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United States Nuclear Regulatory Commission
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Infrastructure Development Working Group Workshop on New Challenges Facing Nuclear Regulators:

Design Certification of Large Light Water Reactors in the U.S.

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Objectives

- Regulatory Framework
- Large Light Water Reactor Licensing
- Part 52 Lessons Learned
- Licensing Challenges
  - AP1000
  - ESBWR
  - APR1400

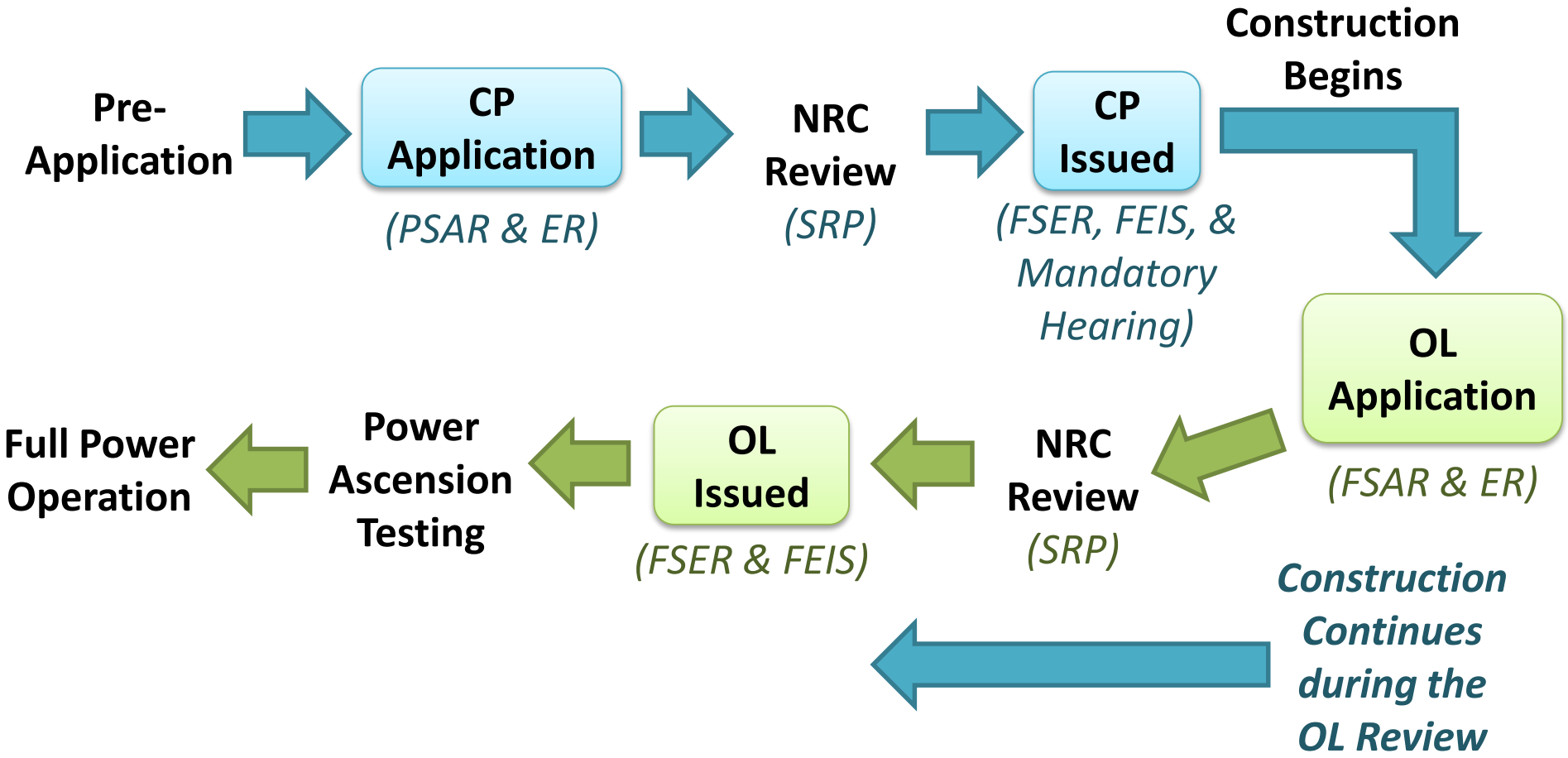
Regulatory Framework

- Two paths exist for licensing new plants
  - 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities”
  - 10 CFR Part 52, Licenses, Certifications, and Approvals for Nuclear Power Plants”

