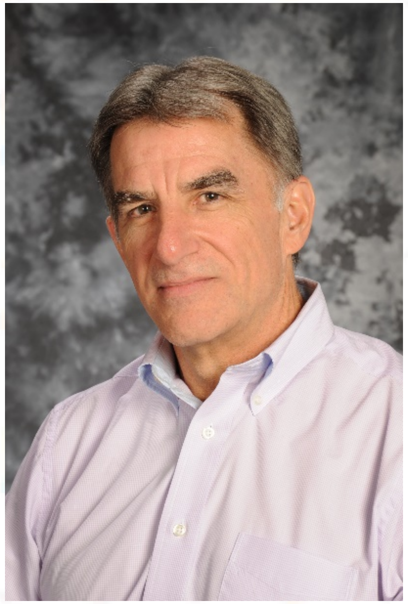
Regulatory Considerations when Developing a Deployment Path

GAIN Regulatory Webinar Series - Review

GAIN Gateway for Accelerated Innovation in Nuclear



Jim Kinsey
Regulatory Affairs,
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Laboratory

Mr. Kinsey has over 40 years of experience in the nuclear industry, including significant commercial experience in licensing, regulatory affairs, system engineering and major project management. He has managed numerous industry licensing and regulatory affairs projects, including the licensing of GE-Hitachi's ESBWR advanced reactor design, and the development of successful recovery and re-start programs for commercial nuclear plants previously placed on the NRC's "Watch List". He also has considerable experience in supporting "day-to-day" commercial nuclear facility operation, including engineering management of safety systems, plant power uprate projects, outage management, and as a primary utility interface with both federal and state regulators.

At the Idaho National Laboratory, he is responsible for licensing strategy development and implementation in direct support of industry's near-term deployment of advanced nuclear technologies. In this role, he has led the development of a series of DOE/industry proposals resulting in key Commission policy changes and related updates to NRC's regulatory guidance, including acceptance of performance-based functional containment approaches, and the use of a risk-informed and performance-based approach for plant event identification and assessment.

Mr. Kinsey holds a Bachelor of Science degree in Nuclear Engineering from the University of Cincinnati and is a Licensed Professional Mechanical Engineer. He has also previously received a Senior Reactor Operator Certification for Boiling Water Reactors.

GAIN Regulatory Webinar # 1

- **Historical** Development of Nuclear Energy
- Structure of NRC Regulatory Framework: Historical Licensing Landmarks
- Structure of the Current NRC Regulatory Framework and Considerations for Advanced Technologies

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Context – Nuclear Reactor Development

- **World War II weapons program emerging into Cold War environment**
  - **Atomic Energy Act of 1946** – *Civilian control via Atomic Energy Commission (AEC); information is born classified; only federal government may produce or possess fissile materials*
  - **Atomic Energy Act of 1954** – *AEC can now regulate; private sector access; licensed use of fissile materials*
- **Power reactor applications often overshadowed by development of nuclear weapons and weapons delivery platforms**
- **Unaligned agendas – President; National Security Council; Congress; AEC; private sector**
- **A vision – "Atoms for Peace"… but who is going to lead development and pay for commercialization?**

Understanding the historical development of nuclear energy requires a grasp of the forces-at-play – POLICIES, POLITICS, AND PERSONALITIES

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Power Reactors: Private Sector's Perspective – The First Two Decades

Major hurdles and challenges

- Uncertain which nuclear technologies were economic and reliable – unclear whether nuclear would be economically competitive
- Access to technical information on nuclear energy held closely by USG
- Commercialization – global or domestic?
- Will nuclear power development be led by the private or public sector?
- How much would or should the private sector invest?
- **No comprehensive regulatory framework – plant licensing and export controls**

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AEC Power Demonstration Reactor Program

Round 1 – 1955

- Yankee Rowe – PWR, 185 MWe (1960-1992)
- Fermi Plant Unit 1 – sodium-cooled fast-breeder reactor, 100 MWe (1965-1973)
- Hallam Plant, sodium-graphite reactor, 75 MWe (1963-1964)

