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New Nuclear Plants: How to Manage Construction Projects in an NRC-Regulated Environment

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NRC Licensing Process and Regulatory Uncertainty

NRC Licensing Basics

- No longer a two-step licensing process
 - Construction Permit
 - Operating License
- NRC will issue a single Combined License (COL)
 - Authorizes both construction and operation
 - May reference a Design Certification (DC)
 - License includes Inspections, Tests, and Analyses and Acceptance Criteria (ITAAC)
 - Completed during manufacture construction
 - Demonstrates compliance with COL
 - Compliance must be maintained



After COL Issuance

- Finalizing the detailed design
 - COL issued before design complete
 - Design constrained by COL and DC
- Building construction infrastructure
 - Starting QA from the ground up
 - Licensee oversight integrated with vendor QA
 - Identifying quality suppliers and contractors
- Transitioning to a construction organization
 - Building a Safety Culture and SCWE

Regulatory Uncertainties Remain

- COL and DC impose limits on ability to adjust design
 - Limits preserve standardization and finality
 - Construction change processes may not align with regulatory change processes
 - Critical to identify potential changes early
- Change management processes required
 - Potential changes must be evaluated
 - If NRC approval required:
 - Some construction may be "at risk"
 - Potentially very costly if not approved by NRC



ITAAC

- Pre-approved set of performance standards that must be met and that the NRC must find to have been met before fuel load
 - Subject to NRC oversight
- ITAAC process is untested
 - Extent of documentation/support to "close" ITAAC?
 - Potential for last-minute delays
 - Opportunity for a Hearing
 - Timeliness of ITAAC review/approvals
- Notifications required by changes in ITAAC status



ITAAC Hearings

- Notice of Intended Operation published in the *Federal Register* under 10 CFR 52.103(a)
 - Published 180 days prior to anticipated fuel load
 - Gives public 60 days to request a hearing
- Proposed contentions must demonstrate that:
 - One or more of the acceptance criteria of the ITAAC in the COL have not been or will not be met; and
 - The specific operational consequences of nonconformance would be contrary to providing reasonable assurance of adequate protection of the public health and safety.

Vendors May Have Best Evidence





Nuclear Construction and NRC Oversight

Nuclear Construction Overview

- Not much recent experience in U.S.
- Construction will take place over a 5- to 7-year period
- Construction represents 1,400 to 1,800 direct jobs, with peak employment as high as 4,000 jobs
 - More for suppliers of commodities (e.g., concrete and steel)
 - More for manufacturers of hundreds of plant components
- But, fewer nuclear suppliers
 - In the 1980s, approximately 400 in the U.S.
 - Today, fewer than 80 in the U.S.
- And, an aging workforce



Nuclear Construction Costs

Construction Starts		Average Overnight Costs		
Year Initiated	Number of Plants	Utilities' Projections (Thousands of dollars per MW)	Actual (Thousands of dollars per MW)	Overrun (Percent)
1966 to 1967	11	612	1,279	109
1968 to 1969	26	741	2,180	194
1970 to 1971	12	829	2,889	248
1972 to 1973	7	1,220	3,882	218
1974 to 1975	14	1,263	4,817	281
1976 to 1977	5	1,630	4,377	169
Overall Average	13	938	2,959	207

Source: Congressional Budget Office, *Nuclear Power's Role in Generating Electricity* (May 2008)

Construction Risks

- Schedule is the primary driver of cost overruns in major construction projects
- The two most important contributing factors to cost escalation and delay:
 - Percentage of the final design that is complete prior to beginning construction
 - Experience and quality of the constructors
- Licensees will do more to manage construction risks
 - Risk analysis is not static — it is dynamic throughout the project.



