

PBMR Pre-application Meeting

April 30, 2001

NRC Headquarters, White Flint, Md.

Introduction

- PBMR Project Team
- Purpose of Pre-Application Activities

Gas Reactor Regulatory Framework

Pre-application Review Framework Goals

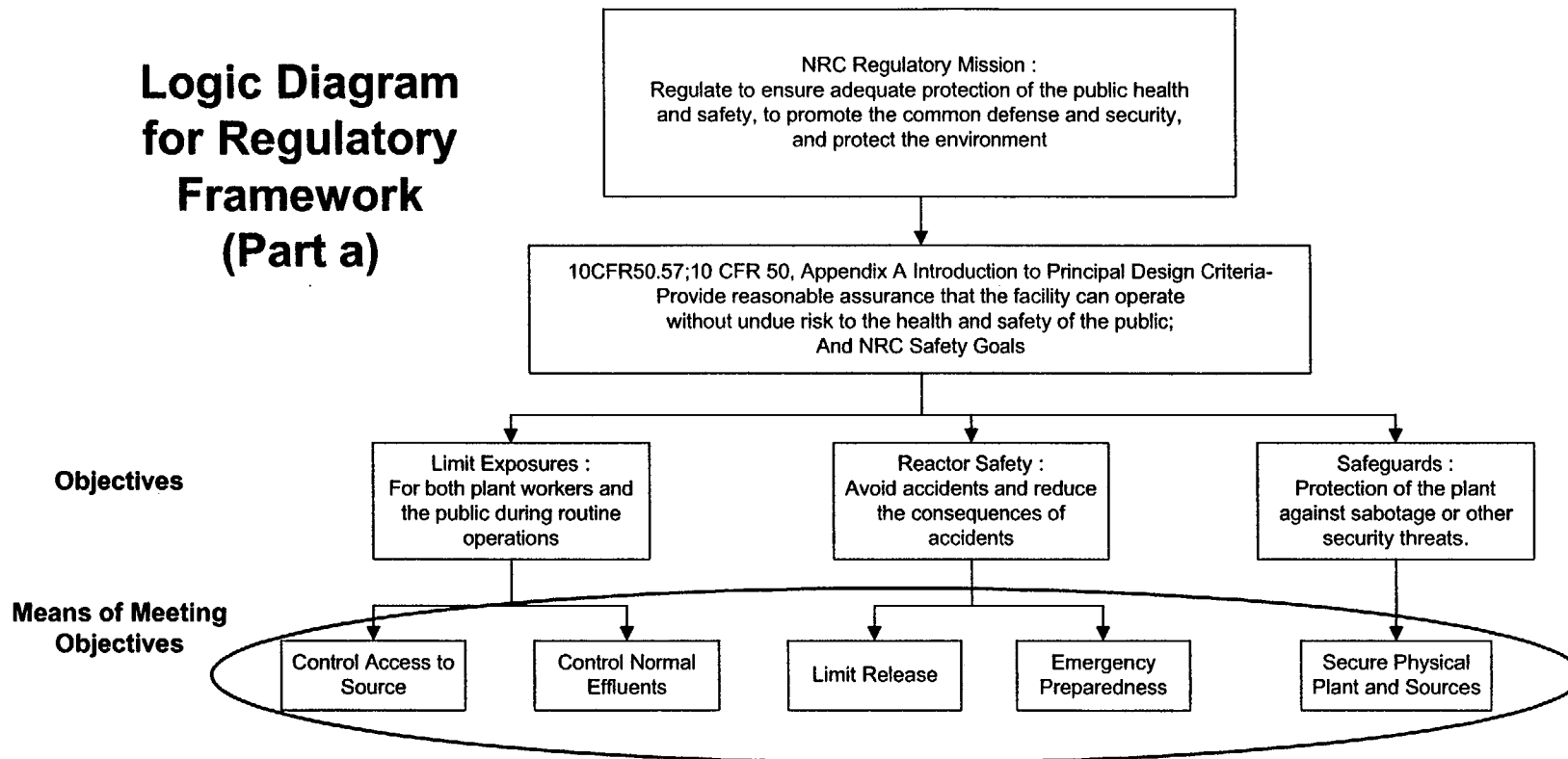
- Input into Exelon's RSA Demo Plant Decision
- Establish Staff Bases for Commission Policy Statement by December 2001
- Establish Appropriate HTGR Framework for Future PBMR License Applications and Staff Reviews
- Input into Exelon's USA Application Decisions