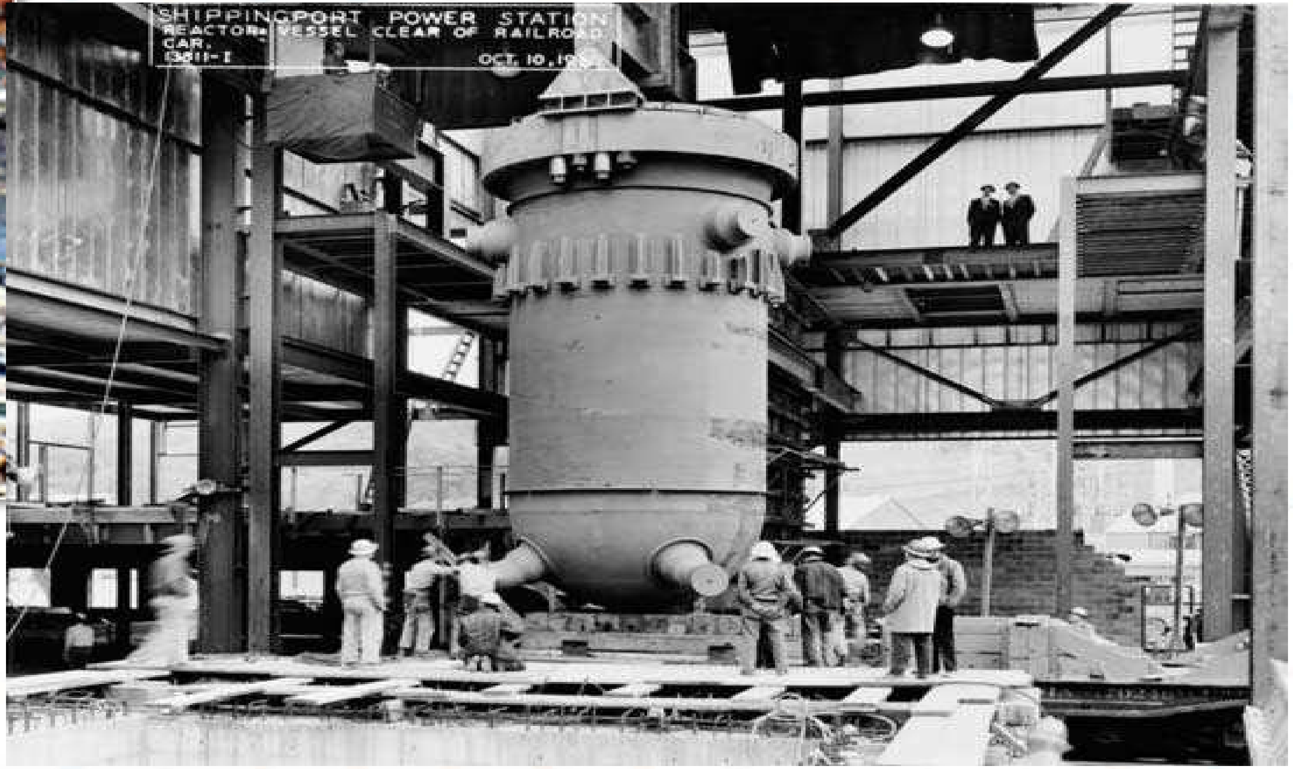
Round 2 – 1956

- Elk River Plant – indirect cycle BWR, 22 MWe (1964-1968)
- Piqua Nuclear Power Facility – organic moderated and cooled reactor, 12 MWe (1963-1966)
- Boiling Nuclear Superheat reactor BWR with integral nuclear superheat, 17 MWe (1964-1968)
- LaCrosse Plant – BWR, 50 MWe (1969-1987)

Round 3 – 1957

- Carolinas-Virginia Tube Reactor PHWR, 17 MWe (1963-1967)
- Big Rock Point – BWR, 67 MWe (1963-1997)
- Pathfinder, BWR with integral nuclear superheat, 59 MWe (1966-1967)
- Peach Bottom Unit 1 – HTGR, 40 MWe (1967-1974)
- San Onofre Unit 1– PWR, 440 MWe (1968-1992)

Shippingport



First US large-scale nuclear power plant (1957)

3 Major “Eras” of Regulatory Framework Development

CORRECTING for Operational Experience 1980 - TODAY

DEVELOPING the Independent Regulator 1975 - 1979

SEARCHING for the Regulator’s Role 1954 - 1975

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Summary of 3 Watershed Eras – Emerging Regulatory Role

1) Searching for the Regulator's Role
   - Atomic Energy Commission (AEC) is in the challenging position of being both nuclear industry promoter and regulator
   - Increased period of public activism
   - Safety reviews focused on power control and containment design, based on smaller demonstration reactor experience
   - Challenges included quality issues in numerous areas (design, hardware, construction, operations)

2) Developing the Independent Regulator
   - New agency establishing rules and guidance to implement its Independent Regulator role
   - In parallel, industry pushing Nuclear Regulatory Commission (NRC) for prescriptive requirements – “tell us what you want”
   - Creates an inappropriate paradigm of “if it’s licensed, it’s safe”

3) Correcting for Operational Experience
   - Design weaknesses
   - Various plant events highlighted the importance of operating practices, material selections, personnel training, etc.
   - Industry ramped up efforts to assess and improve in these areas
   - In parallel, NRC expanded the light water reactor (LWR)-centric regulatory framework and its oversight of day-to-day plant performance

