Project Implementation and Management for New Nuclear Power Plant Projects

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IAEA/ANL Training Course on Leadership & Management of NPP Programmes
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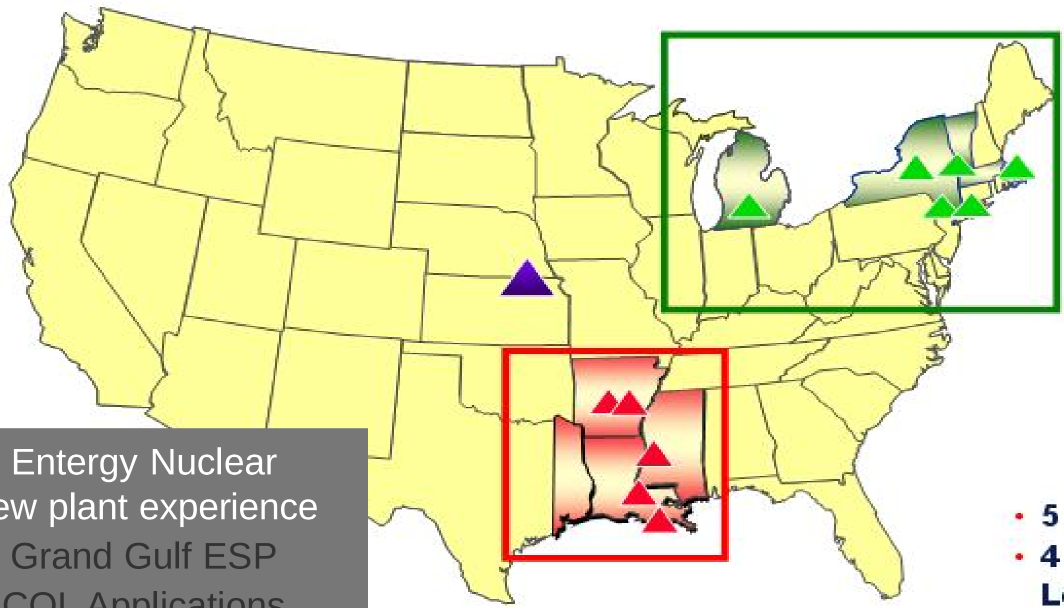
Topics

- Background on Entergy Nuclear and Plans for New Nuclear
- New Nuclear Build in the U.S.
- New Nuclear Build Risk Factors
- Lessons Learned and NRC Regulatory Process for New Nuclear Build in the U.S.

Entergy Nuclear

Principal Lines of Business

Entergy



Entergy Nuclear

- 6 non-utility nuclear units at 5 sites generating 4,998 MWe
- Nuclear life cycle services

▲ Commodity Marketing for Owned Assets

▲ Plant management of Cooper Nuclear Station; 800 MWe

Entergy Utility

- 5 electric utilities; 5 regulators
- 4 contiguous states – Arkansas, Louisiana, Mississippi, Texas
- 22,000 MW of generating capacity
  - 87 generation units
  - ▲ 5 nuclear units; 5120 MW
  - 5 coal units = 2233 MW

Entergy Nuclear
new plant experience

Grand Gulf ESP

COL Applications

- ESBWR
- ABWR
- AP1000
- APWR

Entergy Nuclear

One of the Largest Nuclear Owner/Operators in the U.S.

Entergy Nuclear

6 PWR's (B&W, CE, W)
5 BWR's (GE)

ANO

Unit 1 836 MW B&W PWR
Unit 2 858 MW CE PWR

Riverbend

936 MW GE BWR

Grand Gulf

1210 MW GE BWR

Waterford 3

1075 MW CE PWR

Indian Point

Unit 2 974 MW W PWR
Unit 3 965 MW W PWR

Fitzpatrick

820 MW GE BWR

Pilgrim

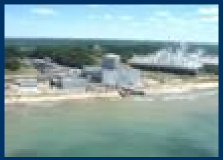
665 MW GE BWR

Vermont Yankee

506 MW GE BWR

Palisades

798 MW CE PWR



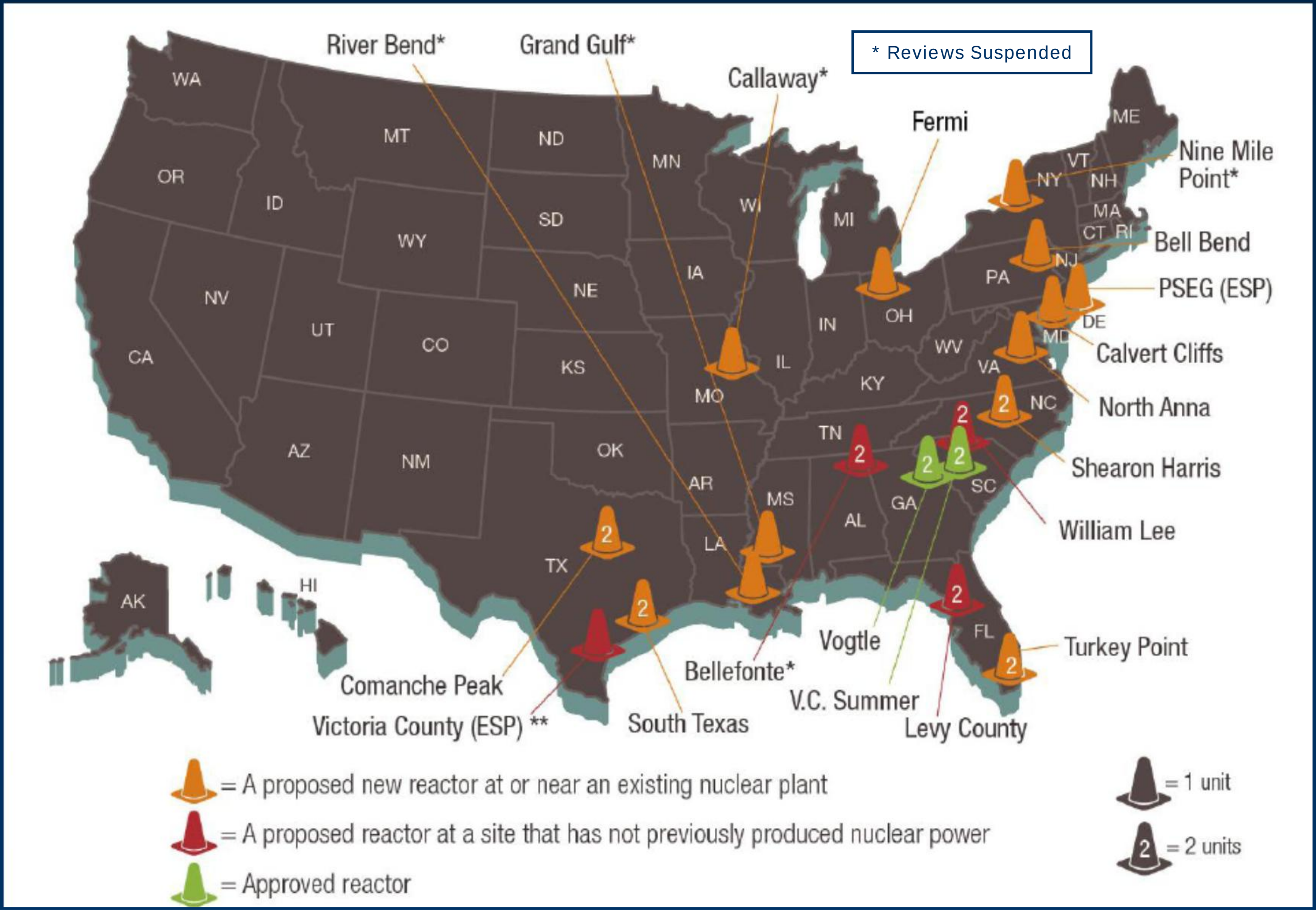
Cooper

764 MW GE BWR

Topics

New Nuclear
Build in the U.S.

Plans for New Nuclear Build in the U.S.



As of June 2012, the NRC had 10 applications for 16 units under active review.

2007-2014 Total Number of Applications = 23   Total Number of Units = 34

Projections for New Nuclear Build

"The AEO96 reference case forecast assumes that all nuclear units will operate to the end of their current license terms, with 49 units (37 gigawatts) retiring through 2015. Just over 80 percent of these retirements occur in the last 5 years of the forecast...

One unit under construction, Watts Bar 1, is assumed to begin operation in 1996, and no new orders are assumed. Given these assumptions, 61 nuclear units are projected to provide 10 percent of total electricity generation in 2015..."

U.S. Energy Information Administration
Annual Energy Outlook 1996

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"Nuclear generating capacity in the AEO2011 Reference case increases from 101 gigawatts in 2009 to 111 gigawatts in 2035, with 6.3 gigawatts of new capacity (5 new plants) and the balance coming from rerated capacity."