Contemporary HTGR Framework

- The DOE MHTGR program in the mid-80's utilized a "clean sheet of paper," integrated approach to their conceptual design
 - Utilized participant experience in PRA's of HTGRs
 - Approach underwent a pre-application review by the NRC/ACRS
 - Effort focused on the preliminary phases of the licensing process
- Build Upon MHTGR Approach
- Opportunity to Establish a Structured Approach
 - Benefiting from Recent Risk-Informed Successes
 - Retaining Defense-in-Depth Philosophy
- MHTGR Approach Included:
 - Establishing Dose and Risk Criteria Framework
 - Selection Process for Licensing Bases Events
 - Selection of Systems, Structures, and Components (SSCs)

MHTGR Regulatory Mission Linkages

Logic Diagram for Regulatory Framework (Part a)

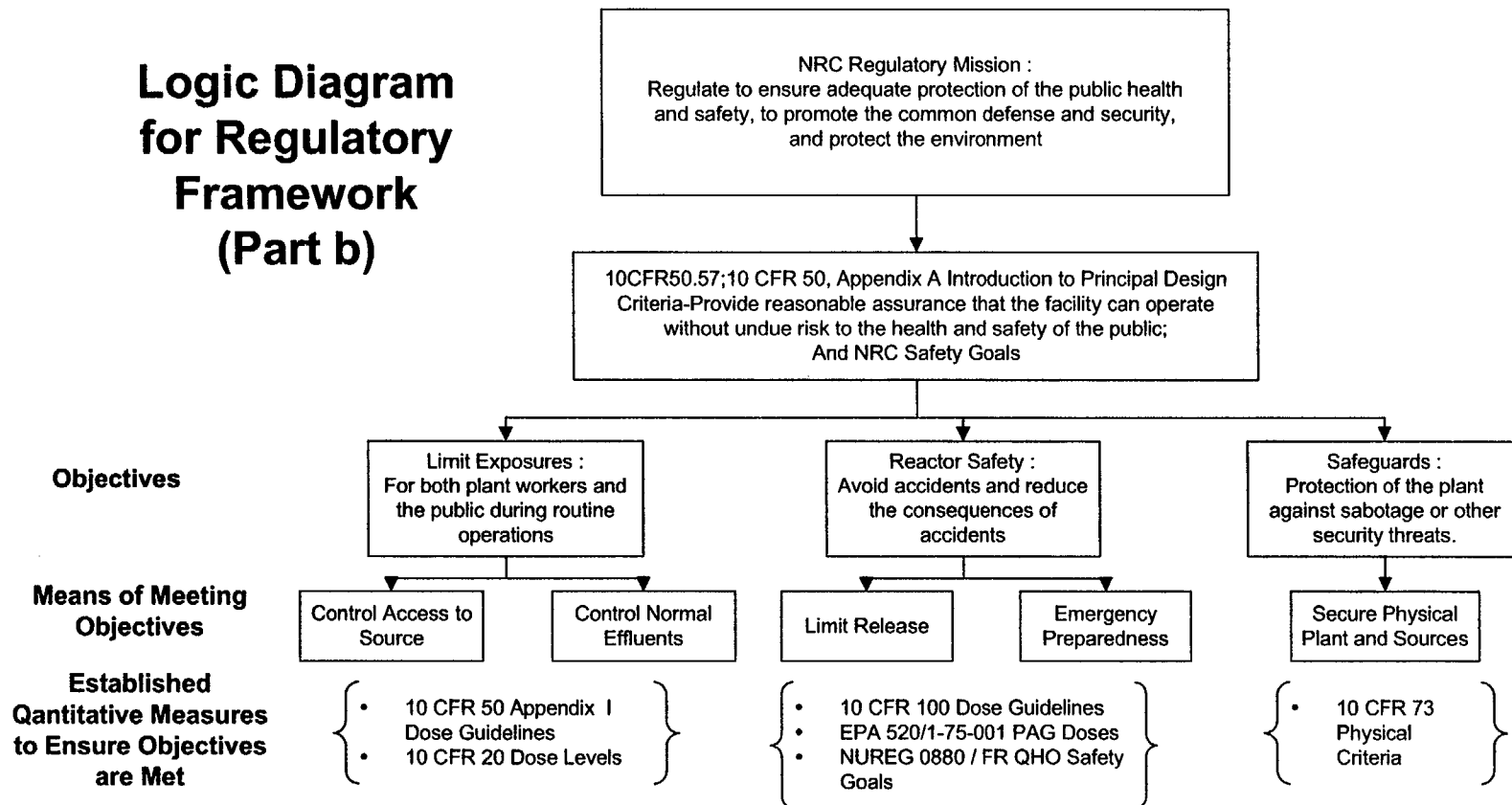


Are the regulatory mission linkages appropriate and acceptable for a HTGR design?