The Part 50 Licensing Process

- 10 CFR Part 50 Licensing Process is a two-step licensing process:
  1. Construction Permit
  2. Operating License
- Requires two separate reviews for a construction permit and then for an operating license
- Final design information and plans for operation are developed during the construction of the plant, making this an unpredictable and less efficient process
- Has potential risk factors after plant construction has started; including no backfit protection or the possibility of having the operating license denied by the NRC if the applicant does not meet the applicable requirements

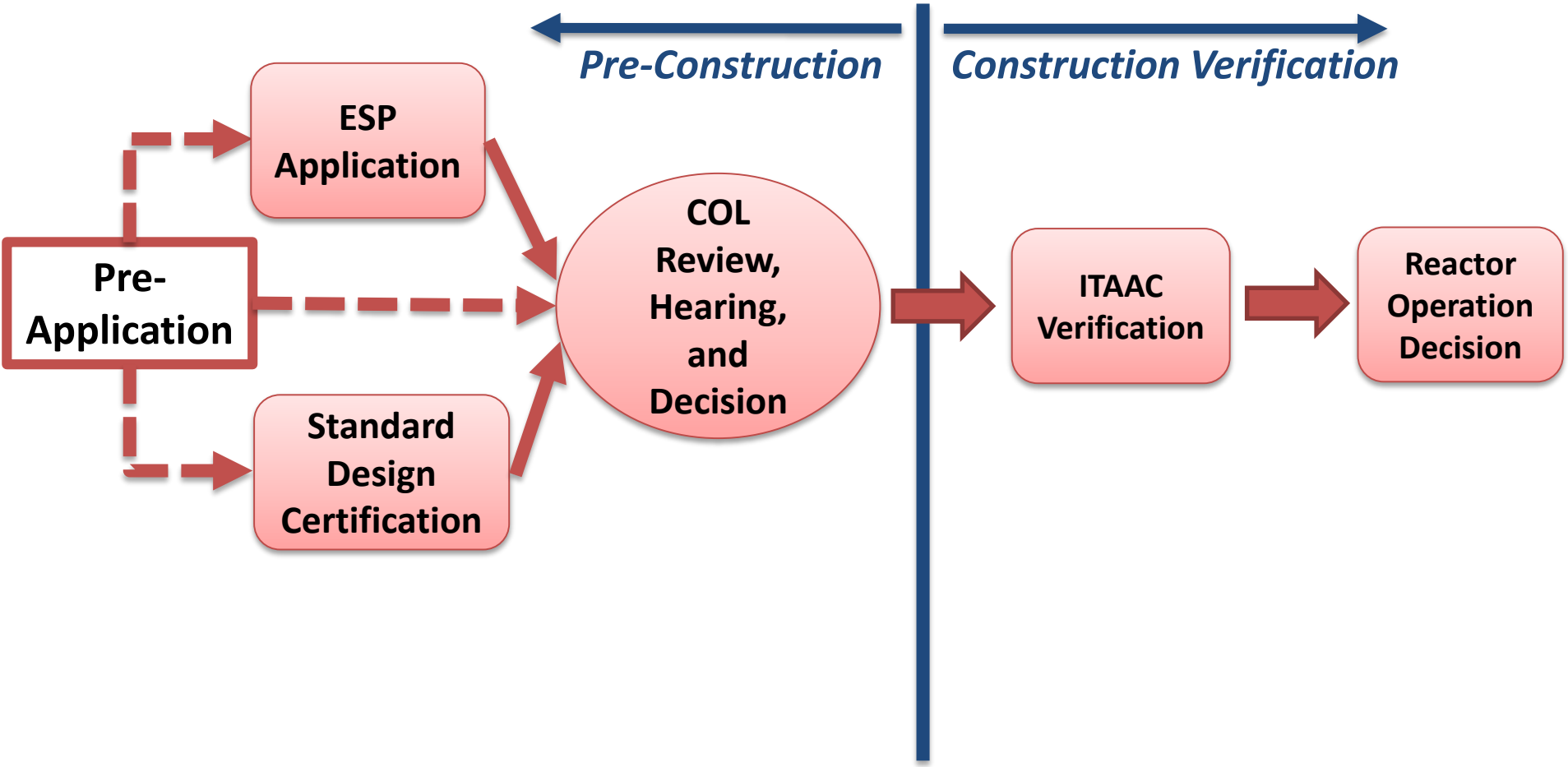
10 CFR Part 50



The Part 52 Licensing Process

- 10 CFR Part 52 is a single step licensing process:
  - Early Site Permit (ESP)
  - Design Certification (DC)
  - Combined License (COL)
- Provides a predictable licensing process
- Resolves safety and environmental issues before authorizing construction
- Provides for timely and meaningful public participation
- Encourages standardization of nuclear plant designs
- Reduces financial risk to nuclear plant licensees

