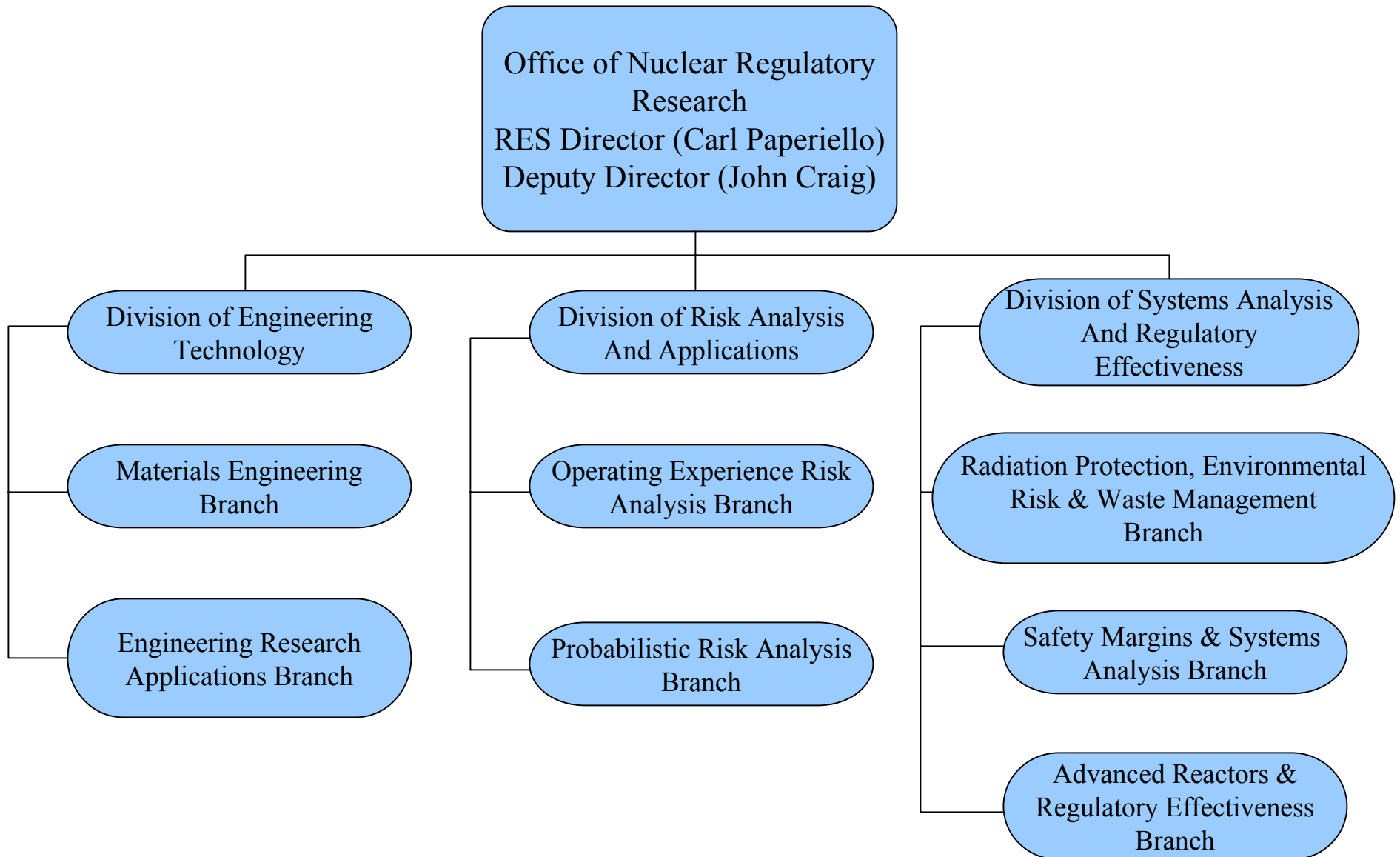


Office of Nuclear Regulatory Research

- Functions (continued)
 - Review operating experience and generic issues
 - Prepare for the future by identifying research needs
 - Develop and maintain infrastructure