U.S. Energy Information Administration
Annual Energy Outlook 2011

Idaho National Lab / Nuclear Power Industry

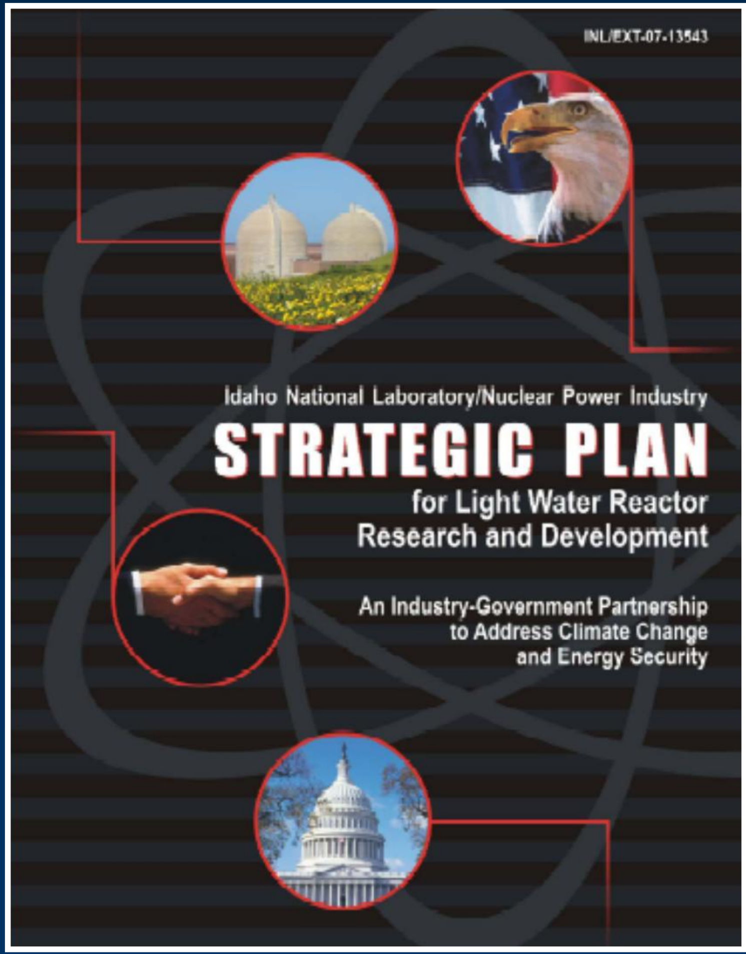
2007
Strategic Plan for U.S. Light Water Reactor Research and Development

Goals for existing LWRs:

Goal 1 – successfully achieve planned life extensions to 60 years and further extend the NRC licenses of existing LWRs to 80 years, and

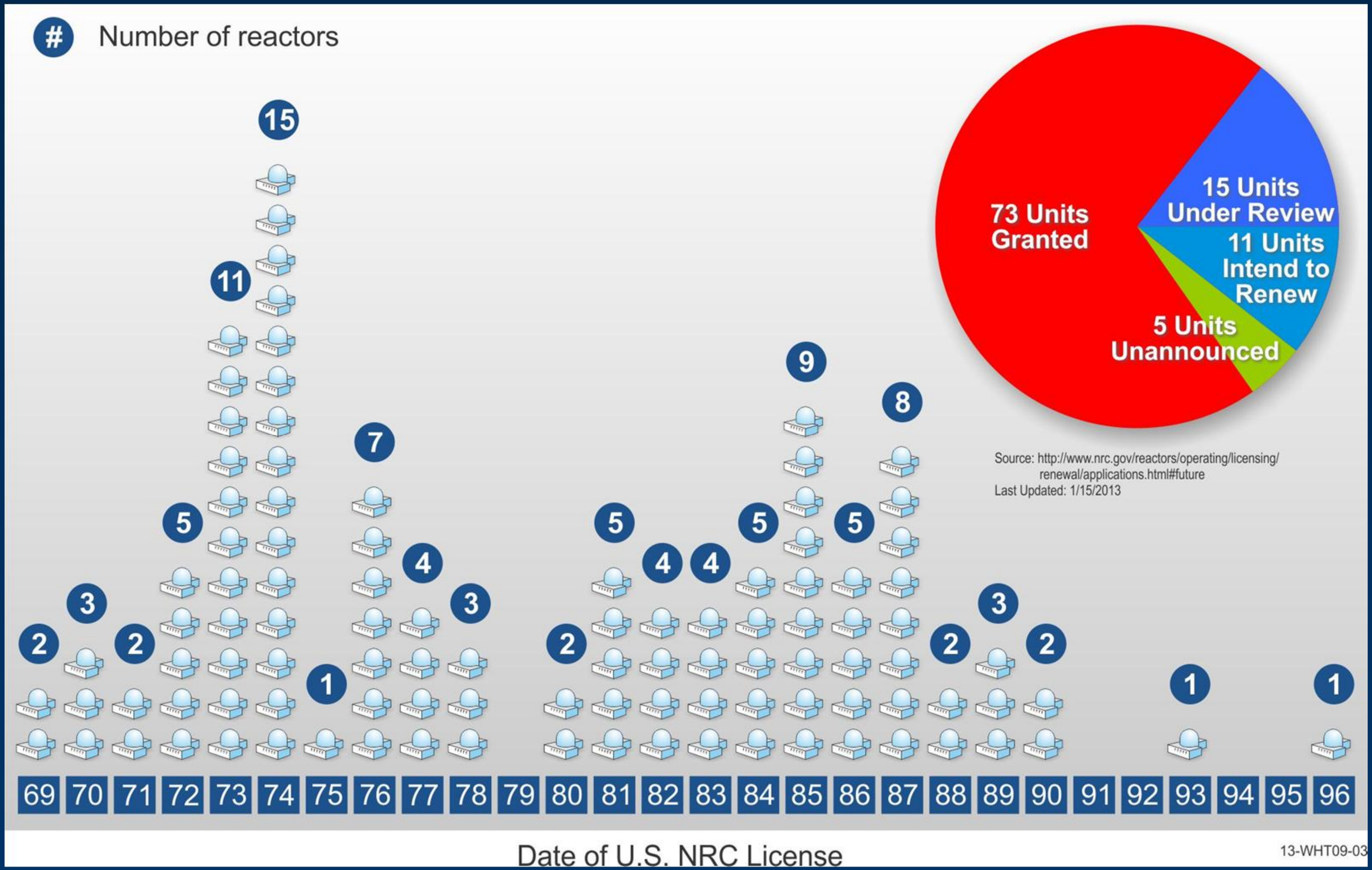
Goal 2 – maintain plant performance to ensure the high capacity factor and superior safety and economic performance of LWRs throughout their 80-year lifetime.

www.energetics.com/nrcdoefeb08/presentations.html



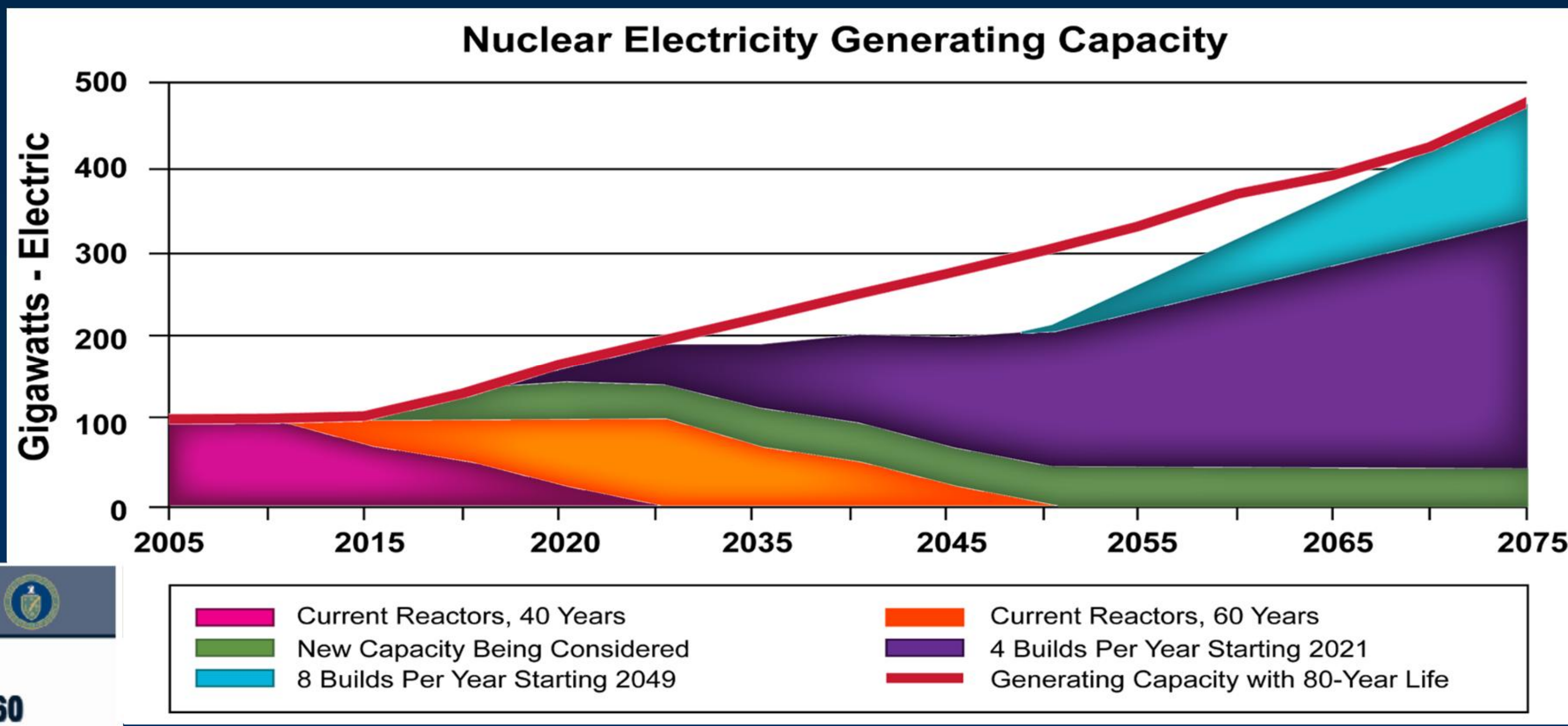
DOE Light Water Reactor Sustainability (LWRS) Program