Nuclear Construction Delays

Applicant	CP Issued	OL Application	OL Issued	CP to OL
Diablo Canyon Unit 1	04/23/68	12/28/73	11/02/84	16+ years
Diablo Canyon Unit 2	12/09/70	10/02/73	08/26/85	14+ years
Shoreham Unit 1	04/04/73	01/26/76	04/28/69	16 years
Comanche Peak Unit 1	12/19/74	02/27/78	04/17/90	15+ years
Comanche Peak Unit 2	12/19/74	02/27/78	04/06/93	18+ years
Seabrook Unit 1	07/07/76	10/01/1981	03/15/90	13+ years

Have we learned from the past?

NRC's Lessons Learned - HISTORIC	NRC's Lessons Learned - RECENT
Inadequate QC documentation	Inadequate QC documentation
Inadequate procedures and instructions	Inadequate procedures and instructions
Poor reporting of non-conformances	Poor reporting of non-conformances
Procedure violations	Procedure violations
Drawing deficiencies	Drawing deficiencies
Inadequate specifications	Inadequate specifications
Materials control deficiencies	Materials control deficiencies
Inadequate licensee audits	Inadequate licensee audits
Inadequate corrective action program	Inadequate corrective action program



NRC Response to Lessons Learned

- Establish a near-constant presence at site
- Apply more attention to design activities
- Develop capability to detect Quality Assurance Program breakdowns
- Conduct in-process QC inspections and
- Improve NRC's ability to inspect ongoing construction activities



Construction Oversight

- NRC has developed Construction Inspection Program (CIP)
 - Supports licensing decisions pre-COL
 - Supports NRC findings of ITAAC completion
- Includes:
 - Procurement and fabrication inspections
 - Engineering inspections
 - ITAAC inspections
 - Non-ITAAC inspections
 - Operational readiness assessment
- Construction ROP ("cROP") under development



Construction Oversight Challenges

- Factoring NRC inspection schedules into construction schedules
- ITAAC cannot be performed unless systems and equipment are available for service
- Preparing and maintaining appropriate documentation
- Documentation must be complete and accurate in all material respects
- All personnel must be aware of regulatory obligations. . .





Important Nuclear Regulatory Obligations

Problem Identification and Resolution

- Corrective Action Program
 - NRC QA requirements necessitate a program for timely identification and resolution of conditions adverse to quality
 - Issues must be documented, prioritized, and resolved
 - Licensee and NRC evaluate CAP "metrics"
 - Issue resolution is open and transparent
- Problem identification and resolution (PI&R) is a big part of a Nuclear Safety Culture . . .



Safety Culture

- Nuclear industry and regulators expect and demand a Nuclear Safety Culture
- Nuclear Safety Culture means:
 - An organization's values and behaviors—modeled by its leaders and internalized by its members—that serve to make nuclear safety the overriding priority
 - Includes "the necessary full attention to safety matters" and the "personal dedication and accountability of all individuals engaged in any activity which has a bearing on the safety of nuclear power plants"

NRC Policy Statement on Safety and Security
Culture Under Development



Principles of a Strong Safety Culture

- Everyone is personally responsible for nuclear safety
- Leaders demonstrate commitment to safety
- Trust permeates the organization
- Decision-making reflects safety first
- Nuclear technology is recognized as special
- A questioning attitude is cultivated
- Organizational learning is embraced
- Nuclear safety undergoes constant examination

Source: Institute of Nuclear Power Operations (INPO)



Safety Conscious Work Environment

Sites must establish and maintain a safety-conscious work environment (SCWE) in which employees feel free to raise safety concerns, both to their management and to the NRC, without fear of retaliation.