S Roles and Responsibilities

- Division of Engineering Technology
 - Engineering, material, and I&C reviews
 - Central role on codes and standards
- Division of Risk Analysis and Applications
 - Develop risk analysis methods
 - Apply risk insights to focus regulatory activities



S Roles and Responsibilities

- Division of Systems Analysis and Regulatory Effectiveness
 - Evaluate radiological consequences of postulated accidents
 - Evaluate margins using codes and models
 - Coordinate/perform research for advanced reactor reviews
 - Analyze operating experience and regulatory effectiveness



S Role in Design Certification

- Research necessary to support review of specific design
 - Identification of safety issues
 - Support licensing review
- Safety focus review topics
 - Thermal-hydraulic analyses
 - Severe accident and source term analyses
 - Nuclear analyses



S Role in Design Certification

- Safety focus review topics (continued)
 - Material properties and behavior
 - Structural analyses
 - Instrumentation and controls
 - Probabilistic risk assessment
 - Human factors
 - Consequence analyses
- Coordination and integration of research

efforts



S Resources

- Subject matter experts
- Technical assistance contracts
- Universities and international agreements
- Phenomena Identification and Ranking Technique (PIRT)



Integration into Licensing Process

- Request, coordination, authorization, allocation
- Inter-office process established
 - Technical staff identify preliminary scope of review/research
 - Senior staff review through a formal Technical Advisory Group (TAG)
 - Senior managers provide oversight through the Advanced Reactor Steering Committee



Summary

- Provide an independent knowledge base with analytical capability
- Identify safety issues and conduct confirmatory analyses
- Support licensing during all phases of the review including Design Certification

ACRS Role in Design Certification



Jerry N. Wilson, PE
New, Research, and Test Reactors
Office of Nuclear Reactor Regulation

ACRS CHARTER

- **The ACRS provides the NRC with independent reviews of, and advice on, the safety of proposed or existing reactor facilities and the adequacy of proposed safety standards. The primary purposes of the Committee are to:**
 - ◆ **Review and report on safety studies and reactor facility license and license renewal applications**
 - ◆ **Advise the Commission on the hazards of proposed and existing reactor facilities and the adequacy of proposed reactor safety standards; and**
 - ◆ **Initiate reviews of specific generic matters or nuclear facility safety-related items.**



ACRS CHARTER (Cont'd)

- **The ACRS is independent of the NRC staff and reports directly to the Commission, which appoints its members (currently 11 members)**
- **The ACRS is structured to provide a forum where experts representing many technical perspectives can provide independent advice that is factored into the Commission's decisionmaking process**
- **The ACRS reviews and provides reports on U. S. naval reactor designs, and also advises DOE with regard to the hazards of DOE nuclear activities and facilities consistent with the Energy Reorganization Act of 1974, as amended**



ACRS CURRENT ACTIVITIES

- **Advanced Reactor Designs**
- **Risk-Informed Regulation**
- **Safeguards and Security Matters**
- **License Renewal Applications**
- **Extended Power Uprate Applications**
- **Transient and Accident Analysis Codes**
- **Operating Plant Issues**
- **NRC Safety Research Program**



ROLE for DESIGN CERTIFICATION

- **10 CFR 52.53 requires that each application for a standard design certification be referred to the ACRS for a review and report on those portions of the application which concern safety**
 - ◆ Provide an independent review of the NRC staff's determination of compliance with the applicable standards and requirements of the Atomic Energy Act and the Commission's regulations
 - ◆ Provide an open forum for public participation in the review process



ACRS ROLE IN DESIGN CERTIFICATIONS (CONT'D)

- **The ACRS review begins early in the licensing process. A series of meetings with the applicant and the NRC staff are held at appropriate times in the review process**
- **When the Committee has completed its review, its report is submitted to the Commission**



ACRS REVIEW PROCESS

- **In-depth reviews are done by the subcommittees**
 - ◆ With input from subcommittee members, subcommittee chairman develops proposed ACRS position
- **Presentations are provided to the full Committee. ACRS positions are developed after extensive deliberations by the full Committee**
- **At times, ACRS issues “interim” letters to identify issues of concern and items for which additional information, discussions, and clarifications are needed**