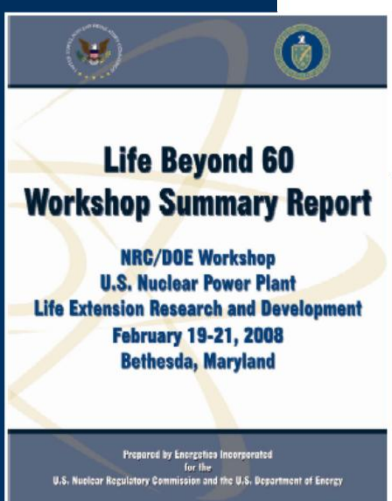
- U.S. NPPs are a national asset: without today's NPPs, we lose:
  - ~100 GWe of low-carbon generation over about 20 years
  - Low-cost generation
- It is unlikely that new plants can be built quickly enough to both replace NPP retirements and meet demand for new clean electricity



“Life beyond 60”
NRC/DOE Workshop in 2008 - 2011

http://www.energetics.com/nrcdoefeb08/presentations.html

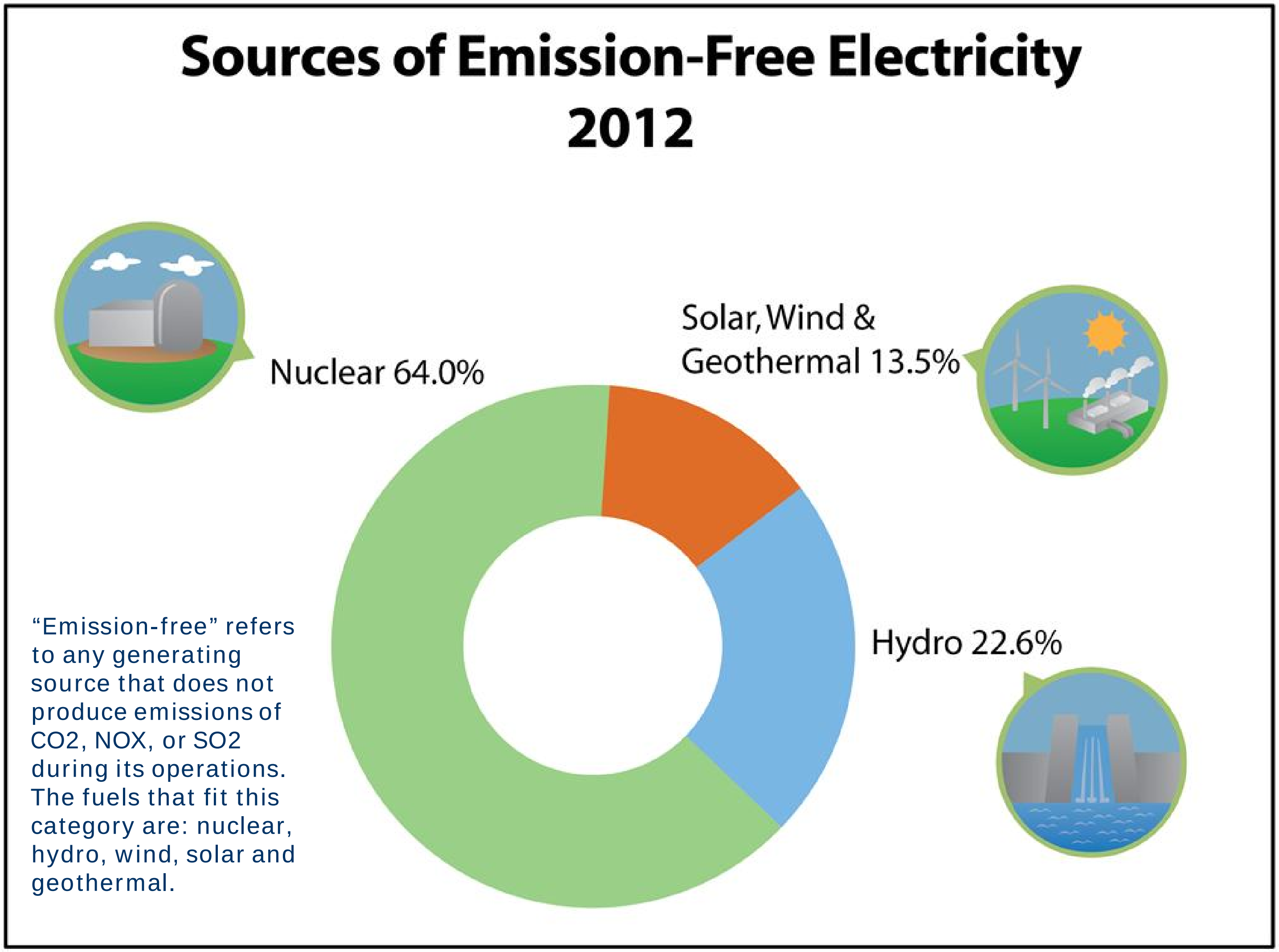




Source: NRC/DOE Life Beyond 60 Workshop February 2008

2nd NRC/DOE/NEI Workshop
February 22-24, 2011
Washington, D.C.

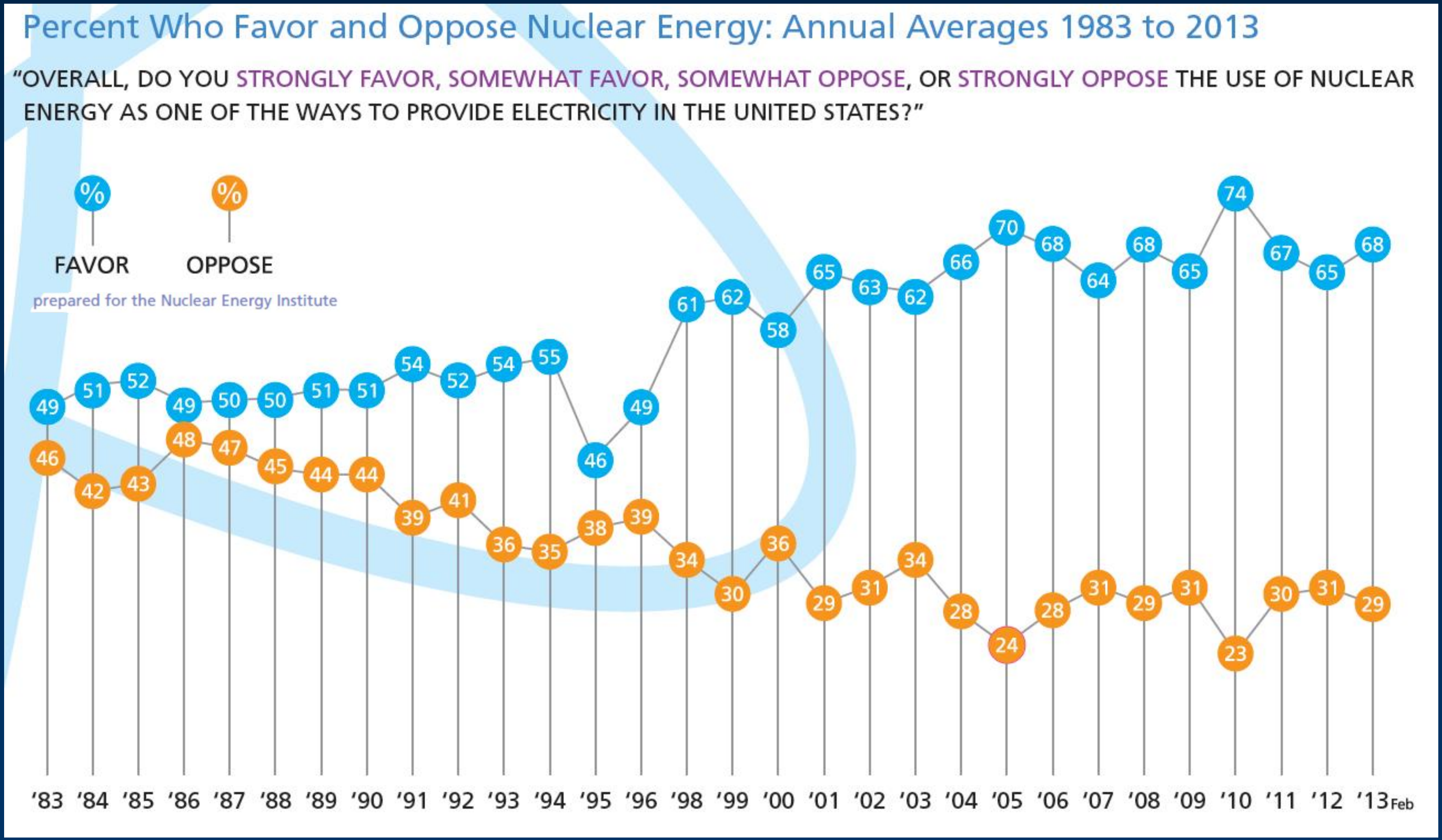
U.S. Sources of Emission-Free Electricity