NRC Establishes its Independence

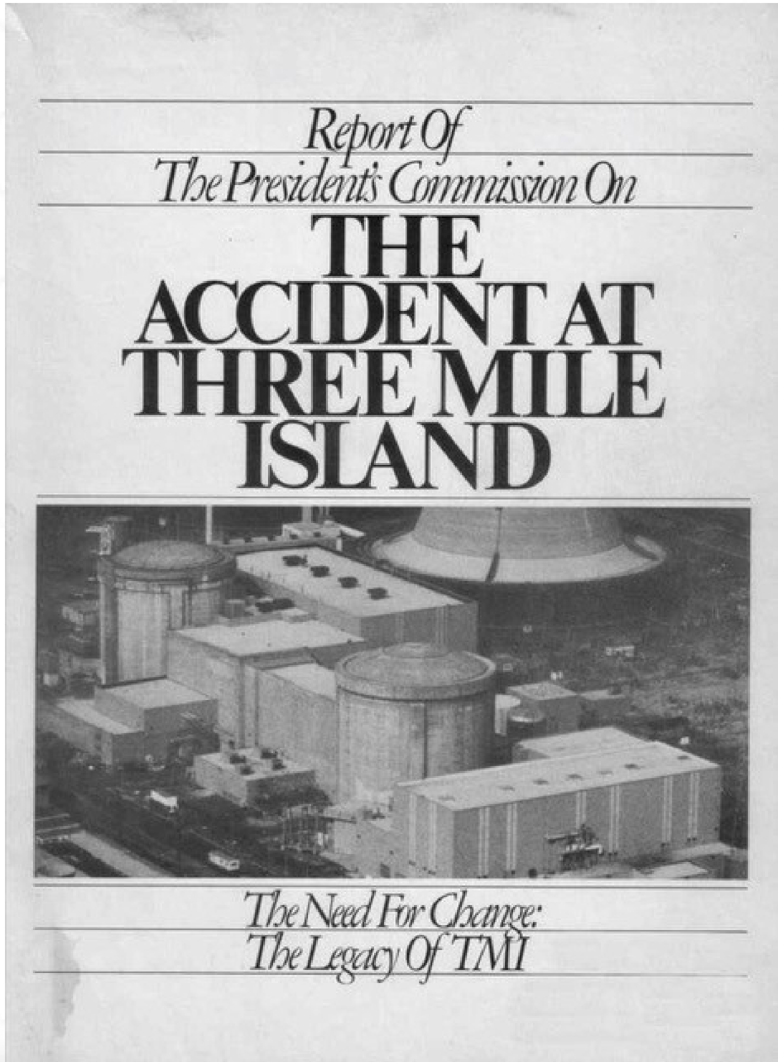
- As NRC issued more detailed licensing requirements in Regulatory Guides, Standard Review Plans and Branch Technical Positions, industry capitulated, “just tell us what you want.”

- Pressure to get licensing done and off the critical path was strong, and NRC staff had greater success resolving issues in contested hearings.

- This deferral to NRC, a reversal of original intentions, persisted until Three Mile Island (TMI) and then it accelerated. It reduced uncertainty for license applicants and sped things up, but it let license reviewers decide engineering issues, rather than reviewing industry’s solutions for engineering issues.

Events Shaped Regulatory Landscape

- 1975 Browns Ferry Fire
- 1979 Three Mile Island Core Melt
- 1983 Salem - ATWS precursor
- 1985 Davis Besse - loss of feedwater
- Late 1980s-1990s Troubled Plants
- 1989 Chernobyl
- 2002 Davis Besse - reactor head
- 2011 Fukushima Daiichi



Regulatory Framework "Patchwork"

- These watershed periods, and more recent updates, have resulted in what some refer to as a "patchwork" of regulatory requirements and implementing guidance that have been "added-on" or modified as time moves on

- The Regulatory Framework includes four major elements:
  1. Commission policy and underlying Energy Reorganization Act authorizing language
  2. Regulations and associated regulatory guidance
  3. Technology-specific licensing technical requirements for implementing those rules
  4. Processes used by NRC to review license applications and assess plant operations

- This "Regulatory Framework" has generally served the industry well and has provided adequate protection of the public
  - These mostly LWR-based documents reflect significant learning that can be evaluated for adaptation to advanced technologies
  - Provides an opportunity to reduce the important types of issues experienced by LWRs in the 60s, 70s, and 80s

Navigating the Regulatory “Patchwork” – Safety Case First, Then Licensing

- History has highlighted that a primary focus on establishing a robust safety case for a reactor facility is the most effective approach to efficient licensing. The basic sequence:
  - Design the plant to provide robust safety while meeting owner/operator needs
  - Assess and prove that the safety case addresses NRC requirements with margin
  - Communicate this proof in a license application
  - Get licensed by NRC
  - Operate and maintain the facility inside the bounds of the safety case and associated licensing basis, maintaining safety and regulatory margins

- In concept, fulfilling the regulatory requirements (which are minimum expectations) and a successful license application review should be straightforward, if the design is robust.

