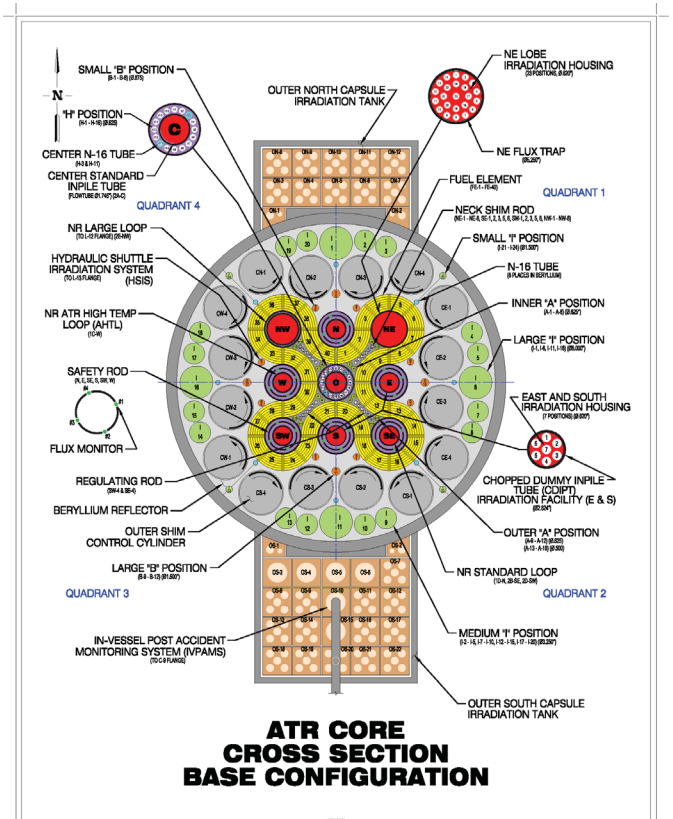
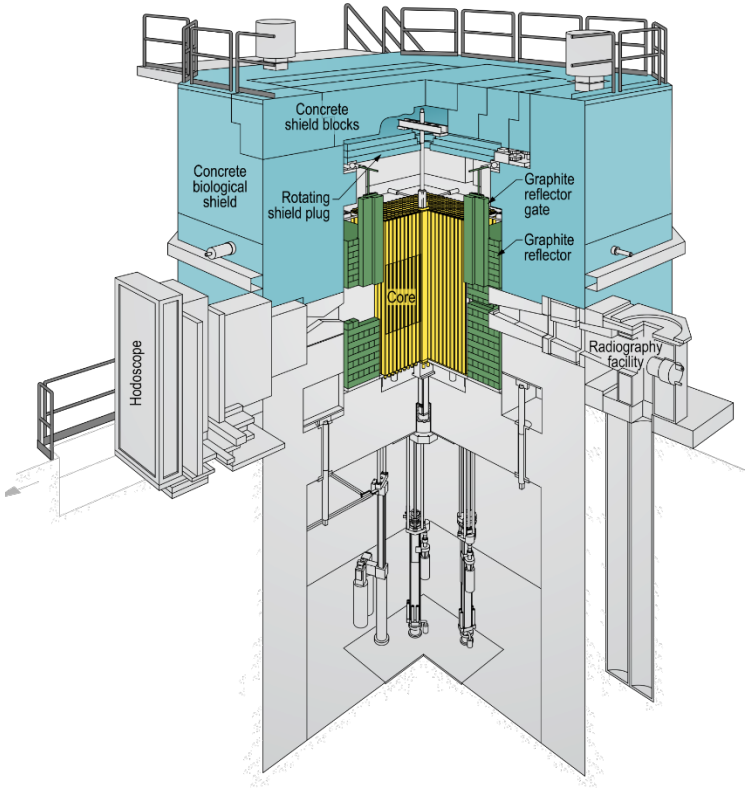
U.S. DEPARTMENT OF ENERGY | Nuclear Energy