U.S. Department of Energy

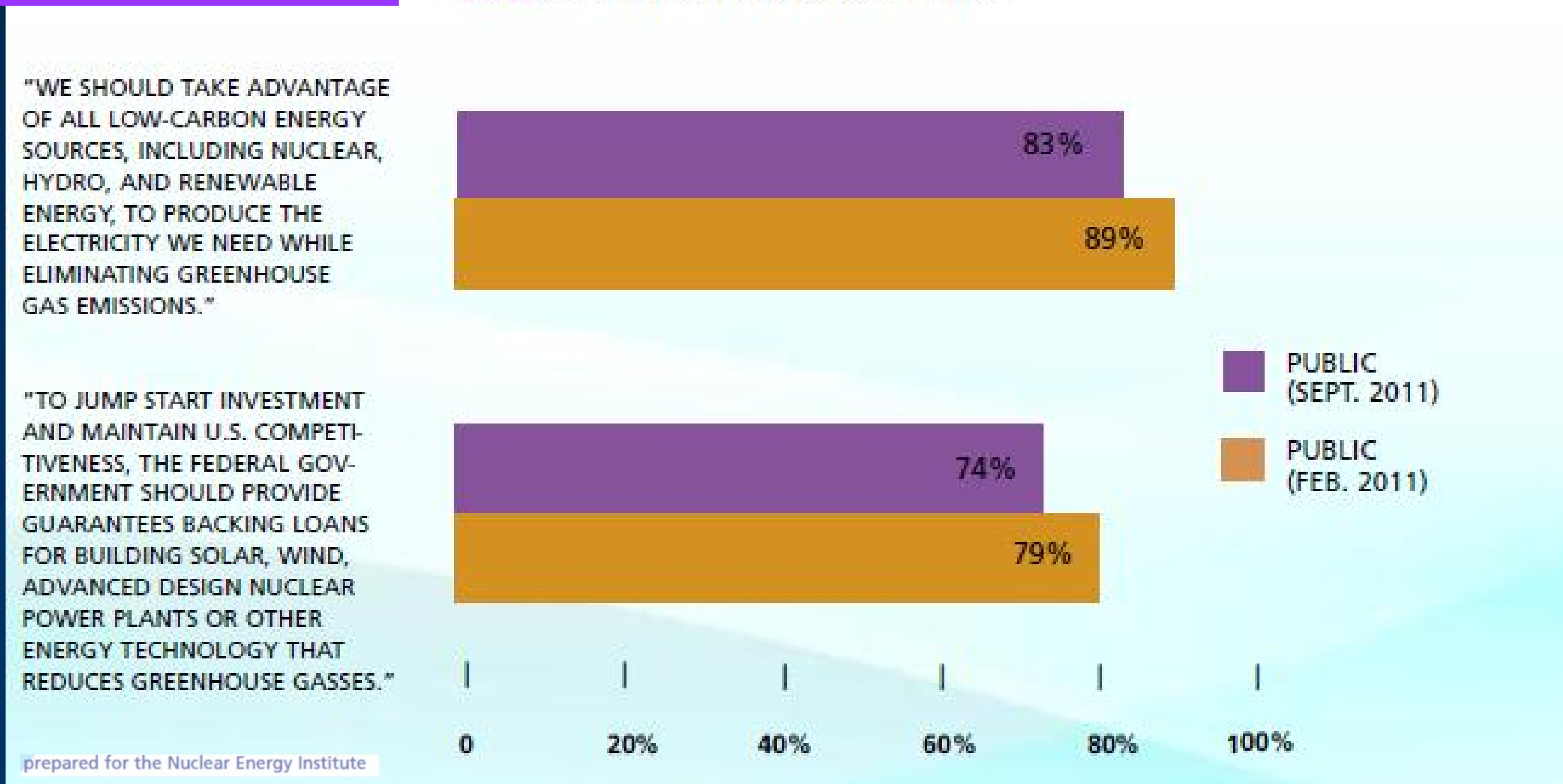
Public Opinion Survey Results

Percent who favor, oppose nuclear energy in the U.S.



Public Opinion Survey Results

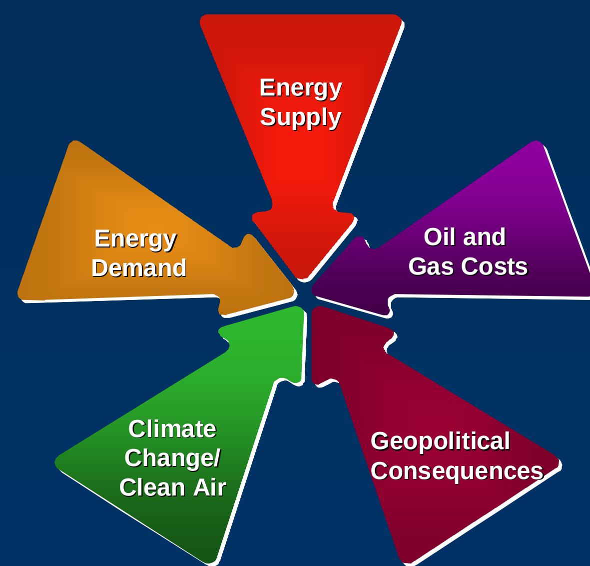
While there is some evidence of the impact of the Fukushima events, public support for nuclear energy continues at high levels.