- It should be noted that fulfilling regulatory requirements and obtaining an operating license do not make a reactor safe. Further, the operating phase can introduce challenges to the safety case, such as:
  - Unforeseen material degradations
  - Unexpected plant configurations or operating practices
  - Inadequate corrective action or maintenance programs

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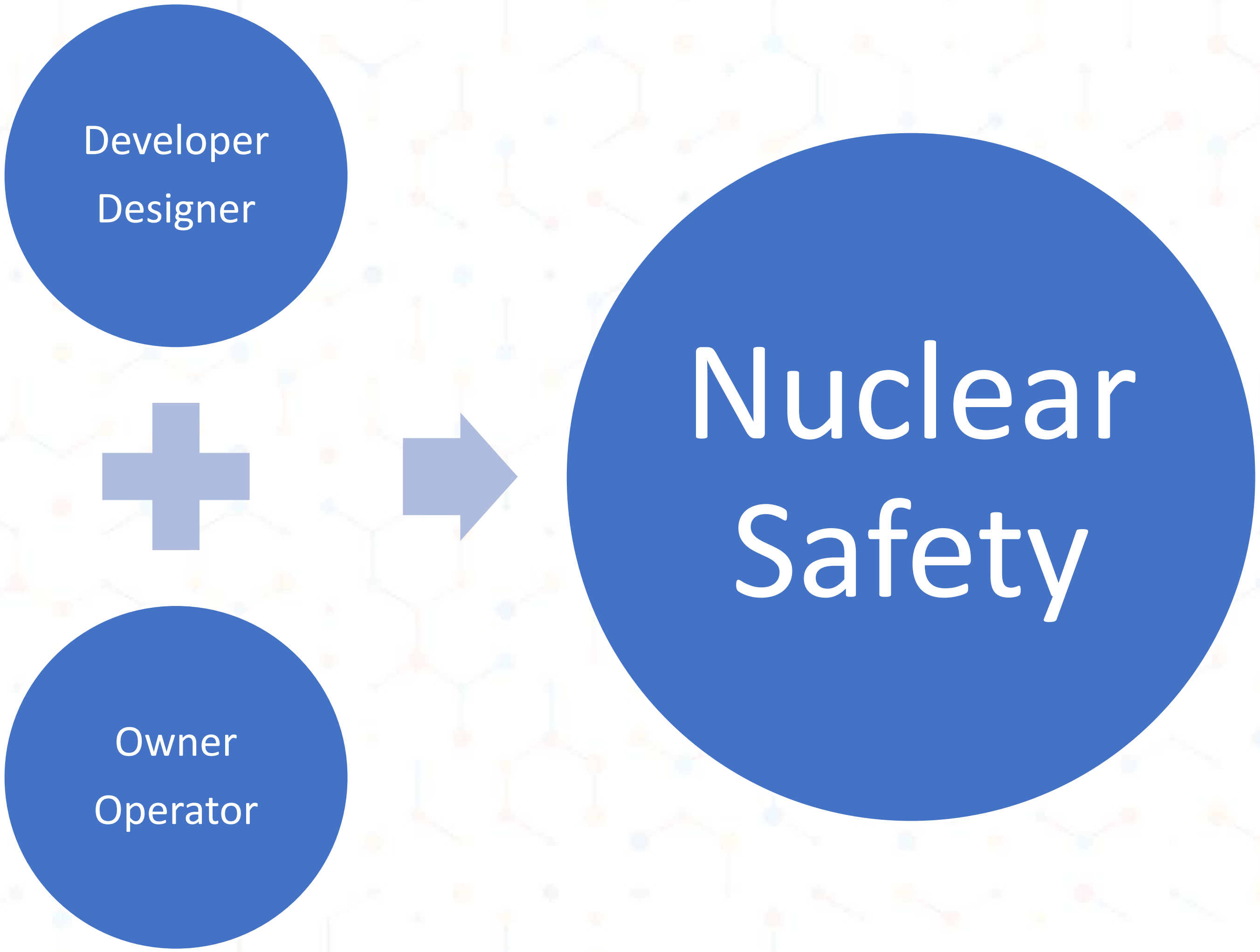
NRC License Applications & Responsibilities

- Adequate design for nuclear safety is the responsibility of the developer/designer, with implementation and oversight by the owner/operator

- The owner is responsible for the safety of the reactor, and protection of the public and environment, in addition to requirements provided by the regulator