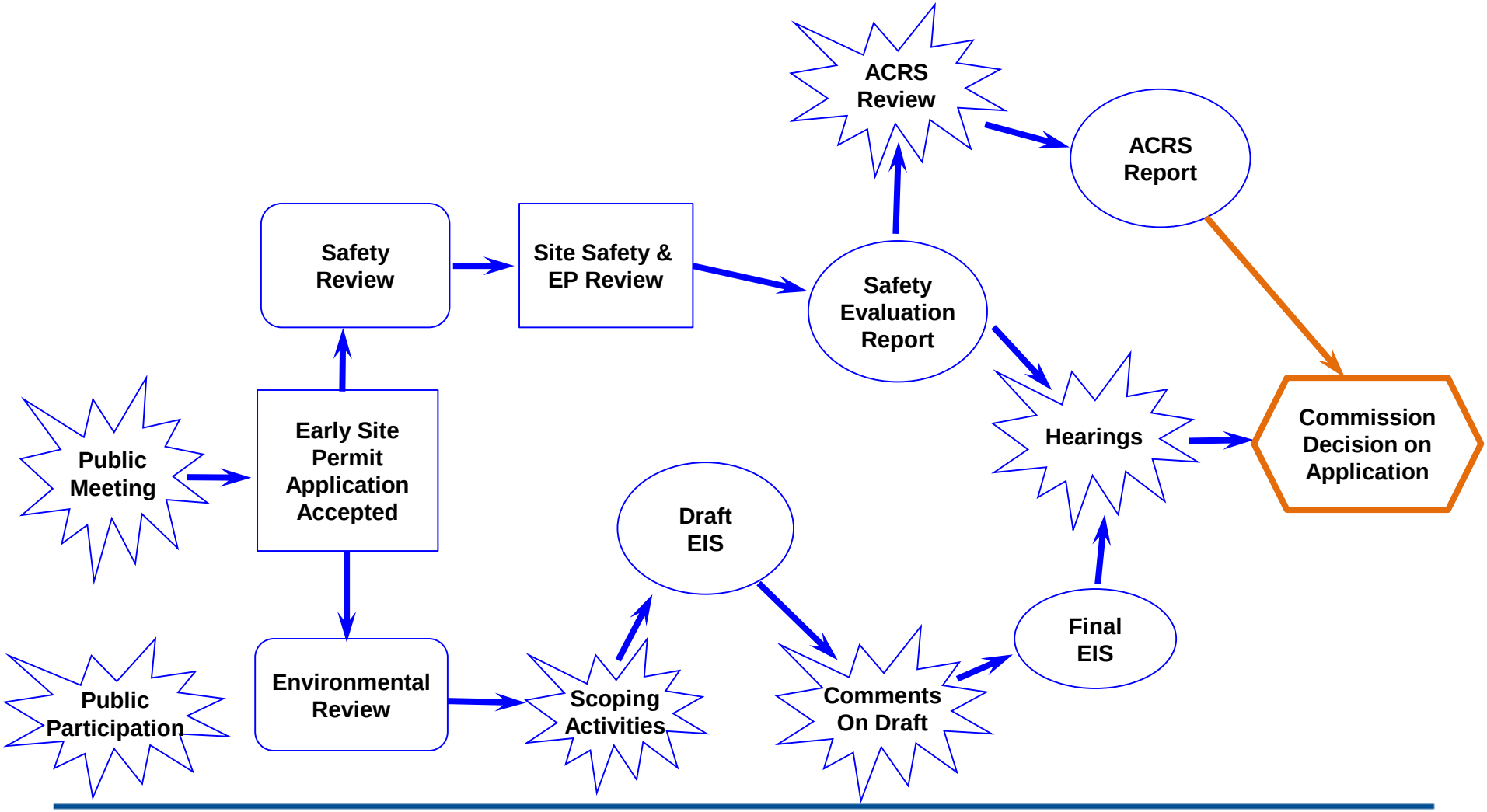
10 CFR Part 52



Early Site Permit (ESP)

- Allows early resolution of siting and environmental issues
- Independent of a COL application
- Valid for 10 – 20 years and can be renewed for an additional 10 – 20 years