U.S. Public Opinion Strategy

Overview of Public Opinion Strategy

Factors Driving Public Opinion



Topics

New Nuclear
Build Risk Factors

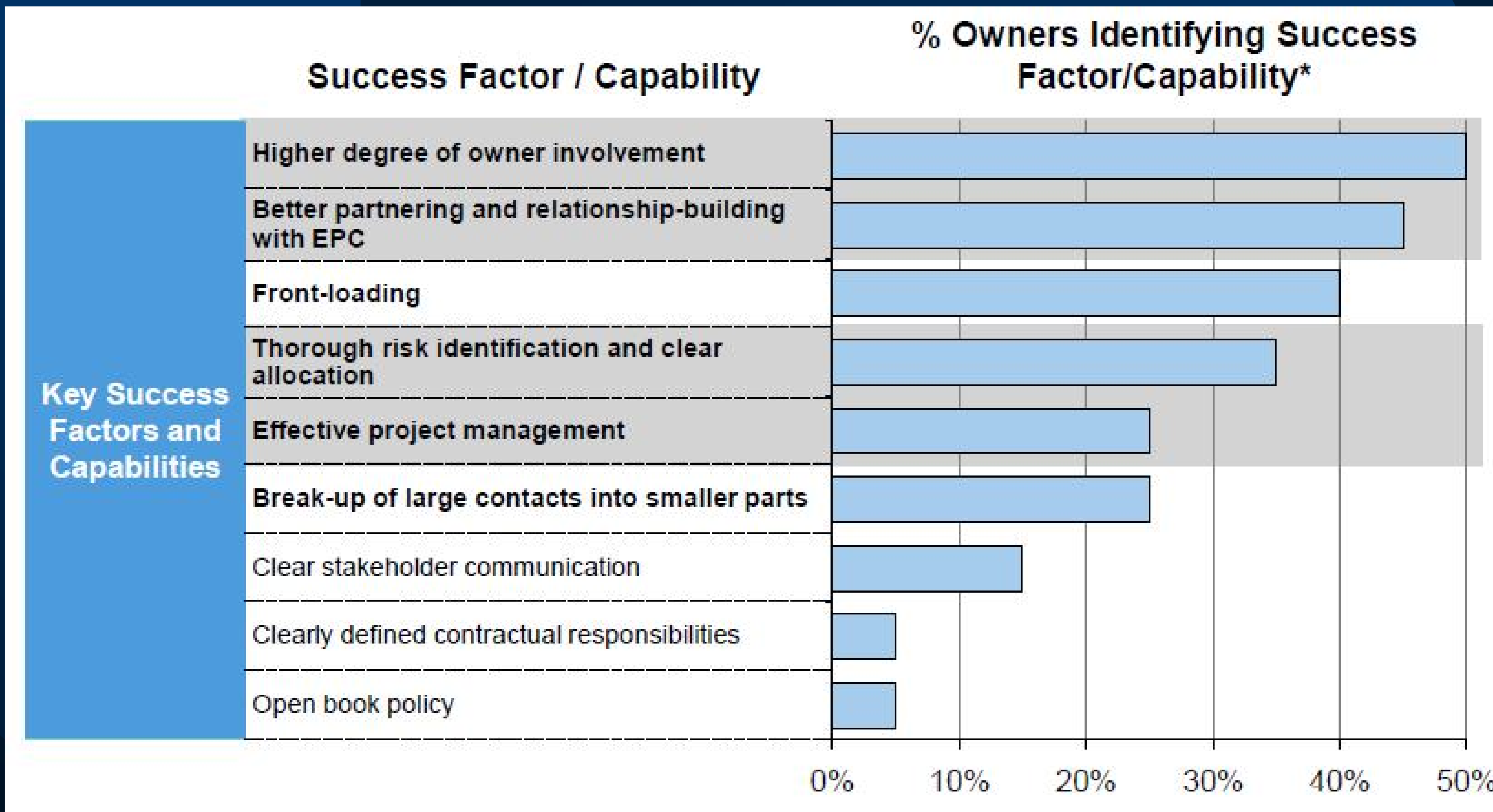
“Natural” Risk Ownership Example

Risk Ownership

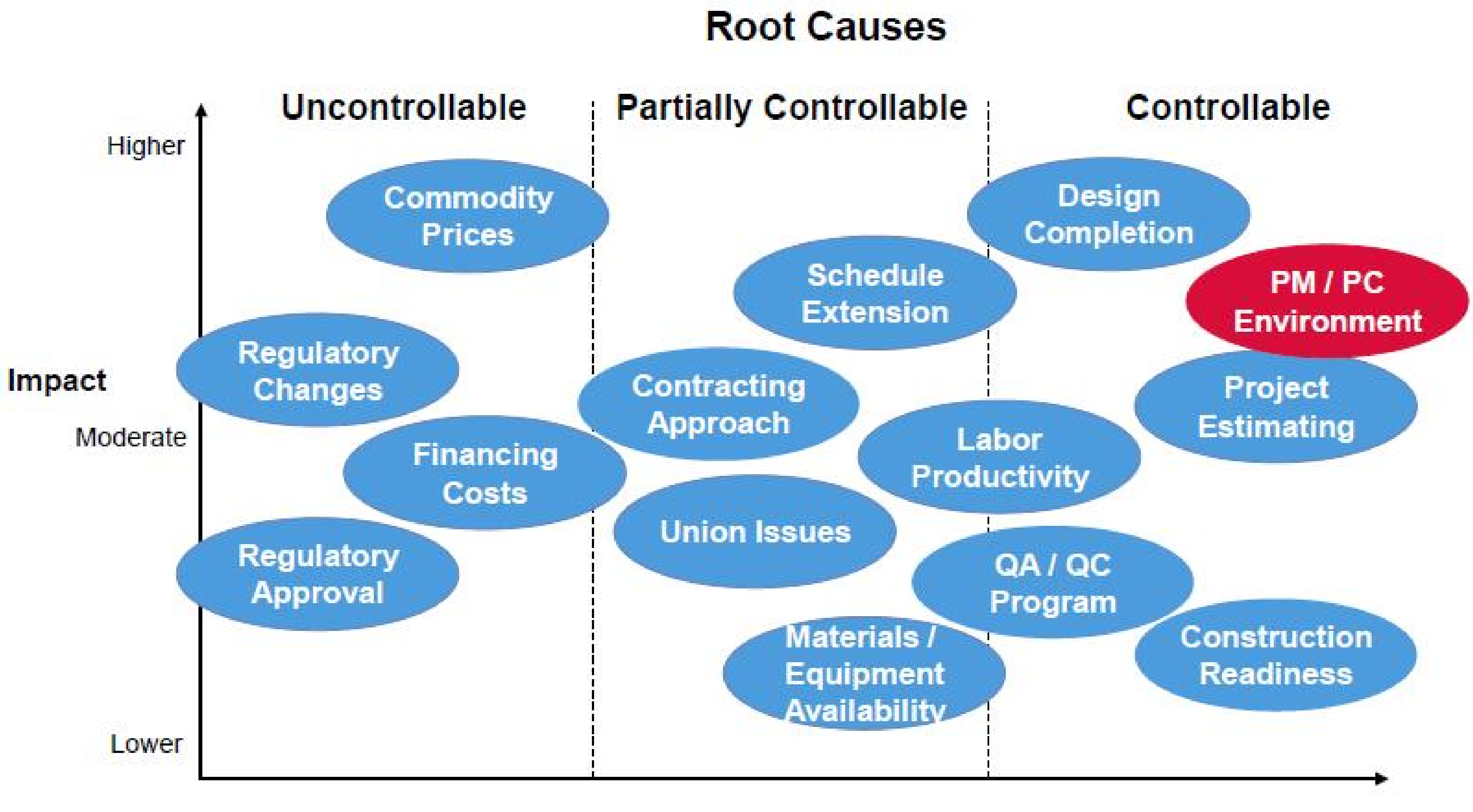
	Owner	EPC	OEM	Risk Description
Regulatory	●			▪ Delays in regulatory approvals that could lead to project delays
Financing	●			▪ Risks that could lead to increased equity requirements or borrowing costs
Technology			●	▪ Risk that technology may not perform as expected (reliability, output)
Project	◐	◐		▪ Project risks that lead to costs being greater than projected or duration that is beyond target
Market	●			▪ Risks that nuclear technology will not be competitive vs. other baseload technologies
Political	●			▪ Political risks that could lead to project delays or increased project costs

● Natural owner ◐ Shared

Owner Requirements for Success



Causes of "Under-Performance"



Source: Booz & Company analysis of over 20 projects

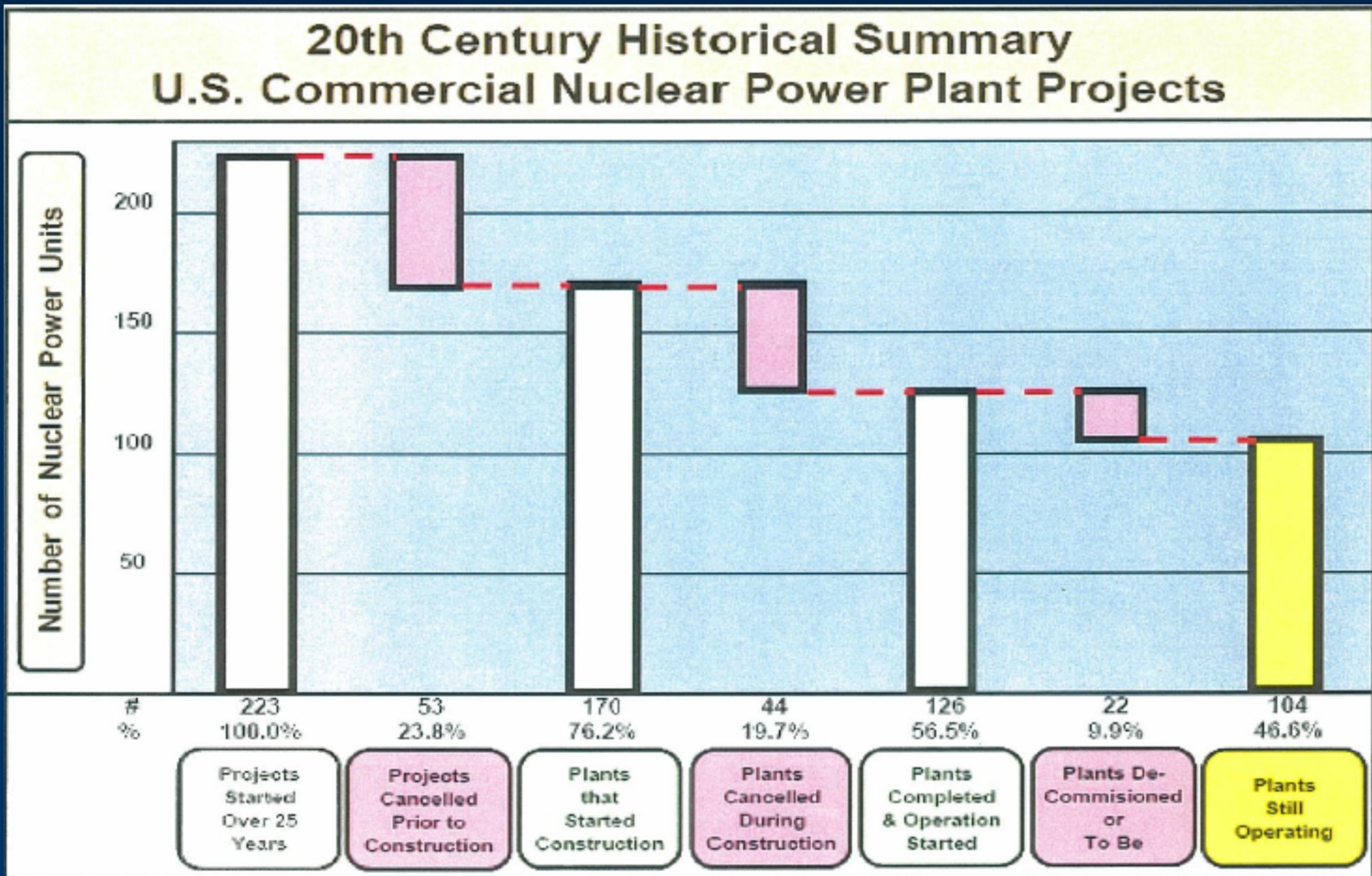
Topics

Lessons Learned and

NRC Regulatory Process

for New Nuclear Build in the U.S.

Historical Perspective



Lessons Learned

Historical Construction Cost Experience

– In the 1960's – construction costs were 2 to 3 times higher than the original estimated cost (i.e., $650 to $780/kW est. were $1350 to $2300/kW actual)

– In the 1970's – construction costs were 2.5 to 3.8 times higher than the estimated costs (i.e., $900 to $1700/kW est. were $3000 to $5000/kW actual)

Reasons for cost overruns and project failures included:

– Regulatory changes, construction errors, inflation and high interest rates, economic recession in 1970's, design changes during construction

– Weak project management teams, lack of project integration, lack of training, lack of "nuclear mindset"

Lessons Learned: Need strong project management and nuclear mindset, need stable and predictable regulatory process, need near final design before beginning construction

Lessons Learned

Over 120 unique designs (non-standard licenses under 10 CFR 50)

- No finality on designs until operating decision
- Large capital outlay for extended period and in advance of key NRC decisions
- Unclear relationship between construction deficiencies and operating decision

Two-step licensing process was unstable and unpredictable:

- Lack of rigor in the hearing process
- Changing requirements and standards applied retroactively