Responsibilities – Insights From Past Experience

- Historically, developers often have not been sufficiently rigorous in establishing the safety case and ensuring its implementation in design, leaving (and accepting) NRC to impose its requirements as the answer.
- A focus on only the reactor and its support systems didn't adequately account for other factors and effects – external events, balance-of-plant effects, human-machine interfaces, effects of connected loads, etc.
- Historically, owners often have not been sufficiently demanding that the developer provide a design that fulfills the owner's operational needs and safety responsibilities, but rather accepted the interaction between the developer and NRC to correct shortfalls.
- The stakeholder community now has over 17,000 reactor-years of operating experience that can and should be utilized as a valuable input to the design and review processes.
- **Ultimate responsibility for safe design and operations rests with license holder, not NRC.**

GAIN Regulatory Webinar # 2

- **So – Just what is the Regulatory "Framework"?**
- **Insights on the Efficient Exchange of Licensing Information**
- **Regulatory Considerations when Developing a Deployment Path**

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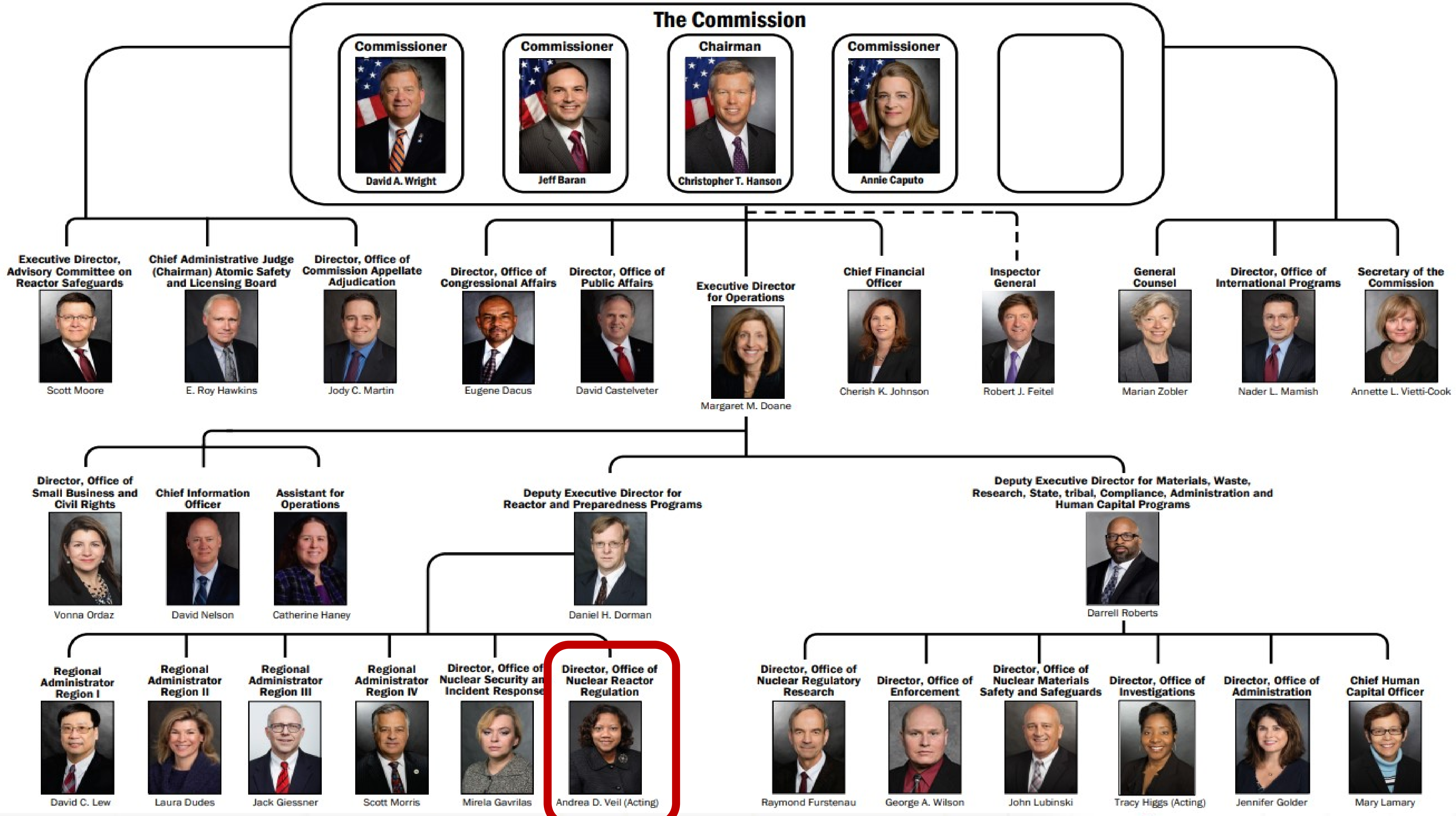
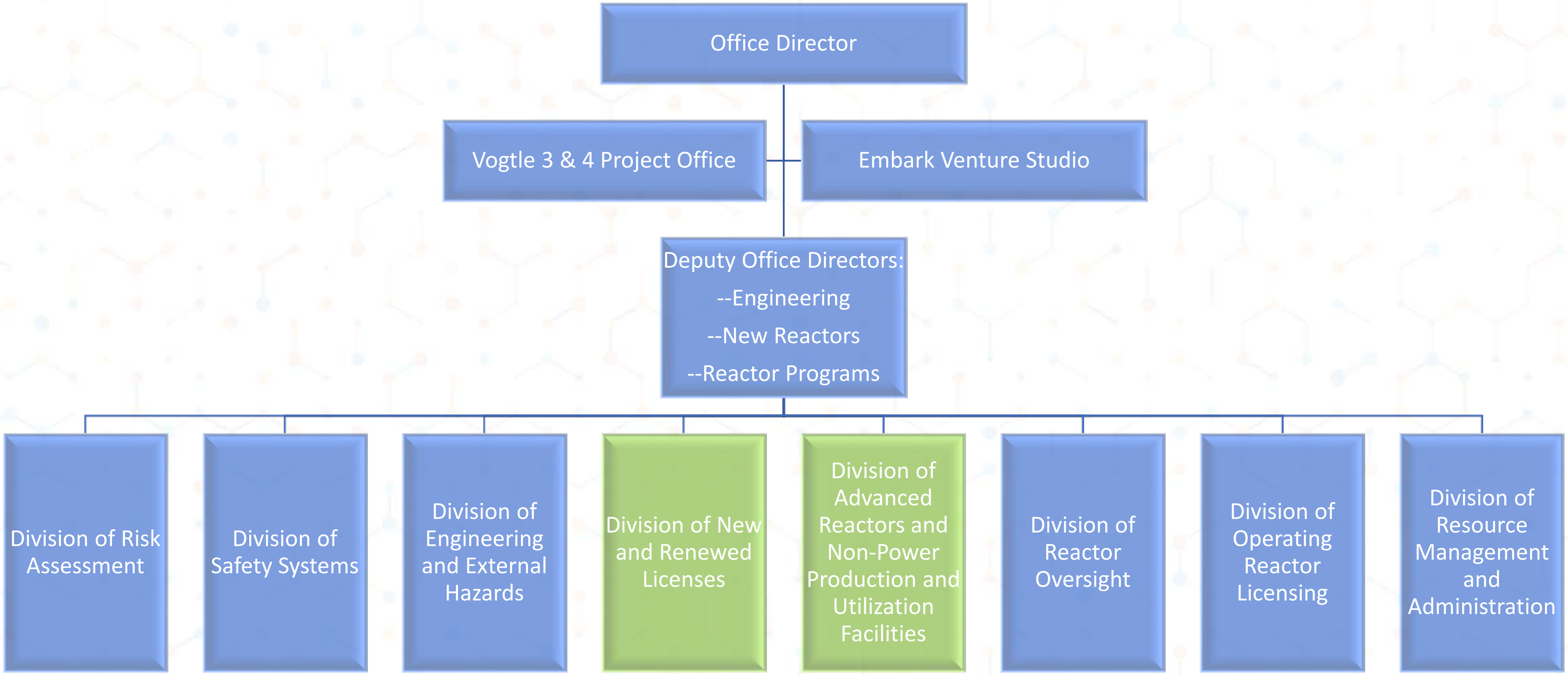
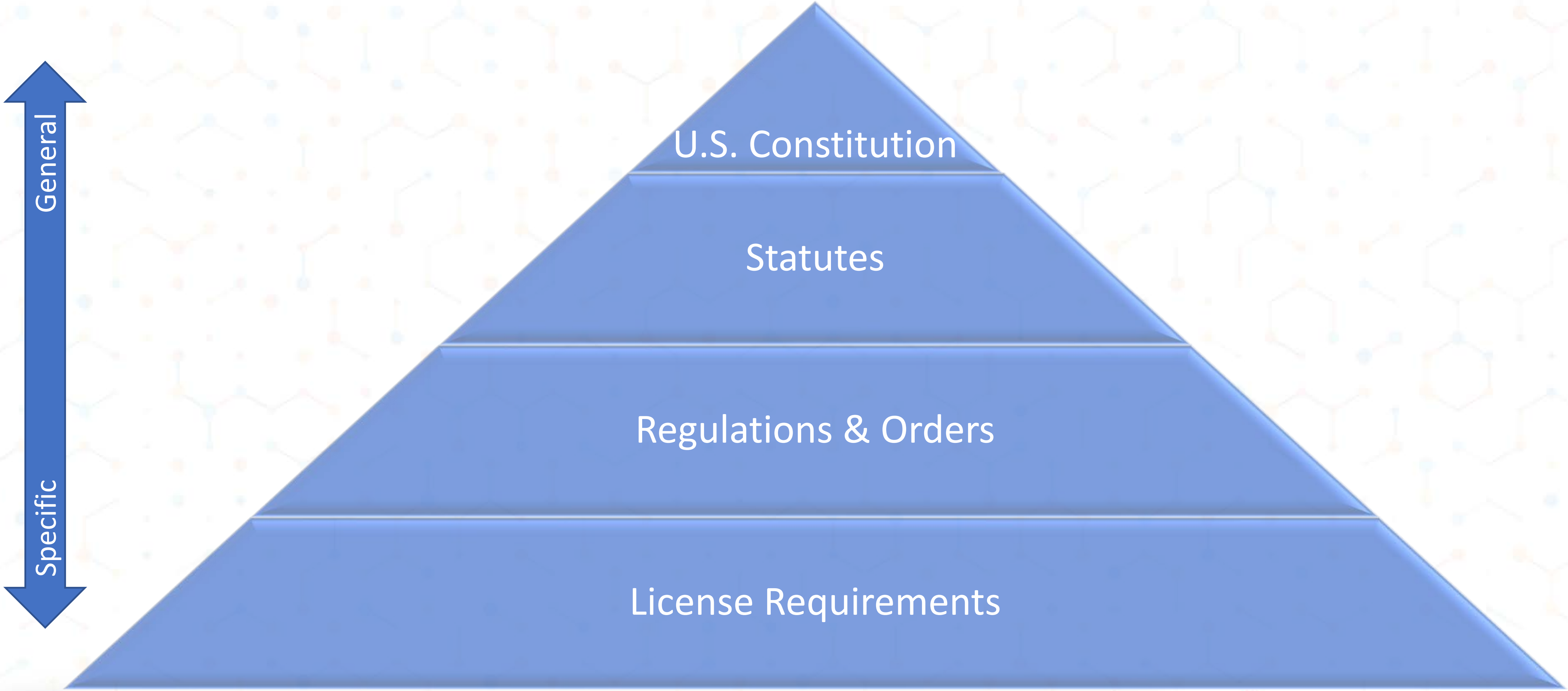
U.S. Nuclear Regulatory Commission