ACRS REVIEW OF AP600 DESIGN

Subcommittee Meetings

Thermal Hydraulic Phenomena
27 meetings
December 1991- June 1998

Future Plant Designs
9 meetings
January 1995- July 1998

Severe Accidents
one meeting
June 1996

Full Committee Meetings

6 ACRS Meetings

August	1996
June	1997
February	1998
April	1998
May	1998
July	1998

Report to NRC Chairman
July 23, 1998



ACRS REVIEW OF AP1000 DESIGN

Subcommittee Meetings

Thermal Hydraulic Phenomena

5 meetings

March 2001- February 2004

Future Plant Designs

3 meetings

February 2002 - June 2004

Reliability and Probabilistic Risk Assessment

one meeting

January 2003

Full Committee Meetings

8 ACRS Meetings

February 2002

October 2002

January 2003

March 2003

October 2003

February 2004

June 2004

July 2004

Report to NRC Chairman

July 2004



Design Certification Schedule/Impacts



Laura Dudes
U.S. Nuclear Regulatory Commission
August 17, 2004



Agenda

- Application Submittal-Quality
- Acceptance Review
- Staff interactions-Requests for Additional Information
- Unique Design Features
 - ◆ Testing Required by 10 CFR 52.47 (b)
- Inspections and Audits
- Resolution of Policy Issues



Application Submittal

- Acceptance Review per 10 CFR Part 2
 - ◆ Complete submittal required
- Essentially Complete Final Design
 - ◆ Detailed design descriptions for safety and non-safety systems
- Review schedule issued after acceptance review