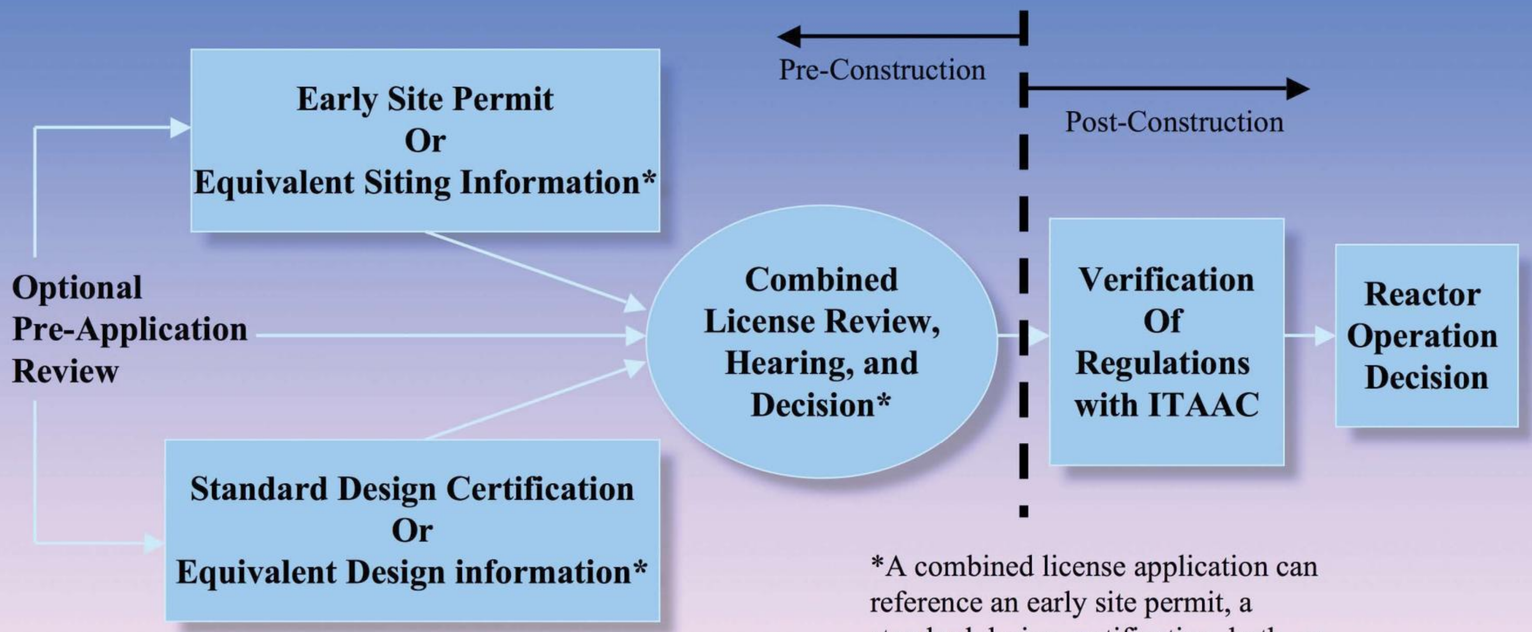
Lessons Learned

Today's Improved U.S. Industry Efforts

- Advanced nuclear plant designs
- Streamlined regulatory process
- Federal incentive program for financing and insurance
- Modest inflation and financing rates
- Standardized designs for nuclear power plants
- More sophisticated management processes/software
- Modularization approach to construction
- Integrated material management planning techniques

Lessons Learned: First-of-a-kind projects are not fully understood, degraded nuclear supply chain, and global supply chain logistics and risks

NRC Regulations – 10 CFR Part 52



*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.

NRC Regulations – 10 CFR Part 52 Processes and Issue Resolution

Process	Issues Resolved
Early Site Permit	• Environmental/NEPA issues • Site characteristics, e.g., seismic, wind, etc. • Emergency Planning (optional)
Design Certification	• Safety issues and ITAAC associated w/standard designs • Probabilistic risk assessment • Interface requirements
Combined License	• ESP and design certification interface issues • Site specific design info & ITAAC • Operational programs, ownership & organizational issues
ITAAC	• Constructed plant meets specified acceptance criteria

NRC Regulations – 10 CFR Part 52
Early Site Permit (ESP)

- ESP Application Content
  - Site Safety Analysis
  - Environmental Report
  - Emergency Preparedness
- ESP Information Needs
  - Site Safety Analysis
    - Geological / Seismology
      - Boring Plan would include multiple borings for each structure
    - Groundwater / Hydrology monitoring well data
    - Meteorological data (2 years; minimum 1 year at docketing)
    - Characterization and analysis of external hazards

NRC Regulations – 10 CFR Part 52
Early Site Permit (ESP)

- ESP Information Needs (continued)
  - Environmental Report
    - Evaluation of habitat and potential threatened and endangered species
    - Environmental Justice evaluation
    - Severe Accident evaluation
    - Fuel Cycle Impacts
    - Environmental Impacts of Construction and Operation
  - Emergency Planning
    - Agreements establishing Exclusion Area Authority
    - Onsite emergency plan
    - Offsite emergency plan

NRC Regulations – 10 CFR Part 52
Early Site Permit (ESP)

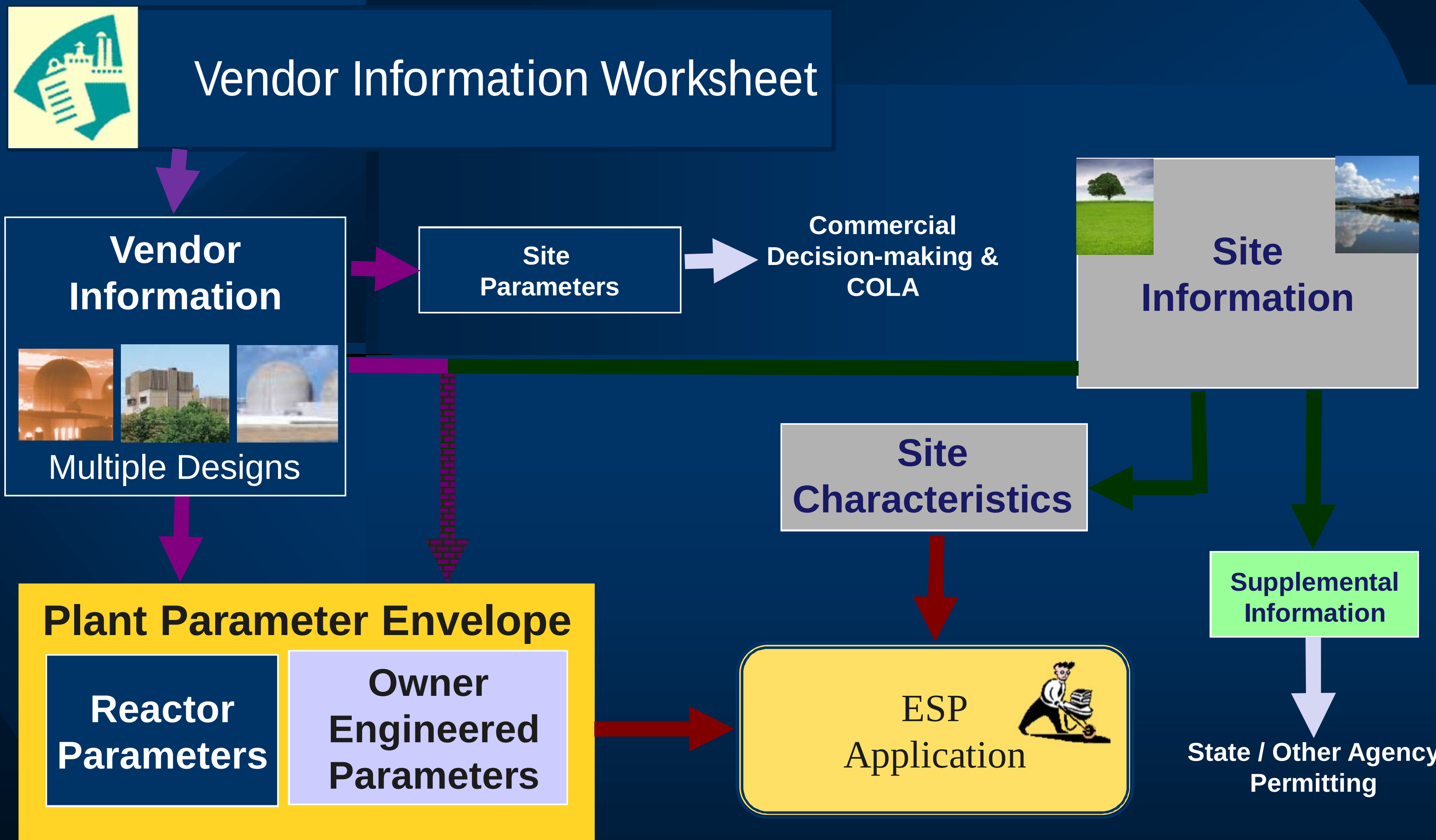
Generally, two types: Technology specific
or
Technology neutral

Financial implications:

- Less beneficial to project with known site acceptability and Emergency Planning capability
- May have significant benefit to a green field site or to “bank” site for future
- May benefit schedule/cash flow if design not yet certified or known
- Could facilitate streamlined COLA review and approval

ESP could be of significant benefit to support competitive bidding process

NRC Regulations – Early Site Permit (ESP)