NRC's Nuclear Reactor Regulation (NRR) Divisions



Hierarchy of Law & NRC Requirements



Spectrum of NRC Guidance

Technical / Environmental	Generic Communications	Guidance for Staff
• NUREGs • Regulatory Guides • Interim Staff Guidance (ISG)	• Bulletins • Generic Letters • Information Notices • Regulatory Information Summaries (RIS)	• Standard Review Plan (SRP) • Management Directives • Office Instructions

Regulatory Engagement Strategy

A Regulatory Engagement Plan (REP) establishes **“Rules of Engagement”** between the applicant and NRC. The primary goal of the REP is to **reduce regulatory uncertainty** by establishing such agreements as early in the regulatory process as possible.

Implementation of a robust REP can provide project **stability and predictability** in the full scope of activities supporting the licensing process. A REP provides the framework to:

- Establish and Manage Communication Protocols with NRC Staff
- Establishing Effective Pre-application Engagement
- Provide Framework of Engagement Strategy thru Completion of Regulatory Action

Pre-Application Engagement - Advantages

An **optimized licensing process** provides review efficiency that translates to lower costs, shorter review schedules and is framed by:

- Early identification and resolution of technical and policy issues that would impact any licensing process
- Early and often public engagement which adds to the transparency of the licensing process
- Performance/Results of both Regulatory and Environmental Gaps analysis are presented to NRC staff for clarification/resolution
- Prompt identification of pending design changes that would result in amendments or supplements to an application and extending completion of the licensing action
- Use of topical reports, standard design approval, and other appropriate mechanisms as tools to introduce stages into the reactor licensing process