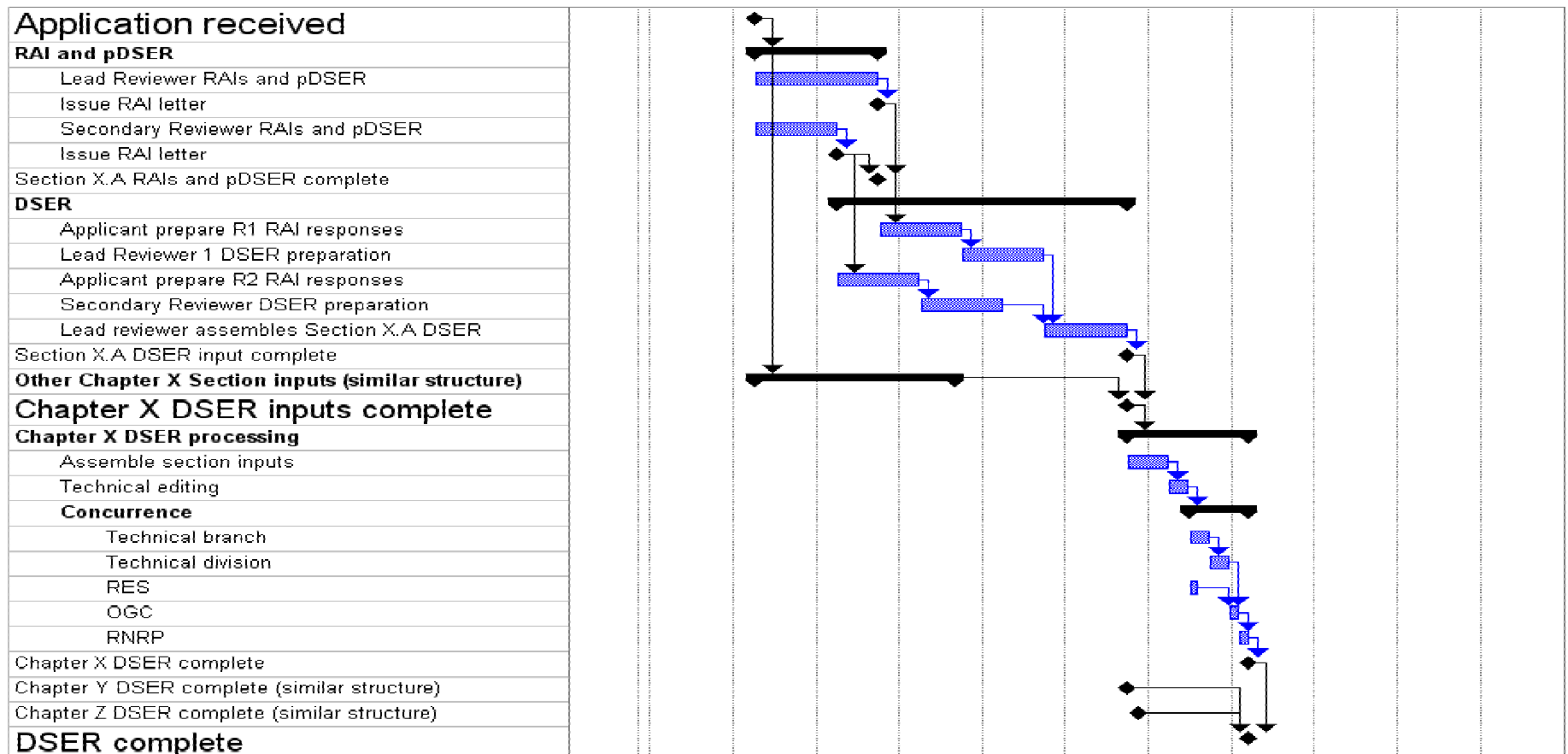


Staff Interactions

- Expect applicant to present DCD to staff in public meeting
- Requests for Additional Information
 - ◆ Generated by staff
 - ◆ Draft RAIs transmitted electronically (comprehension)
 - ◆ Teleconference to discuss RAIs
 - ◆ Letter transmitting RAIs (will include basis for changes from draft to final if applicable)



Schedule Impacts: Complete and Timely Responses





ACR700-Unique Design Features Application Description

- Clear nexus between NRC requirements and guidance and ACR-700 design features
- Provide supporting information on design principles where no NRC requirements or guidance exists (e.g., On-Power Fueling)



Testing Required: 10 CFR 52.47 (b)

- Performance of each safety feature must be demonstrated through analysis, appropriate test program, experience or a combination thereof.
- Expect that DCD will describe testing in sufficient detail to explain how it supports the application
- Testing schedule should be provided
- Review schedule depends on testing described in DCD



Additional Interactions

- Inspections and Audits
 - ◆ Quality Assurance Inspections (Appendix B)
 - ◆ Testing Activities
 - ◆ Audit of calculations



Issue Resolution

- Policy issues – Commission papers on issues such as Design Acceptance Criteria
- Regulatory Issues (e.g., exemptions) - may be resolved at the staff level, including senior management

Screening of Regulations and Guidance for Applicability



Joseph Sebrosky

U.S. Nuclear Regulatory Commission

August 17, 2004



Agenda

- Screening of Regulations for Applicability
 - ◆ Process for Determining Applicability
 - ◆ Treatment of ACR-700 specific features not addressed by current regulations
 - ◆ Treatment and Justification for exemptions
- Applicability and resolution of technical and regulatory issues
 - ◆ NUREG 0800, Standard Review Plan (Official and Draft versions)
 - ◆ Generic Issues
 - ◆ Generic Communications
 - ◆ Commission papers (Technical and Policy)
 - ◆ Severe Accident issue resolution for previously certified designs



Regulations - Process for Determining Applicability

- Criteria and justification for regulations that are not applicable to the design
 - ◆ Need to understand AECL's process
 - ◆ Key issue for review of pebble bed modular reactor (PBMR)
 - ★ PBMR proposed approach reviewed by staff and documented in a March 26, 2002, letter to Exelon
 - ★ 3 purposes
 - Conform with existing regulations while recognizing unique design
 - Review regulations for applicability to design
 - Propose process for treatment of design elements that are not covered by current NRC regulations