*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

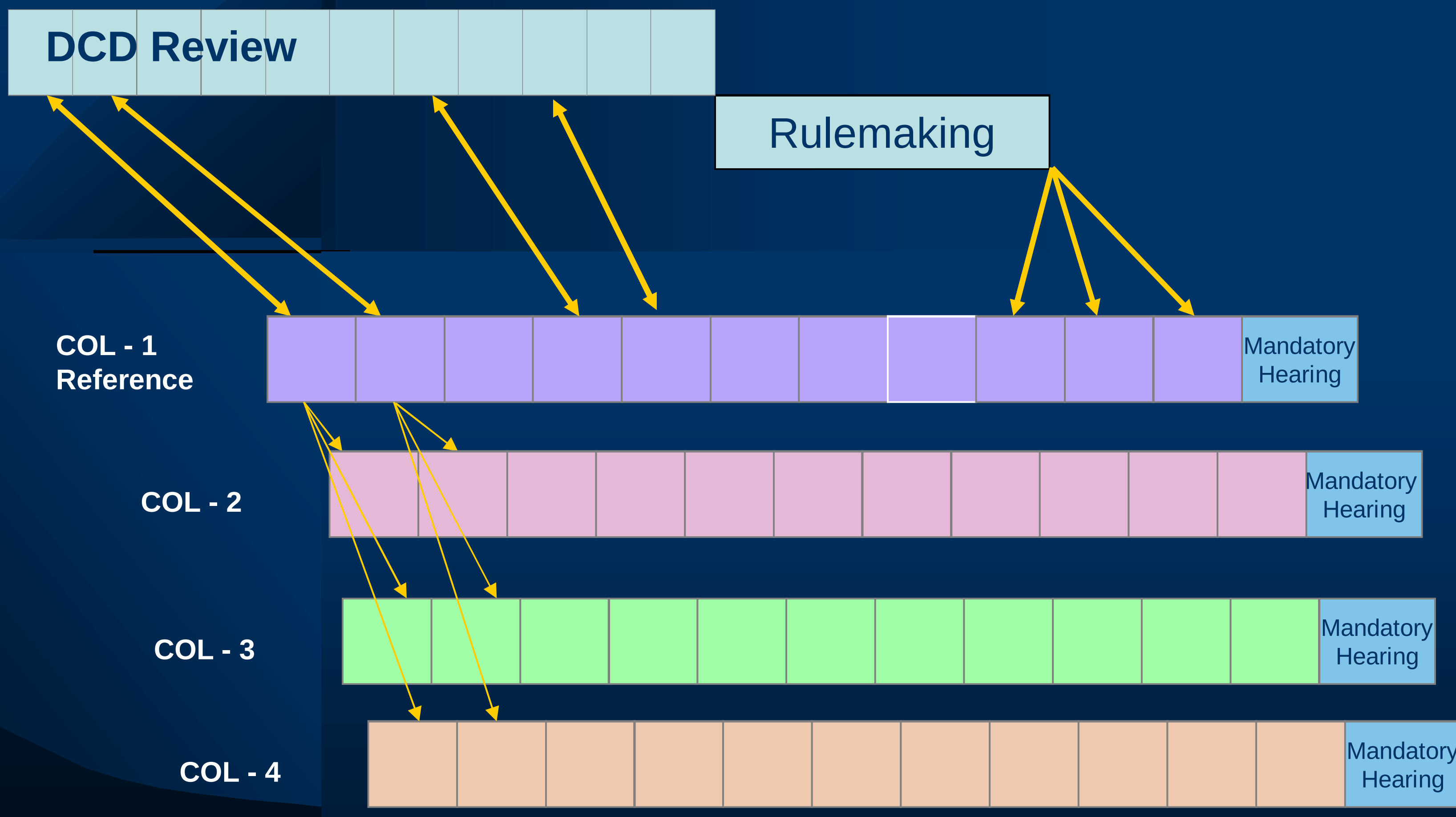
NRC Regulations – 10 CFR Part 52 Design Certification

Vendor responsibility but Owner/Operator implications

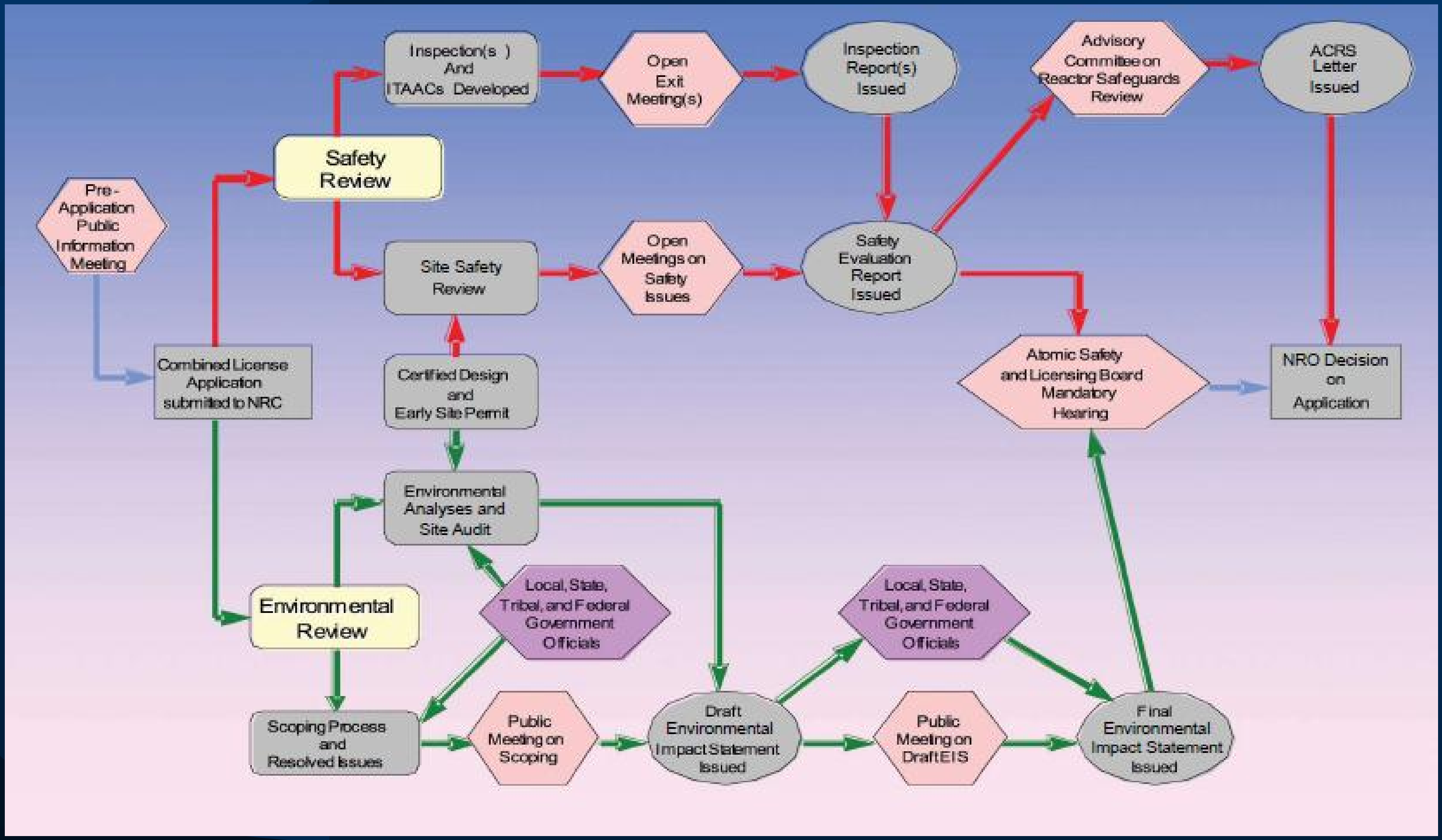
Design Certification essentially the technical requirements of the plant but with:

- Cost to construct implications
- Cost to operate implications
- Regulatory approval implications

NRC Regulations – 10 CFR Part 52
Design Centered Review Approach



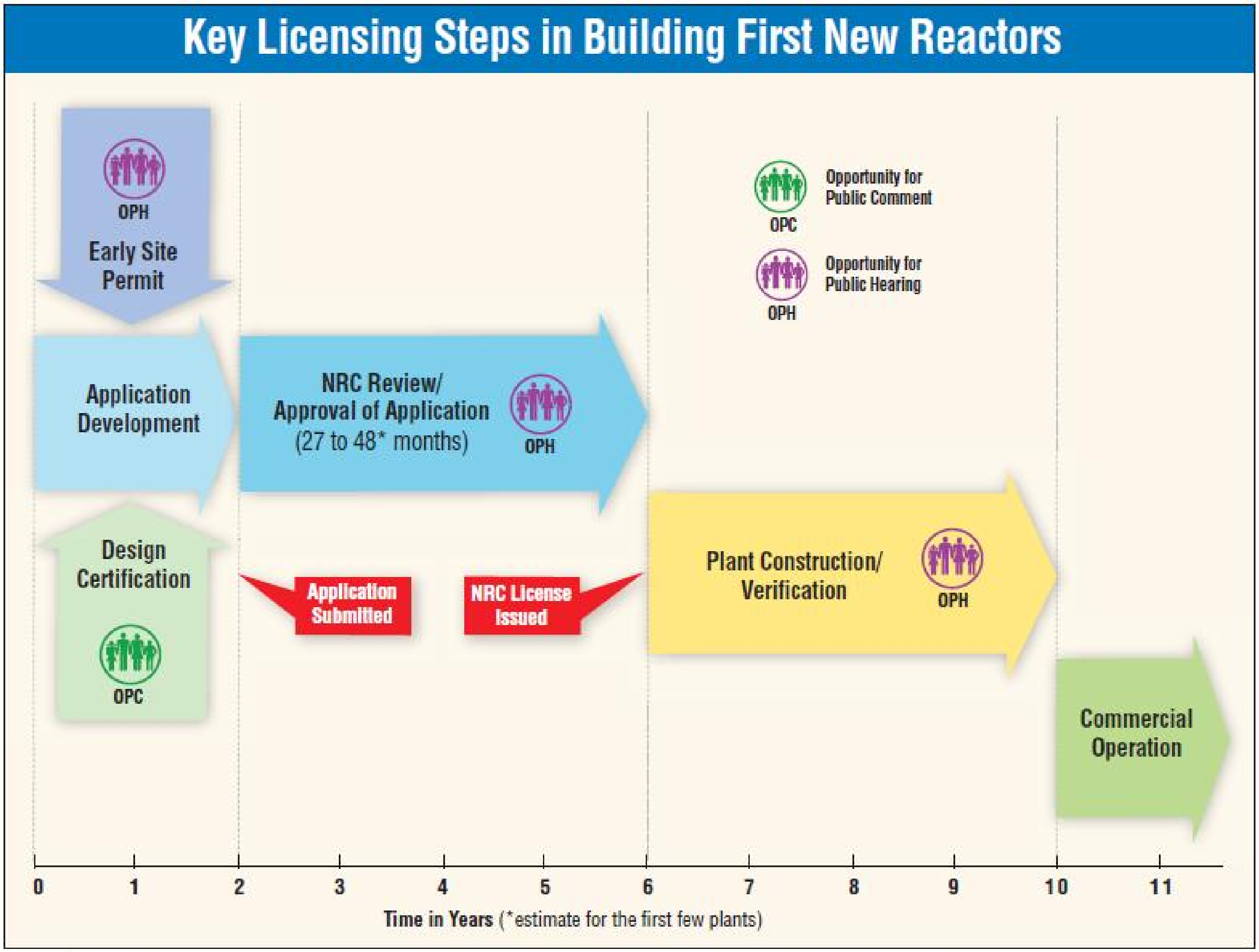
NRC Regulations – 10 CFR Part 52
Combined License Application Review Process