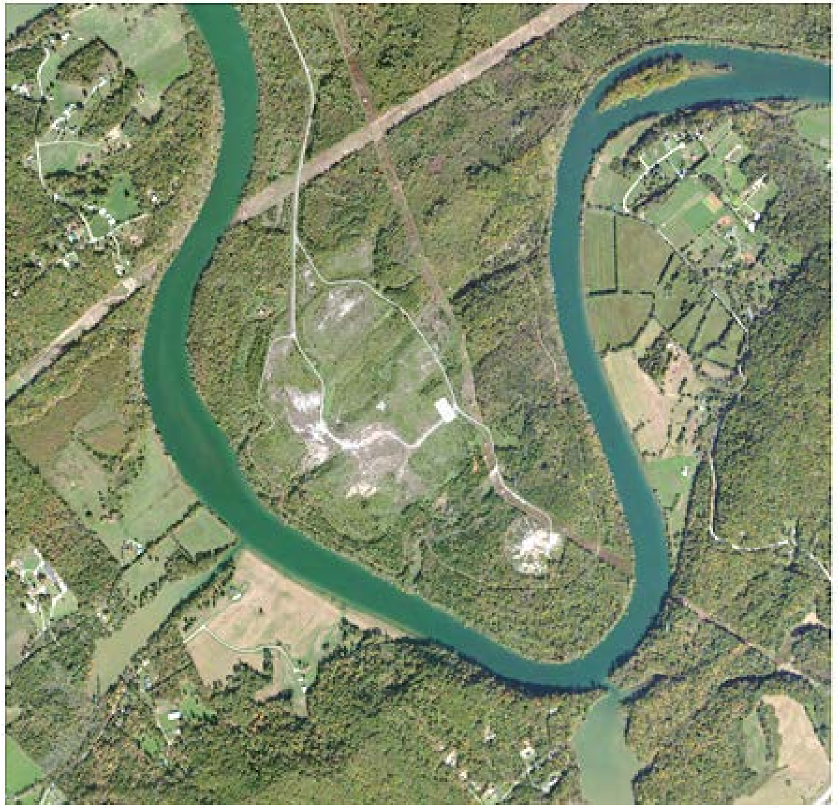
Attributes of Effective NRC Engagement

- Regulatory Engagement Plan concept: “everyone understands what’s coming”
  - Assists NRC in establishing the necessary resources for a timely review

- Develop and provide complete and accurate information
  - Clearly establish and describe the robust safety case for the design
  - Understand the review criteria and guidance that NRC will implement
  - Pre-Application Readiness Assessment (6 months prior to application submittal)

- Establish and maintain effective communications – defined points-of-contact

Clinch River Site



The expected outcome is improved license review efficiency, which translates to lower costs and shorter review schedules

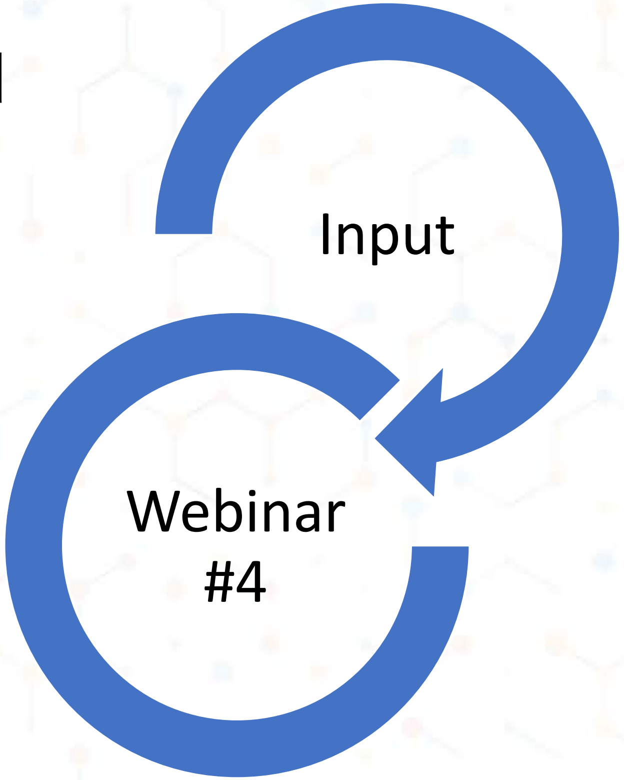
GAIN Regulatory Webinar # 3

- Available NRC Licensing Pathways and Associated Hearing Processes
- The Use of Non-public Information Within the Licensing Process
- The Impact of the Regulatory Process on Overall Project Risk

What’s Planned for the Next Webinar in this Series?

Webinar #4: Establishing New Routes to our Regulatory Future

- Insights and inputs from industry
- Regulatory changes and enhancements going forward



We’d appreciate input from today’s attendees regarding this webinar series and planned Webinar # 4 topics, so that we can adjust accordingly.

Send input to:
GAINEvents@INL.gov

Additional Information: Summary of NRC-DOE MOU for GAIN

- In addition to this webinar series, GAIN can provide insights and support in addressing a range of industry stakeholder questions and challenges associated with advanced technology licensing.

- A DOE-NRC Memo of Understanding (MOU) was established in conjunction with GAIN.
  - MOU Purpose: Assist industry stakeholders as they work to Understand and navigate the regulatory process
  - DOE is the lead for implementation, coordinated via GAIN
  - NRC is responsible for assisting DOE in providing stakeholders with accurate current information

- Stakeholders can review FAQs and request information or ask questions about the NRC's regulatory requirements and activities

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