DOE Safety Authorization Process for New Test Reactors

June 2022





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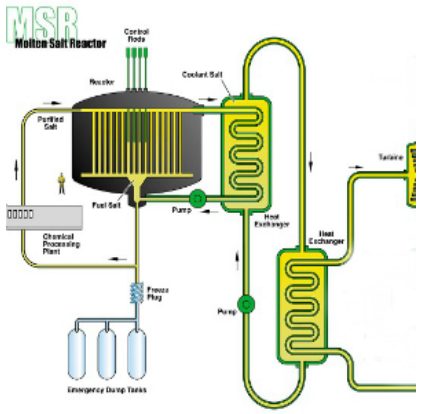
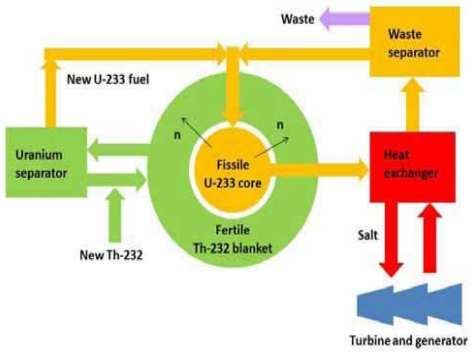
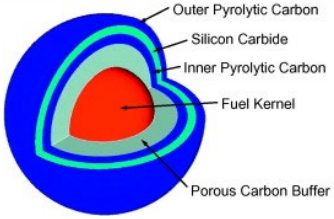
DOE has a Challenge with New Reactor Technology Regulation

- **Numerous technologies coming into play**
  - Molten Salt
  - Gas Cooled
  - Unique Fuel Designs
  - Broad range in size and functionality
- **Rapid pace of progression within the technology lifecycle**
- **Additional data/analysis needed to support NRC licensing for broad application.**

- **Regulatory Framework must be:**
  - Technically Rigorous
  - Flexible
  - Adaptable







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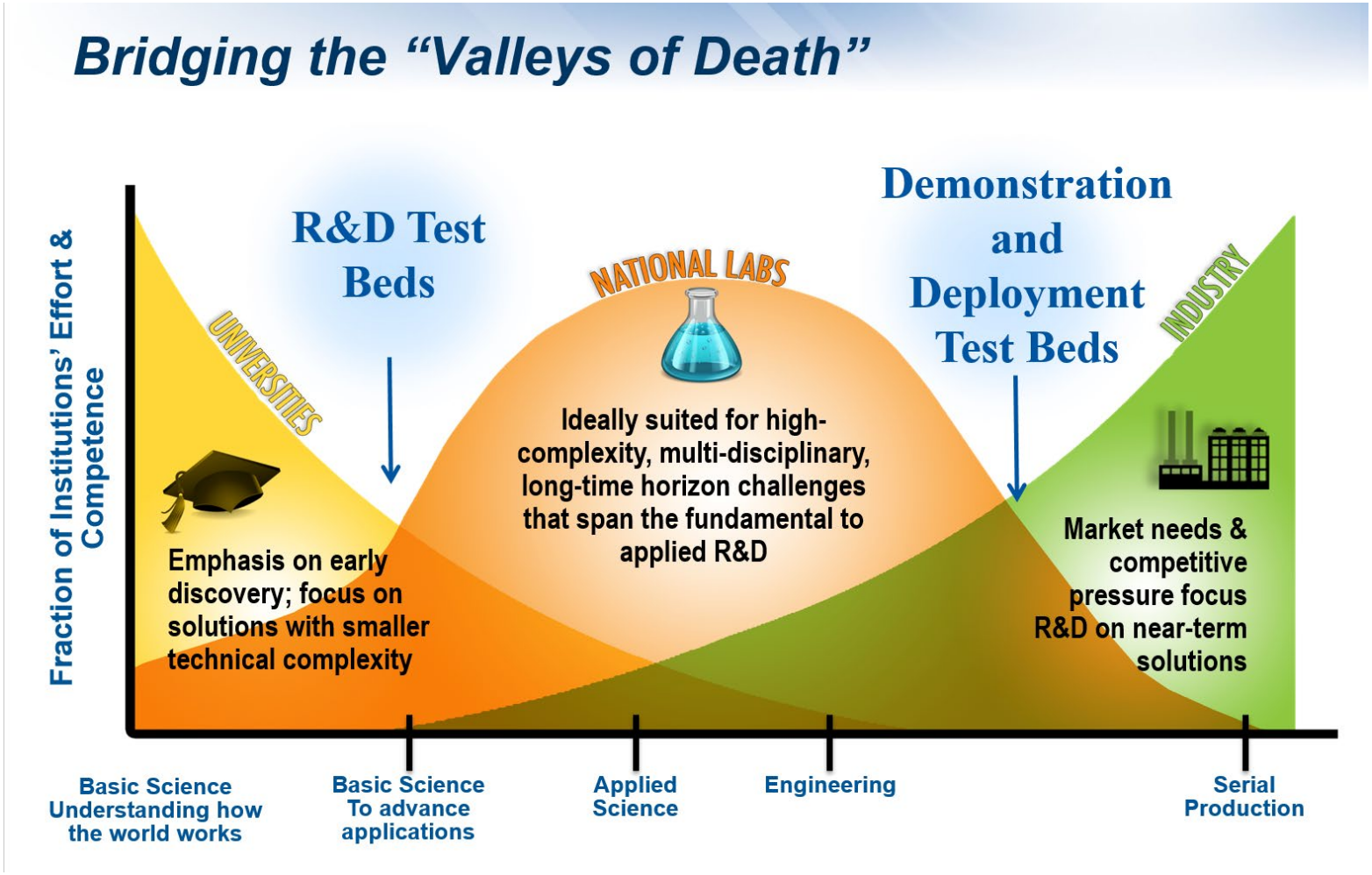
DOE Mission Enables Progressing Ideas to Application



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The DOE processes readily support the advancement of nuclear technology!!