- Review Areas Include:
  - Site safety
  - Environmental impact
  - Emergency preparedness

ESP Review Process



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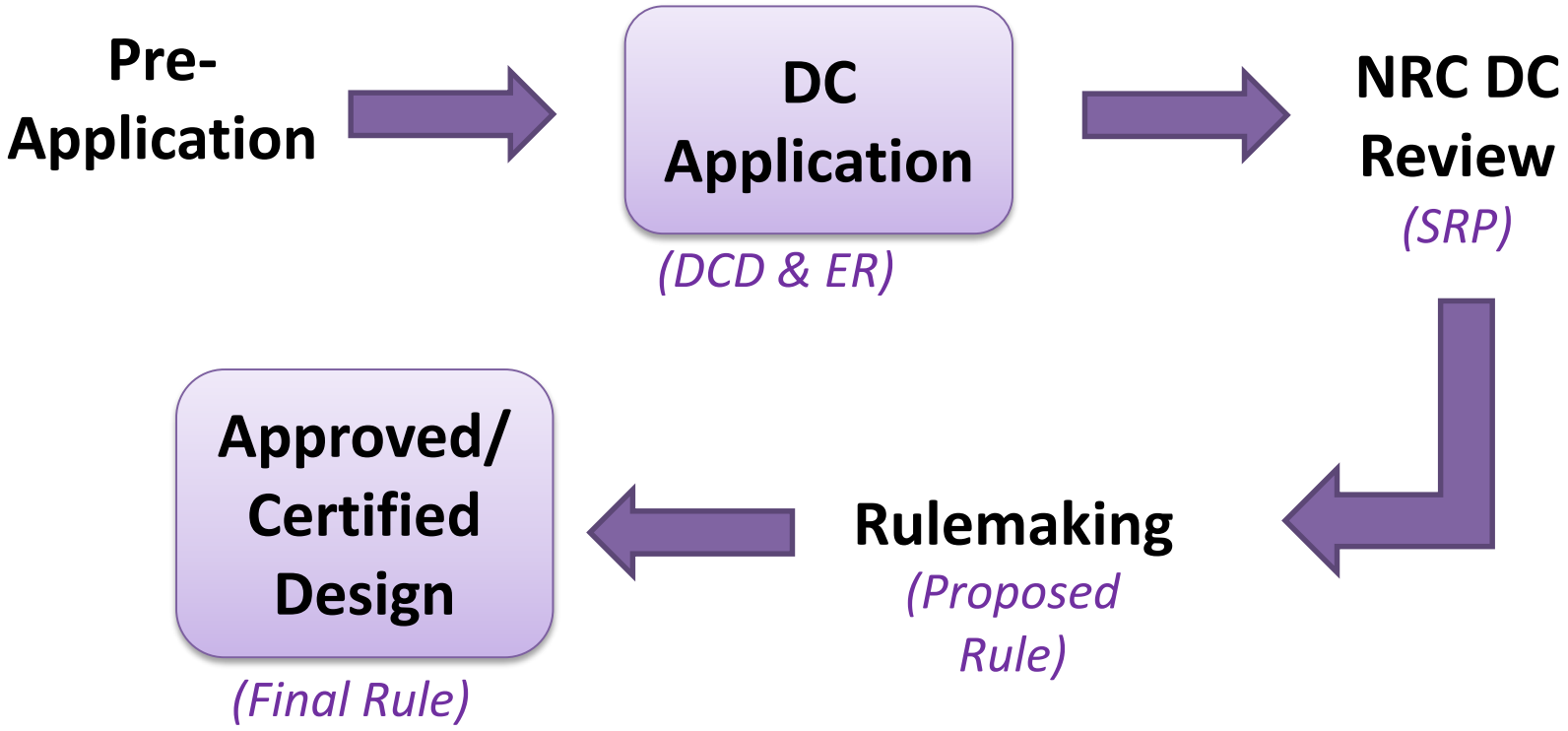
Design Certification (DC)