- NRC's SCWE Policy Statement (1996)

- Responsibility rests with each NRC licensee, its contractors, subcontractors, and employees
- Elements:
 - Management encourages concerns (by policy and deed)
 - SCWE Training — particularly supervisors
 - Concerns are prioritized and resolved
 - Employees receive feedback on resolution



Discrimination

- NRC's regulations prohibit discriminating against employees for engaging in protected activity
- NRC can impose a civil penalty on a non-licensee contractor or subcontractor of a Commission licensee who violates 10 CFR 52.5, 10 CFR 50.7
 - Enforcement can extend to individuals under 10 CFR 52.4 (deliberate misconduct)

NRC Requirements Add a New Category of "Protected Activity"



Whistleblower Protection



- Alleged willful violations of license during refueling
- Resulted in increased NRC scrutiny
 - Millstone Unit 1 never re-started
 - Other two units shut down for many months
 - \$2.1 million civil penalty for technical non-compliances
 - Settlement of discrimination claims



Complete and Accurate Information

- 10 CFR 52.6 - Completeness and Accuracy of Information:
 - Information provided to the Commission by an applicant or by a licensee or information required to be maintained by the applicant or the licensee *shall be complete and accurate in all material respects.*
 - Reporting required if information has *significant implication* for public health and safety.
- Enforcement can extend to individuals under 10 CFR 52.4 (deliberate misconduct)

Reporting Requirements Overview

- Three principles:
 - Reporting requirements apply to the entire “regulatory life” of the license or design certification;
 - Report defects or failures to comply with certain safety hazards when the information would affect the integrity and adequacy of the NRC’s regulatory activities; and
 - Develop and implement procedures and practices to ensure that they comply with reporting requirements in a timely manner.
- Reporting requirements are both "backward" and "forward" looking



Part 21 — "Vendor Notifications"

- Reporting obligation runs directly to firms constructing or supplying components or services to a nuclear plant
 - To "individual director or responsible officer"
- Must notify NRC of:
 - Defects and failure to comply that could create a "substantial safety hazard"
 - Defects relate to deviations in a "basic component" or in "installation of a basic component"



Part 21 Notification — Timeline

- Must evaluate deviations and failures to comply — 60 days of discovery
- Must notify director or responsible officer of reportable condition — 5 days of evaluation
- Must notify NRC — 2 days for initial; 30 days for written
 - Alternatively: If vendor or supplier does not have capability, it may notify purchaser or affected licensees
 - Failure to Notify: director or responsible officer subject to civil penalties

Vendors/Suppliers Must Maintain Traceability



Commercial Grade Dedication

- Vendor or supplier can contract to provide equipment or services as "Nuclear Grade"
 - Subject to NRC-compliant QA program ("safety-related")
 - Subject to Part 21 requirements
- Vendor or supplier can supply equipment "Commercial Grade"
 - Commercial Grade equipment must be "dedicated"
 - Entity is responsible for establishing quality, meeting Part 21
 - QA process to verify critical characteristics
- Auditable records are required