	DOE	NRC
Technical Rigor	YES	YES
Flexibility	YES	
Adaptability	YES	

Technical Rigor – both regulatory structures have mechanisms in place to ensure:

- Understanding of the hazards
- Accident Analysis
- Control set development

Flexibility – NRC processes have long been centered around LWR technology (appropriate for their mission). DOE approach allows for more real-time evaluation of upcoming technologies in support of broader applications.

Adaptability – NRC processes evaluate a finished product for commercial application. DOE processes support conducting R&D in a safe and efficient manner.

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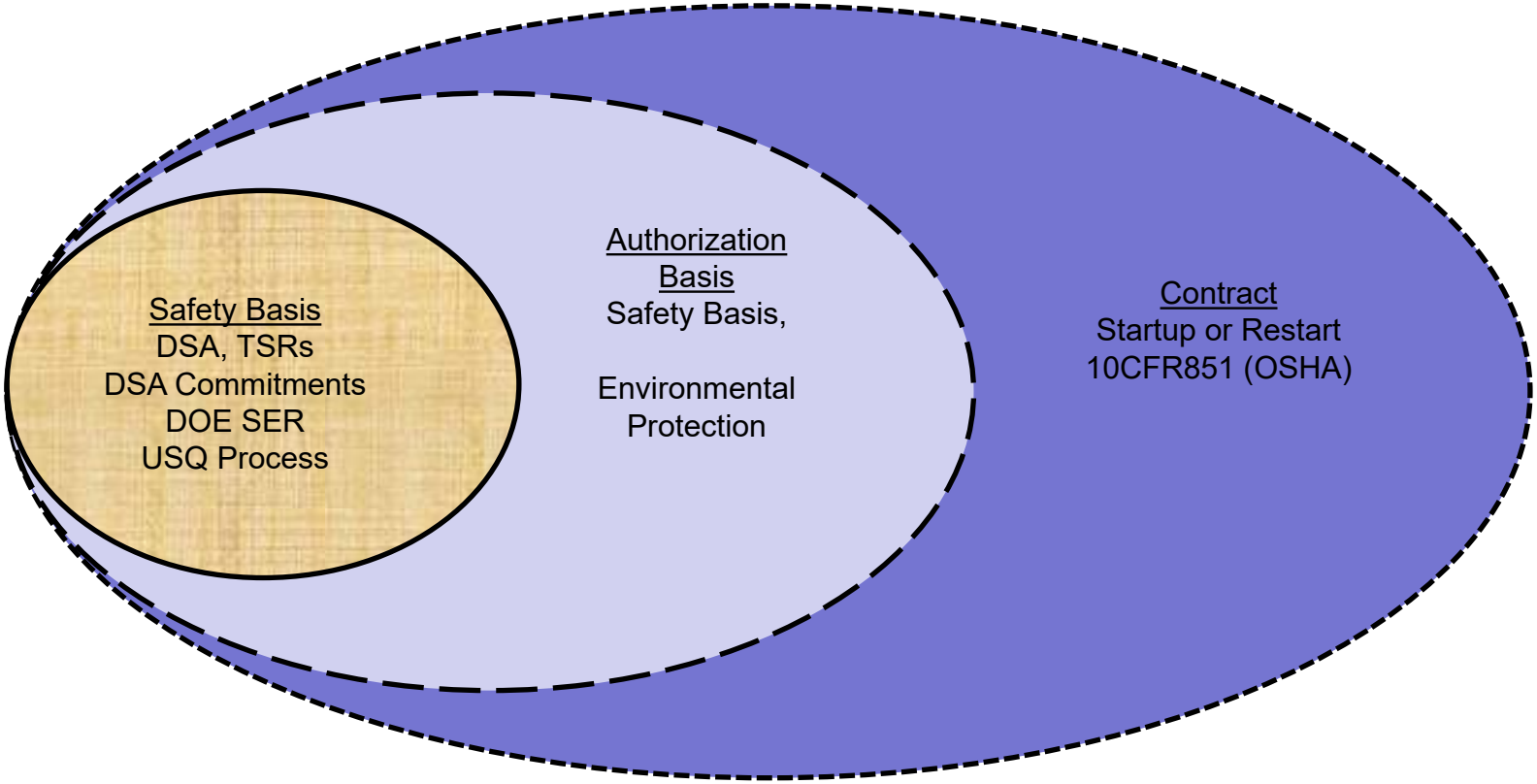
Relationships of Regulatory Requirements