- Allows an applicant to obtain preapproval of a standard nuclear plant design
- Facilitates standardization
- A greater degree of design detail provides greater regulatory finality within certification
- Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC)
- 15 year duration

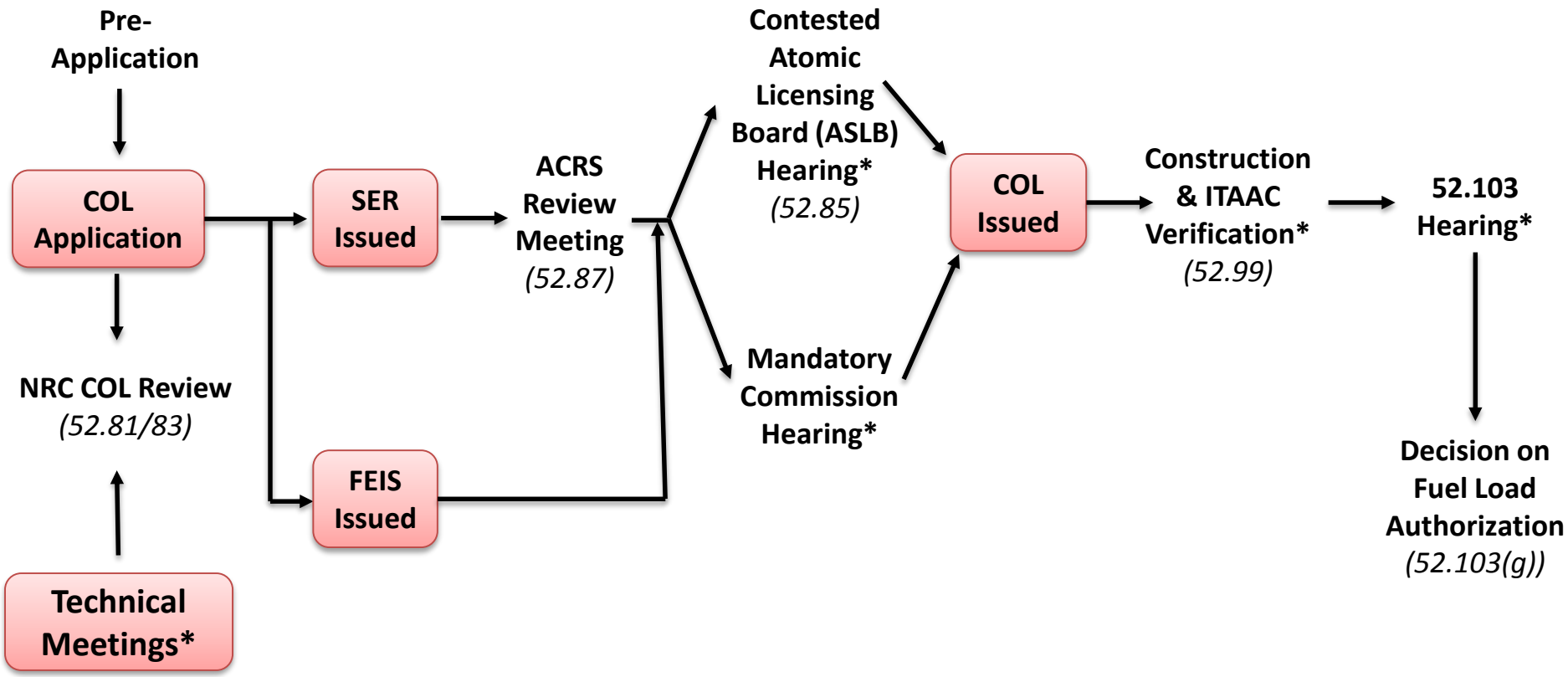
DC Review Process



Combined License (COL)