Treatment of ACR-700 Unique Features

- ACR-700 draft table of contents identifies several new design control document sections (next slide)
 - ◆ What regulations and guidance are applicable to these new sections?
 - ◆ Has AECL determined which general design criteria and regulations are applicable to these sections?
 - ◆ Are there areas where AECL has identified no applicable NRC regulation and is using some other design commitment (e.g., Canadian regulation)?
 - ◆ Need to understand AECL's process



Treatment of ACR-700 Unique Features

Table 2: New DCD Sections Specific to ACR

Section #	Section Title
5.3.1	Fuel Channels and Fuelling Machine Head Design
5.4.10	Pressure and Inventory Control System
5.4.11	Heat Transport Purification System
5.4.13	Heat Transport Pump Seal Cooling System
6.8	Shutdown Systems
6.8.1	Shutdown System No. 1
6.8.2	Shutdown System No. 2
7.10	Fuel Handling Control System
3.9.9	Calandria Shell and End Shield Assembly
3.9.10	Fuelling Machine
9.2.7	Reserve Water System
9.3.6	Annulus Gas System
9.3.7	Shield Cooling System
9.3.8	Resin Transfer System
9.3.9	Deuteration and Dedeuteration System
9.3.10	Gas Control System
9.4.9	Secondary Control Building HVAC System
9.5.9	Crane and Hoists – Reactor Building
9.6	Moderator Systems
9.7	Heavy Water Management
9.8	Light Water Management
10.4.10	Auxiliary Steam System
10.4.11	Chemical Injection System
10.4.12	Sampling System



Exemptions

- Exemptions and Justification for Exemptions
 - ◆ Identified early in the process by the applicant (see Westinghouse AP1000 letter dated 12/03/02)
 - ◆ Reviewed by staff in final safety evaluation report (FSER)
 - ★ AP600 FSER section 1.6 provides index of exemptions
 - ◆ Discussed in Design Certification Rulemaking
 - ★ 10 CFR 52 Appendix A, B, and C, Section V discuss exemptions for the designs that have been certified



Comparison to Standard Review Plan

- 10 CFR 50.34(h) requires comparison
- What version of SRP will AECL use?
 - ◆ Issue for past design certifications
 - ◆ Official and Draft versions available
 - ◆ NRC Office Instruction LIC-200, “Standard Review Plan (SRP) Process”
 - ★ Provides NRC process for updating SRP
 - ★ Contains list of SRP sections, title, primary review branch and SRP section owner



Comparison to Standard Review Plan

- AECL provided draft design control document table of contents
 - ◆ Close to SRP table of contents
 - ◆ Proposed ACR-700 DCD section 1.1.6.2 labeled SRP
 - ◆ AECL also identified differences between DCD table of Contents and SRP
 - ◆ DCD/SRP challenges



Comparison to Standard Review Plan

◆ DCD/SRP Challenges

- ★ DCD table of contents for which there is no SRP section (see slide 52)
- ★ Areas that DCD and SRP do not match
 - DCD – Materials for Fuel Channel and Fuelling Machine Head Assemblies Section 5.3.2
 - SRP – Reactor Vessel Materials
 - Some guidance established
- ★ Preapplication Safety Assessment Report
 - AECL should consider in applicable DCD sections
 - Staff will consider in DC review



Comparison to Standard Review Plan

- ◆ DCD/SRP Challenges (continued)
 - ★ Chapter 15 accident analysis
 - Roadmap from CANDU safety analyses reports to SRP would be helpful
 - ★ Chapter 16 technical specifications
 - What standard technical specification will be the basis for the ACR-700 review?
 - Design reliability and investment protection section reviews
 - ★ Areas not covered by the SRP
 - Severe Accidents
 - Generic Issues
 - Codes and Testing
 - Regulatory Treatment of Non-Safety Systems



Generic Issues

- Evaluated in Chapter 20 of the staff's FSER
- 10 CFR 52.47(a)(1)(ii) – Three Mile Island Requirements
- 10 CFR 52.47(a)(1)(iv) – Unresolved Safety Issues and high-priority Generic Safety Issues
 - ◆ Six months prior to the date of application
 - ◆ NUREG-0933 scheduled to be revised in August 2004
- AECL DCD table of contents appears to address issue in Chapter 1 of the DCD