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Integration of Safety and Design

- **For a test reactor, DOE is uniquely qualified and has the established Authority under the Energy Reorganization Act of 1974 Title II.**
- **DOE has a codified process to ensure safety in design for new reactors. NRC regulations have been adopted by the DOE process.**
- **10 CFR 830 requires a safety analysis consistent with NRC RG 1.70.**
- **10 CFR 830 also allows for an Alternate Methodology to RG 1.70**
  - An Alternate Methodology for a safety basis format/content and analysis strategy may be prepared and approved by the PSO (DOE-STD-1083)
  - DOE has a Standard (DOE-STD-1237) that outlines alternative approach's using (NUREG-1537 or ANS 15.21, RG 1.232, NEI-18-04)
- **Using the DOE-STD-1237 (Section 4 – Safety Basis Strategy) newer methodologies and consensus standards may be brought in with DOE approval such as:**
  - NEI 21-07 “Technology Inclusive Guidance for Non-Light Water Reactors”
- **DOE has the same Adequate Protection Standards for the public but strives to have very low design basis accident doses at the public boundary (0 mrem).**

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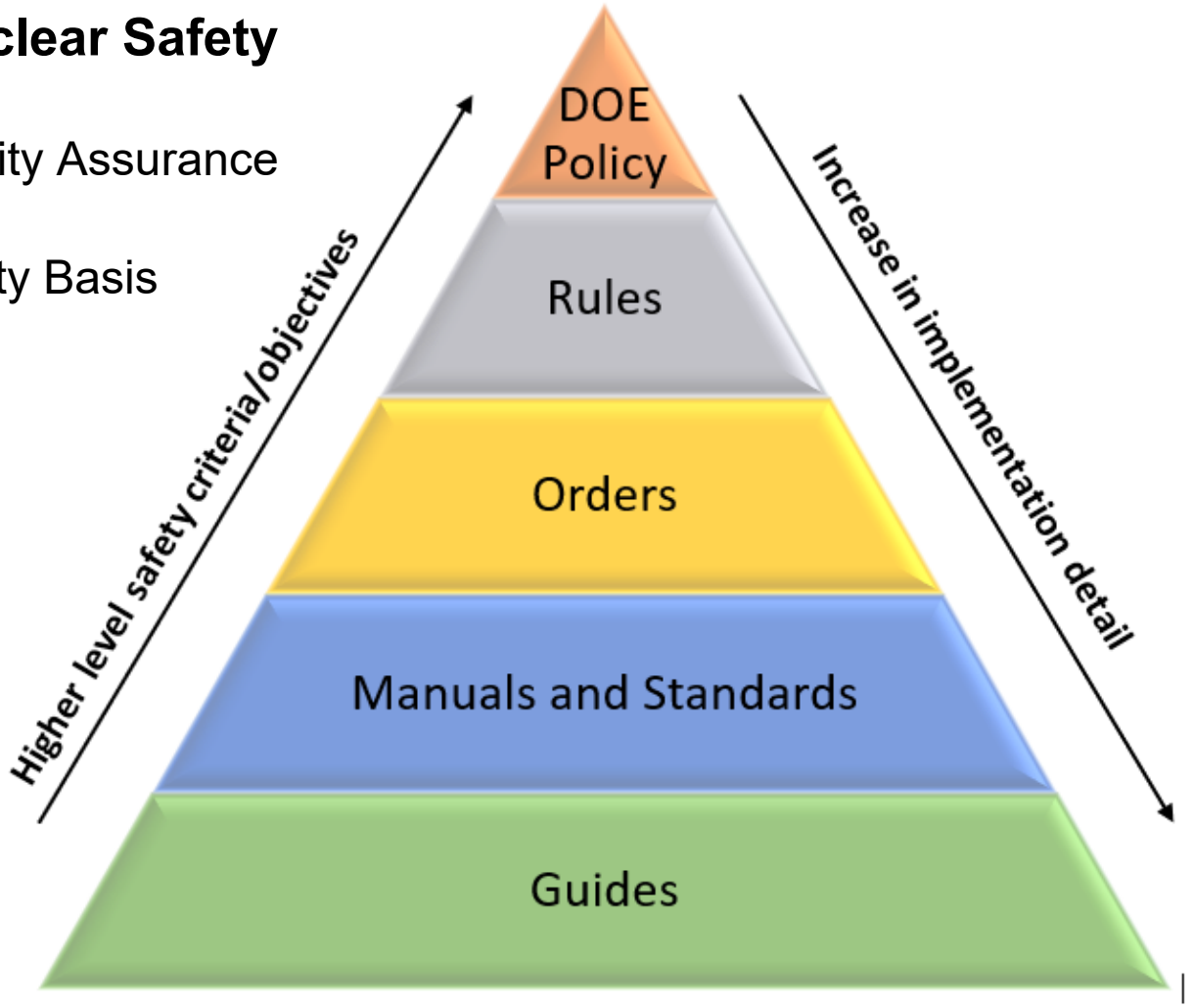
Nuclear Safety – Regulatory Structure