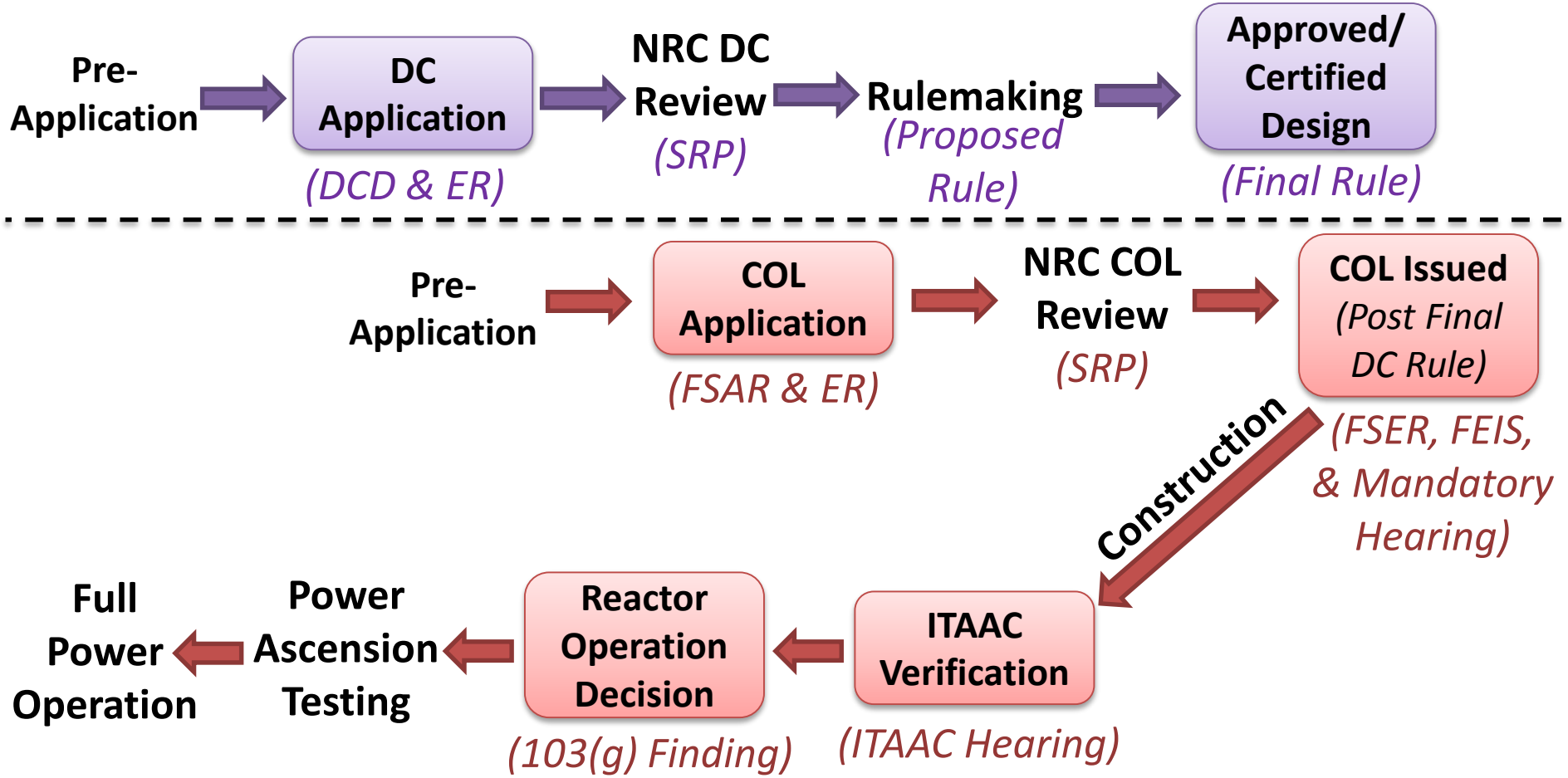
- Upon issuance, authorizes the licensee to construct and (with specified conditions) operate a nuclear power plant at a specific site
- All stakeholders (including the public) are given notice as to how and when they may participate in the regulatory process
- Valid for 40 years (can be renewed for an additional 20 years)