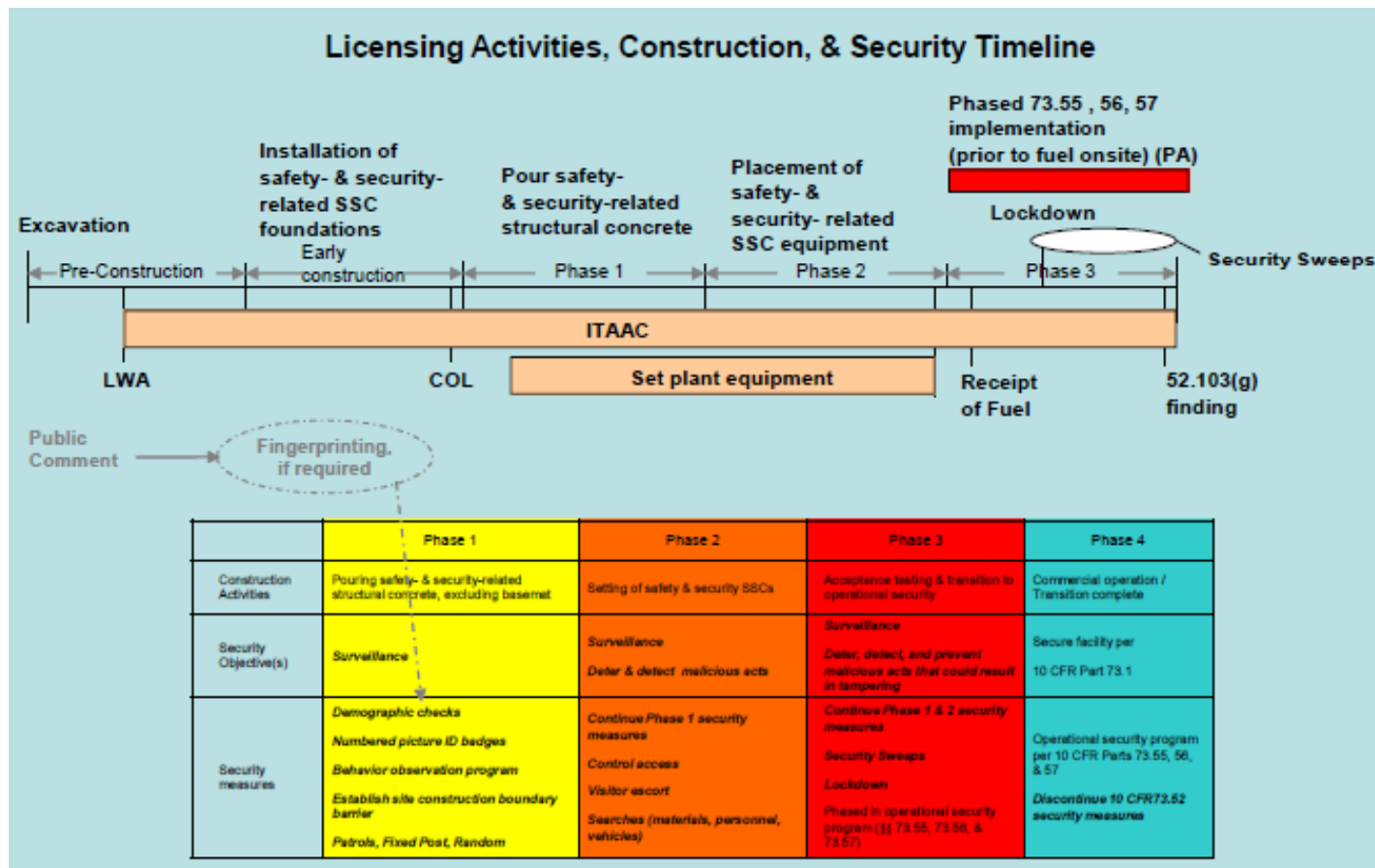


Access Authorization

- Need for security clearances will challenge resources
- "Full" NRC access authorization requires:
 - Background check
 - Criminal history check (FBI fingerprints)
 - Psychological exam
 - Fitness for duty (drug and alcohol) test
 - Continuous behavior observation program (CBOP)
- NRC developing proposed rule to implement access authorization and physical security at "milestones" during construction



Access Authorization Phased Approach



Source: <http://www.nrc.gov>



NRC Enforcement

- NRC Enforcement for non-licensees
 - "Deliberate misconduct"
 - Discrimination/retaliation
 - Complete and accurate information
- Deliberate misconduct subject to criminal and civil penalties
 - Investigated by Office of Investigations
- Other issues subject to NRC enforcement process
 - Notices of Violation, Civil Penalties
 - cROP



Other Issues — Nuclear Insurance

- Public Liability Protection — Price-Anderson Act
 - Insurance maintained by operator/licensee
 - Primary and secondary coverage
 - Liability limit and government indemnity
 - Coverage is "omnibus"
- At-reactor Property Coverage
 - Required for operator/licensee
 - Vendors not necessarily insured
 - Liability addressed by contract



Closing Thoughts

- Over the long term, construction quality is biggest threat to Nuclear Renaissance
 - Cost and schedule implications
 - Regulatory and licensing implications
- Vendors, suppliers, and construction firms have regulatory responsibilities
 - Subject to NRC inspection, investigations, and enforcement (civil and criminal)
 - Proper planning can reduce risk of enforcement and delays once construction begins





Questions?



Thank You.

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