- **10 CFR 830 – Nuclear Safety Management**
  - Subpart A, “Quality Assurance Requirements”
  - Subpart B, “Safety Basis Requirements”



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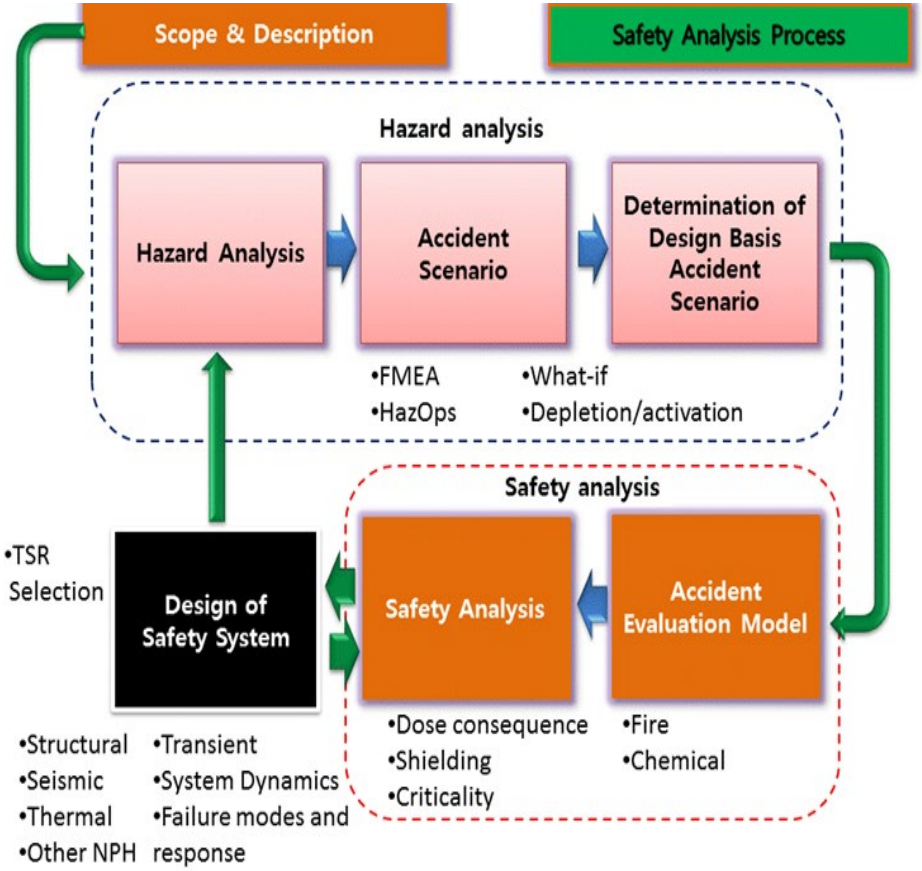
Additional Detail on 10 CFR 830 Subpart B

- **Defines content of DSA**
  - Facility description
  - Systematic identification of natural and man-made hazards associated with the facility
  - Evaluate normal, abnormal, and accident conditions
  - Derive adequate controls necessary to ensure adequate protection of the public, workers, and the environment
  - Define characteristics of the safety management programs necessary to ensure safe operations
- **Unreviewed Safety Questions**
  - Similar to 10CFR50.59



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Nuclear Safety – Regulatory Structure (Cont)

- **Numerous orders, guides, and standards are used to ensure a consistent approach in DSA development and nuclear facility operations. Some examples…**
  - DOE O 420.1C, "Facility Safety"
  - DOE O 425.1D, "Verification of Readiness to Start Up or Restart Nuclear Facilities"
  - DOE O 426.2, "Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities"
  - DOE-STD-1020-2016, "Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities"
  - DOE-STD-1027-2018, "Hazard Categorization of DOE Nuclear Facilities"
  - DOE-STD-1104-2016, "Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents"
  - DOE-STD-1189-2016, "Integration of Safety into the Design Process"