NRC Regulations – 10 CFR Part 52
Combined License Application Review Process

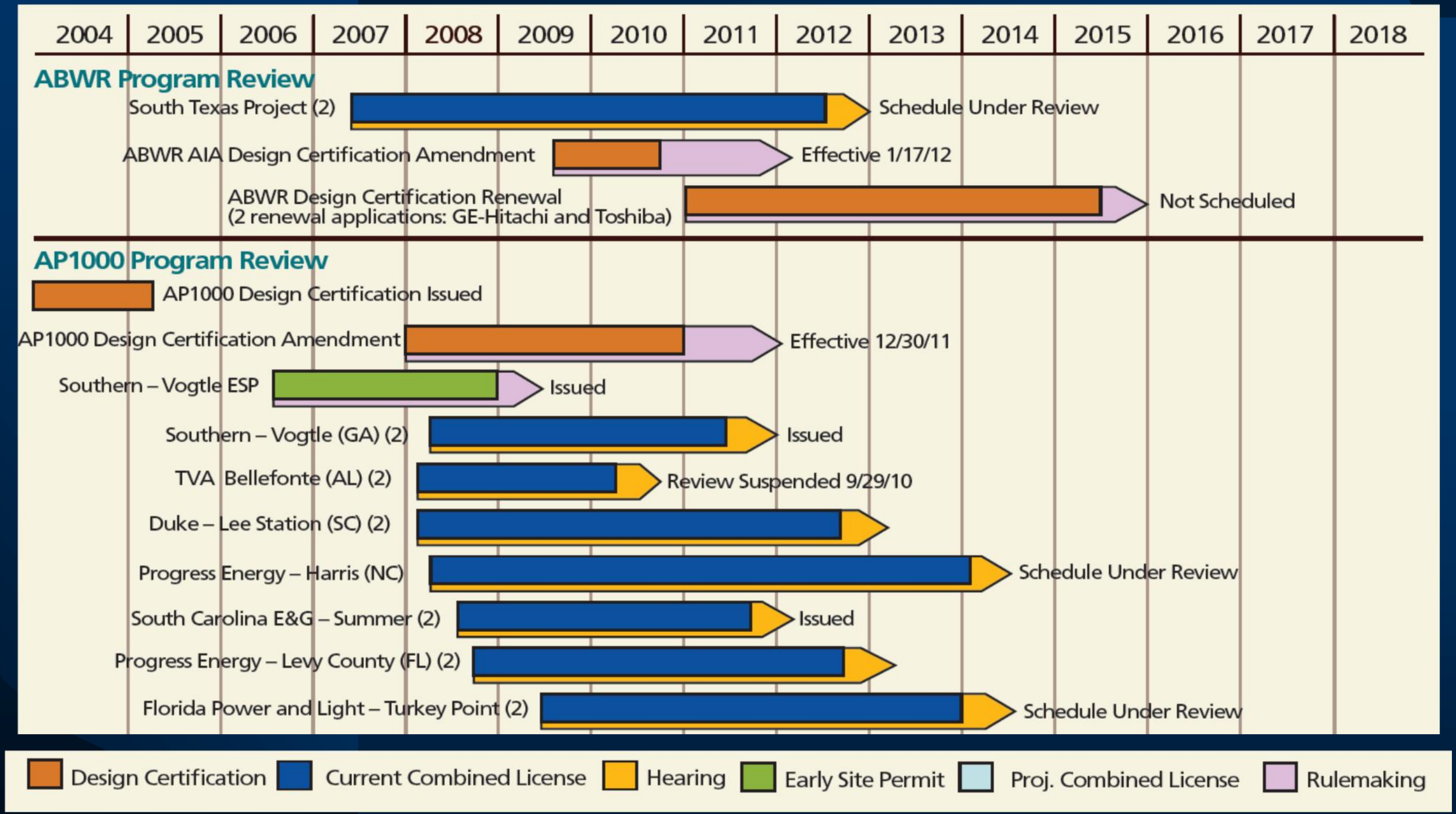
Cost Element	Budgetary Estimate: Greenfield	Budgetary Estimate: Existing Site
COL application development	$20M - $25M	$18M - $22M
Support for NRC review	$4M - $6M	$3M - $5M
External legal costs	$3M – $6M	$2M - $4M
NRC review fees	$20M - $26M	$18M - $22M
TOTAL	$47M - $63M	$41M - $53M

NRC Regulations – 10 CFR Part 52

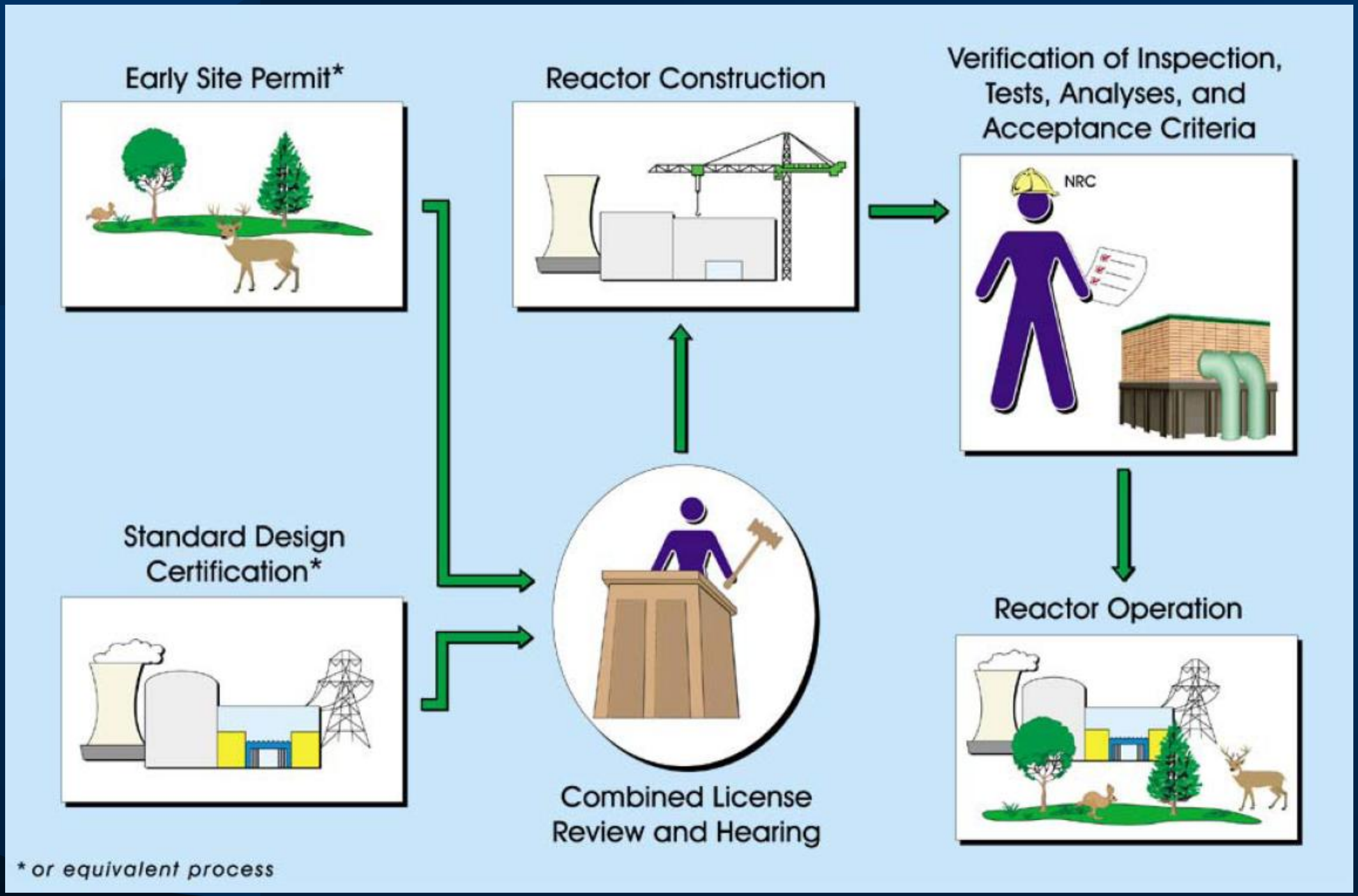


The NRC's new licensing process offers multiple opportunities for public input.

NRC Regulations – 10 CFR Part 52
Example NRC Review Schedules



Combined Licenses, Early Site Permits and Standard Design Certifications



Questions?