Generic Issues

- Chapter 20 of the staff final safety evaluation report (FSER)
 - ◆ 20.1 Overview
 - ◆ 20.2 – Task action plan items
 - ◆ 20.3 – New Generic Issues
 - ◆ 20.4 – Three Mile Island Action Plan Items
 - ◆ 20.5 – Human Factors Issues
 - ◆ 20.6 – Three Mile Island Plan Requirements (provides roadmap for 10 CFR 50.34(f))
 - ◆ 20.7 – Incorporation of Operating Experience



Generic Issues

- Comparison of DCD to SER issues
 - ◆ ACR-700 seems to follow AP1000 DCD model
 - ◆ Review of Incorporation of Operating Experience (FSER section 20.7)
 - ★ ACR-700 DCD section 1.9.4.2.3 Canadian Generic Action Items



Generic Issues

- ◆ Need to determine generic issues relevant to the ACR-700 design
 - ★ AP600/AP1000 DCD table 1.9-2 and AP600 FSER table 20.1-1 provide information
 - ★ ACR-700 DCD table of contents provides information regarding which 10 CFR 50.34(f) items apply
 - Not enough detail for “TMI Action Plan Issues” and “Task Action Plan Items” to assign review responsibilities
 - ★ AP600 FSER generic issues that do not map to ACR-700 DCD
 - Section 20.3, “New Generic Issues”
 - Mapped to AP600/AP1000 DCD section 1.9.4.2.3
 - FSER Section 20.5, “Human Factors Issues”



Commission Papers

- Technical and Policy Issues
 - ◆ SECY papers written to request direction from the Commission or to inform the Commission of an issue
 - ◆ Past papers provide guidance on how issues were resolved
 - ★ 42 SECY papers referenced in Advanced Boiling Water Reactor (ABWR) FSER
 - ★ 69 SECY papers referenced in AP600 FSER
 - ◆ Expect that past SECY papers will be reviewed for applicability to the ACR-700 design
 - ◆ New issues maybe identified that will result in SECY papers unique to the ACR-700 design



Commission Papers

■ Example

- ◆ SECY-90-016, “Evolutionary Light Water Reactor Certification Issues and Their Relationship to Current Regulatory Requirements”
 - ★ Identified and provided recommendations on significant issues
 - ★ Identified in ACR-700 table of contents
 - ★ Discussed mostly in FSER Chapter 19, “Severe Accidents” (identified by*below)

Public safety goal

Source term

Earthquake design

Mid-loop operation*

Station blackout*

Fire protection*

Intersystem loss-of-coolant
accident*

Hydrogen generation and
control*

ABWR containment vent
design*

Equipment survivability*

Containment performance*

Core-concrete interactions*

High pressure melt ejection*

Anticipated Transient Without
Scram*

Inservice testing of pumps
and valves



Commission Papers

- Staff will review ACR-700 DCD to determine how Commission guidance through SECY papers is incorporated
- AP600/AP1000 SECY papers need to be reviewed for applicability to ACR-700 design
 - ★ Example – treatment of passive safety features
- Severe Accident Review
 - ◆ Chapter 19 of the final safety evaluation report
 - ◆ Heavily dependent on SECY paper guidance
 - ◆ SECY 90-016 example
 - ★ Station blackout for evolutionary designs resulted in an alternate ac source for evolutionary designs (i.e., non-safety combustion turbines for System 80+ and ABWR)
 - ★ ACR-700 DCD should address how this issue is addressed in the ACR-700 design

Lessons Learned From Previous Design Certification Reviews



Joseph Colaccino
U.S. Nuclear Regulatory Commission
August 17, 2004



Lessons Learned - Agenda

- Design Issues
- Testing Issues
- Policy Issues
- Administrative



Lessons Learned – Design Issues

- Exemption Identification and Justification
 - ◆ Need to identify early
 - ◆ Critical path item for previous design certifications
- Criteria and justification for regulations that are not applicable to the design
 - ◆ Need to understand AECL's process
- Detailed design not complete
 - ◆ Design acceptance criteria in some cases
 - ◆ Changes in Design Control Document (DCD) content can impact schedule