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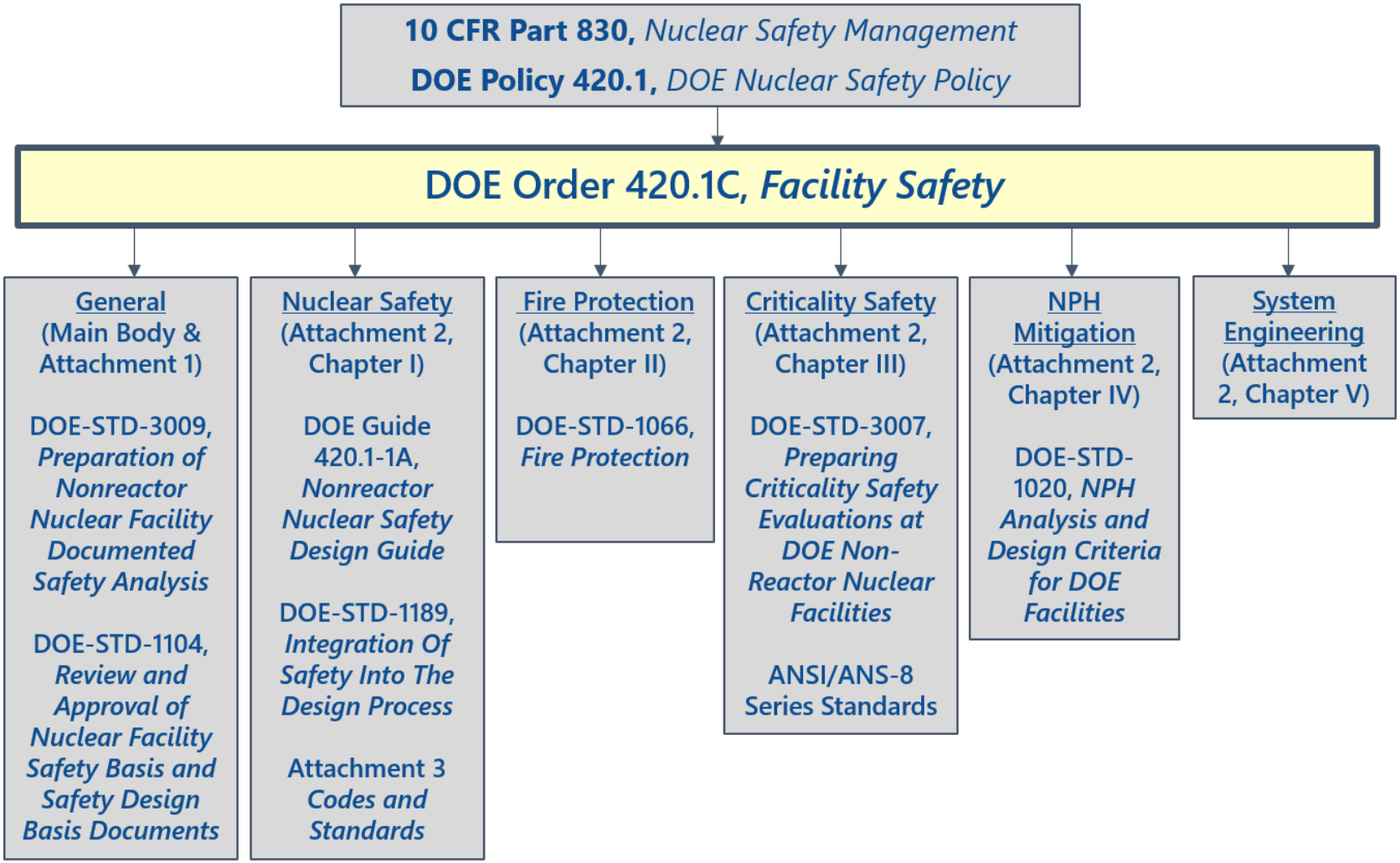
Engineering Design Perspective



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Integration of Safety in Design

- **DOE-STD-1189 (invoked by DOE O 413.3 for Capitol Acquisition projects) ensures project management, design engineering, safety (and security) works together for successful design (incorporate safety principles from the beginning of a project)**
  - The processes in DOE-STD-1189 is tailored for the complexity of reactor design and construction.
  - The Safety Design Strategy provides a road map for the safety-in-design strategy that the project will follow

APPLICABILITY

The applies to the design and construction of:

- New DOE hazard category (HC) 1, 2, and 3 nuclear facilities, including reactors.
- Reactor Classification Definitions (DOE-STD-1027-2018):
  - Category A Reactor – Those production, test, and research reactors designated by DOE based on power level (i.e., design thermal power rating of 20 megawatts steady state and higher), potential fission product inventory, and experimental capability. Category A reactors are Hazard Category 1 nuclear facilities.
  - Category B Reactor – A reactor as defined by 10 CFR Part 830, Section 830.3, that is not a Category A Reactor. Category B reactors are Hazard Category 2 nuclear facilities.