COL Review Process



** Opportunity for Public Participation*

10 CFR Part 52



Technical Nuclear Safety Areas of Review

- Site Characteristics and Site Parameters
- Systems, Structures, Components, and Equipment Design
- Reactor Internals
- Reactor Coolant and Connected Systems
- Engineered Safety Features
- Digital Instrumentation and Controls/Electrical Power
- Auxiliary Systems
- Steam and Power Conversion Systems
- Radioactive Waste Management and Radiation Protection
- Conduct of Operations
- Initial Test Program and ITAAC
- Transient and Accident Analysis
- Technical Specifications
- Quality Assurance Program
- Human Factors Engineering
- Severe Accidents

Large Light Water Reactor Licensing (1/4)

- NRC has reviewed and issued design certifications (DCs) for five reactor designs and 1 amended design:
  - **ABWR (General Electric (GE) Nuclear Energy)**

    Application submitted: September 29, 1987 through March 31, 1989
    Design certified: May 12, 1997
  - **AP1000 (Westinghouse Electric Company)**

    Original Application submitted: March 28, 2002
    Design certified: April 18, 2005 (Revision 15)
    Revision 16 submitted: May 26, 2007
    Revision 17 submitted: October 14, 2008
    Revision 18 submitted: December 1, 2010
    Revision 19 submitted: June 13, 2011
    Revision 19 certified: December 30, 2011

Large Light Water Reactor Licensing (2/4)

- **ESBWR (GE-Hitachi Nuclear Energy)**
  Application submitted: August 24, 2005
  Design certified: October 15, 2014
- **ABWR Amendment (South Texas Project Nuclear Operating Company)**
  Amendment Application submitted: June 30, 2009
  Amendment certified: December 16, 2011

- Two design certifications have now expired and are no longer available to be referenced in a COL application:
  - System 80+ (Westinghouse Electric Company)
  - AP600 (Westinghouse Electric Company)

Large Light Water Reactor Licensing (3/4)

- NRC has reviewed and issued combined licenses (COLs) for 14 reactor sites:
  - Fermi 3 COL Issued: 05/01/2015
  - Levy Nuclear Plant Unit 1 COL Terminated: 4/26/2018 *(Issued on 10/26/2016)*
  - Levy Nuclear Plant Unit 2 COL Terminated: 4/26/2018 *(Issued on 10/26/2016)*
  - North Anna Plant Unit 3 COL issued: 06/02/2017
  - South Texas Project Unit 3 COL issued: 02/12/2016
  - South Texas Project Unit 4 COL issued: 02/12/2016
  - V.C. Summer Unit 2 COL issued: 03/30/2012
  - V.C. Summer Unit 3 COL issued: 03/30/2012
  - Vogtle Unit 3 COL issued: 02/10/2012
  - Vogtle Unit 4 COL issued: 02/10/2012
  - William States Lee III Nuclear Station Unit 1 COL issued: 12/19/2016
  - William States Lee III Nuclear Station Unit 2 COL issued: 12/19/2016
  - Turkey Point Unit 6 COL issued: 04/12/2018
  - Turkey Point Unit 7 COL issued: 04/12/2018

Large Light Water Reactor Licensing (4/4)

- NRC has reviewed and issued early site permits (ESPs) for 5 reactor sites:
  - Clinton ESP issued: 3/15/2007
  - Grand Gulf ESP issued: 4/5/2007
  - North Anna ESP issued: 11/27/2007
  - Vogtle ESP issued: 8/26/2009
  - PSEG ESP issued: 5/5/2016

Recent Lessons Learned Reviews

- "New Reactor Licensing Process Lessons Learned Review: 10 CFR Part 52" (April 2013)
- "Post-Combined License Part 52 Implementation Self-Assessment Working Group Report" (July 2013)
- "Staff Report: 10 CFR Part 52 Application Reviews: Efficiency Opportunities and Review Timelines" (March 2016)

What Have We Learned?