Lessons Learned – Design Issues (continued)

- Quality Assurance review of design information
 - ◆ Inspection of Advanced Boiling Water Reactor (ABWR) and AP600/AP1000 design information
 - ◆ Similar inspections expected for ACR-700
- Design changes because of probabilistic risk assessment (PRA) insights
 - ◆ PRA feedback into design
 - ◆ Significant PRA changes could result in design changes
 - ◆ Robust identification of PRA insights in application greatly reduces late identification of insights and potential changes to the design



Lessons Learned – Testing Issues

- Testing concurrent with review can extend review schedule
 - ◆ Chapter 15 analysis dependent on latest version of code
- Use of contemporary codes
 - ◆ Use of older codes could complicate review
- Quality Assurance of test program and codes
 - ◆ Issue for the past design certification reviews
- Independent Calculations
 - ◆ Staff challenge to develop independent calculation capability
 - ◆ Typically done to support draft safety evaluation report (DSER) and final safety evaluation report (FSER)



Lessons Learned – Policy Issues

- Identify policy issues beyond focused topics as early as possible
 - ◆ Potential critical path item
- Results could impact design
 - ◆ (e.g., AP600 containment spray and post 72 hour actions)
- Reach resolution of issues at lowest working level as early as possible
 - ◆ Identify major issues to upper management as soon as possible
 - ◆ Determine which issues need Commission involvement as soon as possible



Lessons Learned – Administrative (continued)

- Electronic submittal format (file sizes, etc)
- DCD configuration control
 - ◆ Integrity of document
 - ◆ Revisions in one DCD section can affect other sections
 - ◆ Communicate
 - ★ Applicant initiated changes
 - ★ Applicant initiated removal of DCD information



Lessons Learned – Administrative (continued)

- Requests for Additional Information (RAI)
 - ◆ Numbering scheme
 - ◆ Tracking system
 - ★ Developed by NRC shared with applicant
 - ★ Clear understanding by both sides of status of issue



Lessons Learned – Administrative (continued)

- Number of RAIs is dependent on many factors
 - ◆ High quality submittals generally reduces the number of RAIs
 - ◆ Complexity of review generally increases the number of RAIs
 - ◆ Areas that do not have past precedent generally increase the number of RAIs
 - ★ For example, review of passive safety systems for AP600
 - ◆ Scope of review will impact the number of RAIs
 - ★ For example, code and testing review performed for the AP600/AP1000 not performed for ABWR and System 80+



Lessons Learned – Administrative (continued)

- Number of RAIs and DSER Open Items (OIs) identified in previous Design Certification reviews

	<u>RAIs</u>	<u>DSER OIs</u>
System 80+	~1500	
ABWR	~1200	
AP600	~6200	~1200
AP1000	~700	174



Lessons Learned – Administrative (continued)

- Requests for Additional Information (RAI) (continued)
 - ◆ Need to determine how RAI responses will be captured in DCD
 - ★ ABWR/System 80+ model
 - RAIs in appendix
 - ★ AP600/AP1000 model
 - RAIs responses reviewed by applicant to determine if it warrants changes to DCD
 - DCD changes because of RAIs clearly identified in RAI response



Lessons Learned – Administrative (continued)

- Schedule coordination
 - ◆ Process for developing hi-level schedule
 - ★ Timing
 - ★ Assumptions (e.g., hi-quality timely submittals)
 - ◆ DCD revision process
 - ★ Scheduling of revisions
 - Need to be conscious of DSER/FSER schedule and lead time needed by staff
 - Redline/strikeout and change bars



Lessons Learned – Administrative (continued)

- Schedule coordination (continued)
 - ◆ NRC high intensity/ low interaction time periods
 - ★ During preparation of DSER and FSER staff can not support meetings and phone calls in parallel with writing DSER/FSER inputs
 - ★ Not all the latest information will necessarily be reflected in the DSER
 - ★ Time period frustrating for applicants