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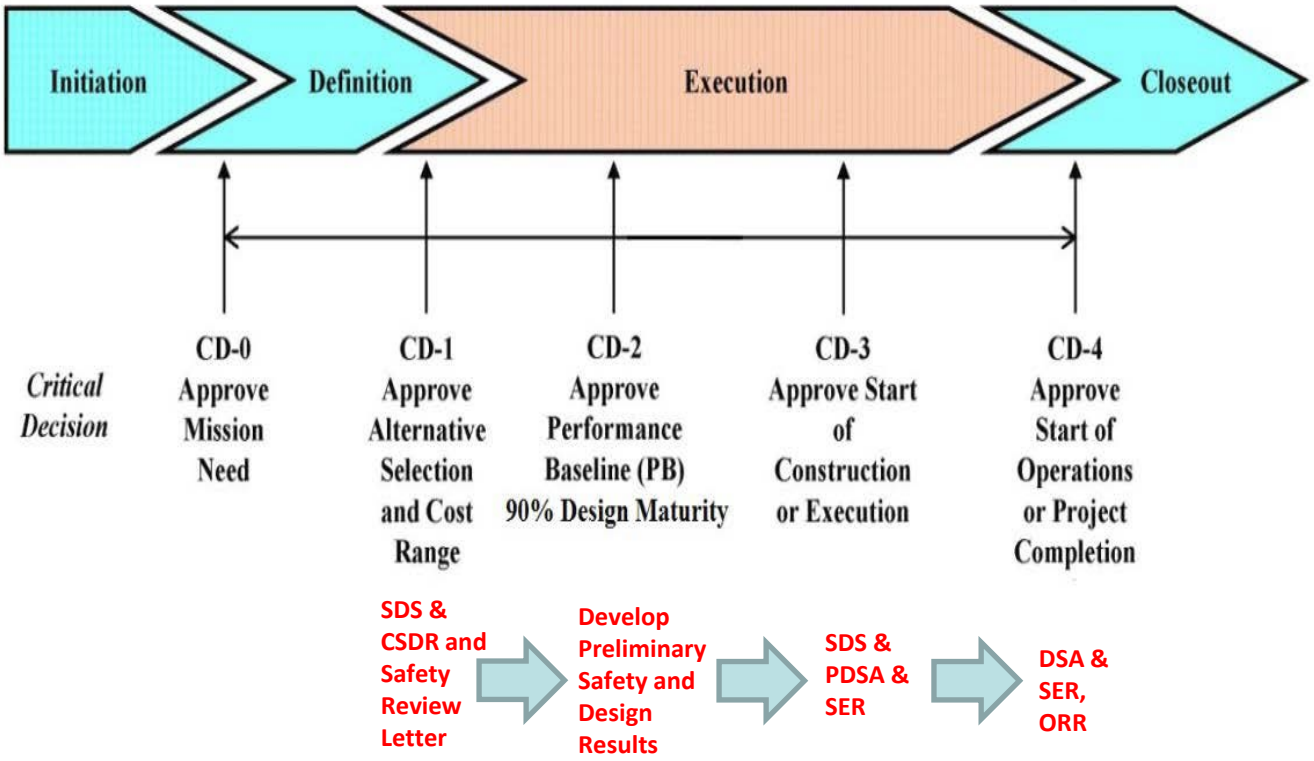
DOE-STD-1189 (DOE O 413.3) Integration of Safety into the Design Process



Safety Design Strategy (SDS), Conceptual Safety Design Report (CSDR), Preliminary Documented Safety Analysis (PDSA), Safety Evaluation Report (SER), Operational Readiness Review (ORR)