- Part 52 works best and is most efficient when:
  - ✓ An approved design certification is followed by a combined license application referencing the approved design
  - ✓ There is a complete and quality application
  - ✓ Technical and regulatory challenges are identified and addressed during pre-application
  - ✓ There is early and frequent communication and coordination between the applicant and NRC

Part 52 Lessons and Results (1/2)

- Lesson 1: A process was needed to allow construction to continue while the licensing process was ongoing. Result: Preliminary amendment request process was established.

- Lesson 2: Enhanced pre-application interactions and timely readiness reviews are critical. Result: Readiness review guidance was revised; use of “gap letters.”

Part 52 Lessons and Results (2/2)

- Lesson 3: The factors used in making docketing decisions could use clarification. Results: The NRC revised the Office Instruction in 2014.

- Lesson 4: The design certification renewal process would benefit from clarification. Results: NRC is developing guidance.

What Can Applicants Do to Support More Efficient Application Reviews?

- Provide complete responses to requests for additional information (RAIs) on the established schedule
- Maintain open and frequent communication with NRC staff at all levels throughout the technical review of the application, as necessary
- Use of technology and audits (i.e., electronic reading rooms)
- Local satellite office

AP1000 Major Licensing Challenges

- Shield Building
  - The amended AP1000 design did not originally demonstrate that certain structural components of the revised shield building design could withstand design-basis loads.
  - The staff requested that Westinghouse modify the design and provide the results of testing that demonstrated the building will perform its intended safety function under design-basis loads.
- Post Certification Design Errors
  - Multiple design errors were found after the design was certified. The staff continues to work with Westinghouse to modify the design to correct these errors.

ESBWR Major Licensing Challenges

- Steam Dryer Design Methodology
  - Following the issuance of the FSER on March 9, 2011, the NRC staff identified issues applicable to the ESBWR steam dryer structural analysis based on information obtained during the NRC review of a license amendment request for a power uprate at an operating Boiling Water-Reactor (BWR) nuclear power plant.
  - As a result of the resolution of those issues at the operating BWR plant, General Electric-Hitachi revised the DCD to withdraw the original topical reports that addressed the ESBWR steam dryer structural evaluation, and to reference new engineering reports that describe the updated ESBWR steam dryer analysis methodology. The NRC staff reviewed the revised DCD sections and supporting information and issued a supplement to the ESBWR FSER in September 2014.

APR1400 Major Licensing Challenges

- The staff is currently reviewing this application but has identified the following areas as a major challenge during its review:
  - Tier 2*
  - Initial Tests, Analyses, and Acceptance Criteria (ITAAC)

Summary

- Two licensing options available for new reactors – 10 CFR Part 50 and 10 CFR Part 52
- Under the Part 52 process, an applicant can pursue an ESP, DC, or COL via a predictable licensing process
- Part 52 works best when used as planned and when supported by frequent and clear communications
- Pre-application interactions are <u>optional</u> in the regulations, but <u>necessary</u> for the most efficient application review
- NRC continues to work with Westinghouse via our regulatory processes in place to handle necessary changes to the AP1000 design/licensing basis during construction of the Vogtle plants.
- Licensee is ultimately responsible for building the plant as designed and licensed.

Questions

Thank You!

For additional information on the NRC or new reactor licensing please visit us at:
www.nrc.gov/reactors/new-reactors.html

Acronyms

10 CFR	Title 10 of the *Code of Federal Regulations*	ESP	Early Site Permit
ABWR	Advanced Boiling Water Reactor	FEIS	Final Environmental Impact Statement
ACRS	Advisory Committee on Reactor Safeguards	FSAR	Final Safety Analysis Report
AP1000	Advanced Passive 1000	FSER	Final Safety Evaluation Report
AP600	Advanced Passive 600	GE	General Electric
APR1400	Advanced Power Reactor 1400	ITAAC	Initial Tests, Analyses, and Acceptance Criteria
ASLB	Atomic Safety and Licensing Board	NRC	Nuclear Regulatory Commission
BWR	Boiling Water Reactor	OL	Operating License
COL	Combined License	PSAR	Preliminary Safety Analysis Report
CP	Construction Permit	RAI	Request for Additional Information
DC	Design Certification	SER	Safety Evaluation Report
DCD	Design Control Document	SRP	Standard Review Plan
ER	Environmental Report	U.S.	United States
ESBWR	Economic Simplified Boiling Water Reactor		