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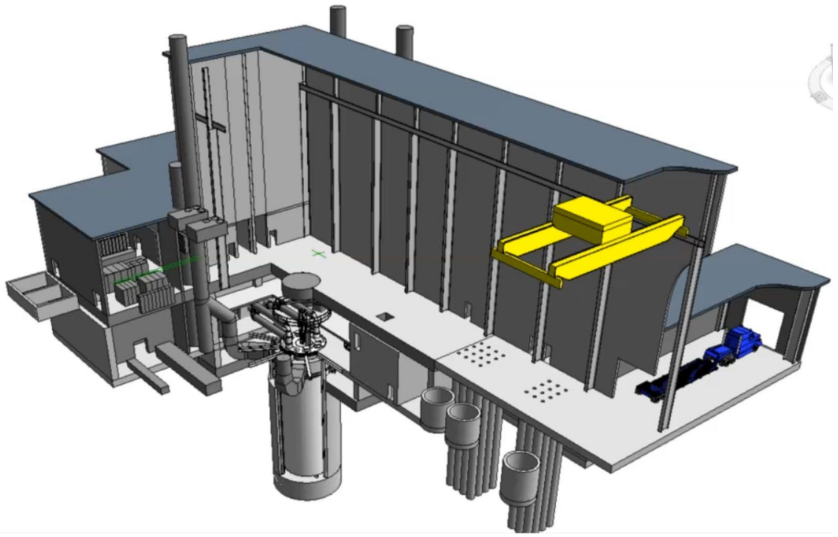
NEPA

NATIONAL ARCHIVES
FEDERAL REGISTER
The Daily Journal of the United States Government

Notice of Intent To Prepare an Environmental Impact Statement for a Versatile Test Reactor



Environmental Impact Statement

DOE is developing an Environmental Impact Statement (EIS) to ensure that all environmental factors are considered before making a final decision to move forward with the project. A Notice of Intent to prepare the EIS for VTR was published on the Federal Register on August 5, 2019. If you would like your name added to the mailing list or request copies of the EIS when it is published, please send an email or letter to the following address:

- Email VTR.EIS@nuclear.energy.gov
- Send mail to:
  Mr. James Lovejoy
  Document Manager
  U.S. Department of Energy
  Idaho Operations Office
  1955 Fremont Avenue, MS 1235
  Idaho Falls, Idaho 83415

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Verification of Readiness

- **Verification of Readiness to Start Up or Restart Nuclear Facilities**
  - The Readiness Review process provides a high degree of confidence that new nuclear facility operations will be conducted as intended by the design and safety basis.
  - An independent review approach is used.
    - Avoids conflicts of interest that could compromise reviewer ability to objectively determine the status of the proposed operation.
  - The Readiness Review process was modeled after Naval Nuclear Propulsion and Nuclear Regulatory Commission programs and processes.
  - Reviews are based on records review, observation of equipment and operations, and interviews of relevant personnel.
    - For new DOE reactors two reviews are required (contractor and Federal).
  - DOE Authorization Official – Authorization to startup. Secretary of Energy (can be delegated)

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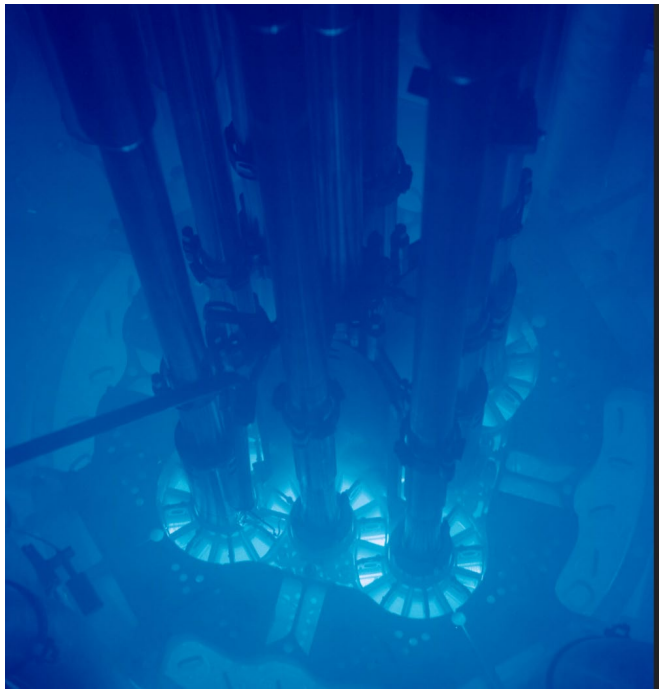
Current Reactor Operations

- **Advanced Test Reactor**
  - Experience with significant modifications
- **Advanced Test Reactor Critical Facility**
- **Neutron Radiography (NRAD) Reactor**
  - Insertion of completely new fuel type
  - New console replacement
- **Transient Reactor Test (TREAT)**
  - Complete rewrite of the TREAT Documented
  - Safety Analysis

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