MHTGR Consequence and Risk Criteria

- Top Level Regulatory Criteria
 - Direct statements of acceptable consequences or risks to the public or the environment
 - Quantifiable
 - Independent of plant design
- Applicable Frequency Range
 - Anticipate Operating Occurrences (AOO)
 - Design Basis Event (DBE)
 - Emergency Planning Bases Event (EPBE)

MHTGR Top Level Regulatory Criteria

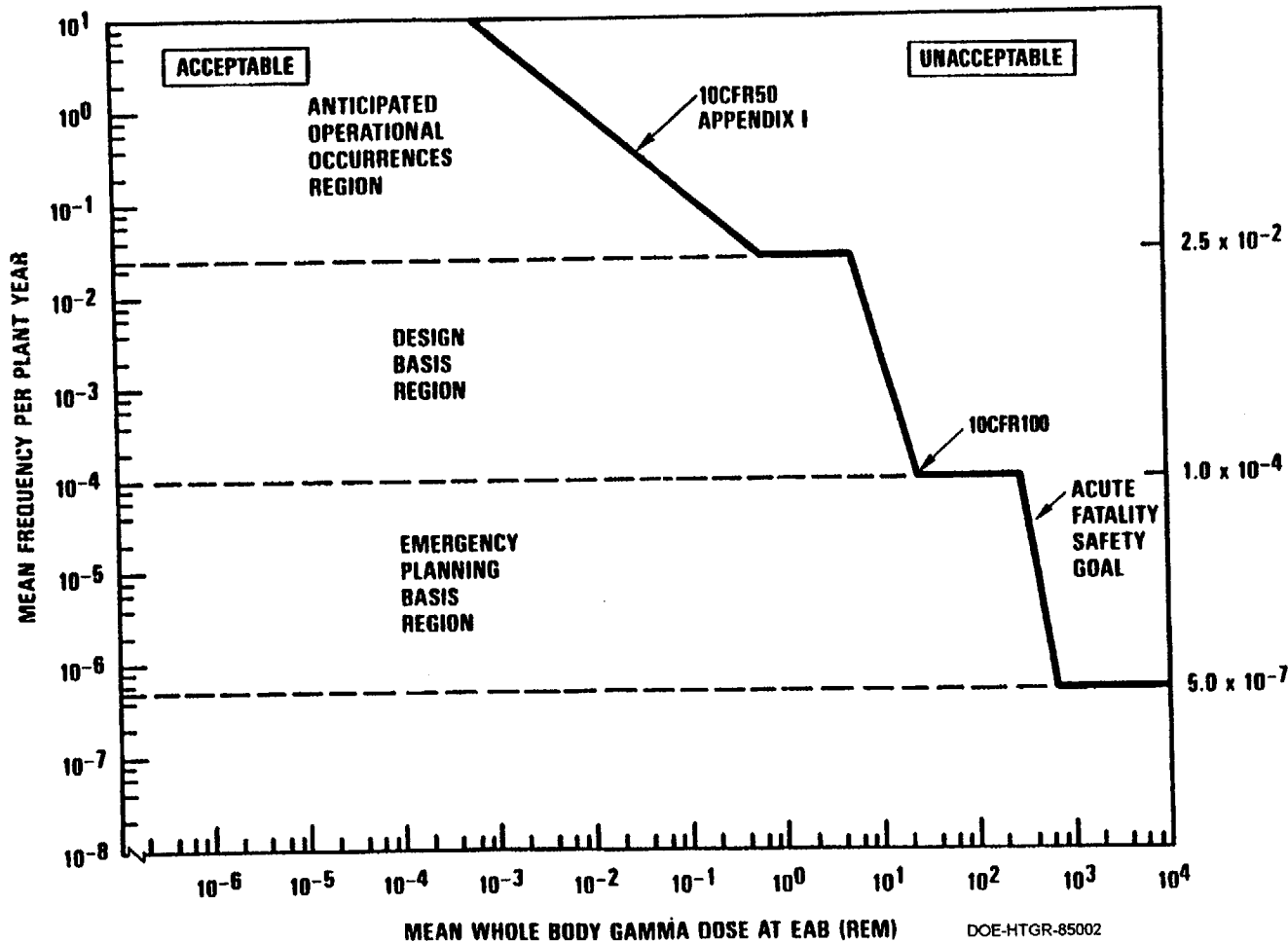


Are the top level regulatory criteria acceptable and can they remain valid through final design approval?

MHTGR Licensing Basis Events

- Off-normal or accident events used for demonstrating design compliance with the Top Level Regulatory Criteria
- Collectively, analyzed in PRAs for demonstrating compliance with the 51FR28044 safety goals
- Encompass following event categories
 - Anticipated Operational Occurrences (AOO)
 - Design Basis Events (DBE)
 - Emergency Planning Basis Events (EPBE)

MHTGR Frequency Ranges



Can the relationship between criteria and acceptable ranges provide the acceptance goals for gas reactor approval?

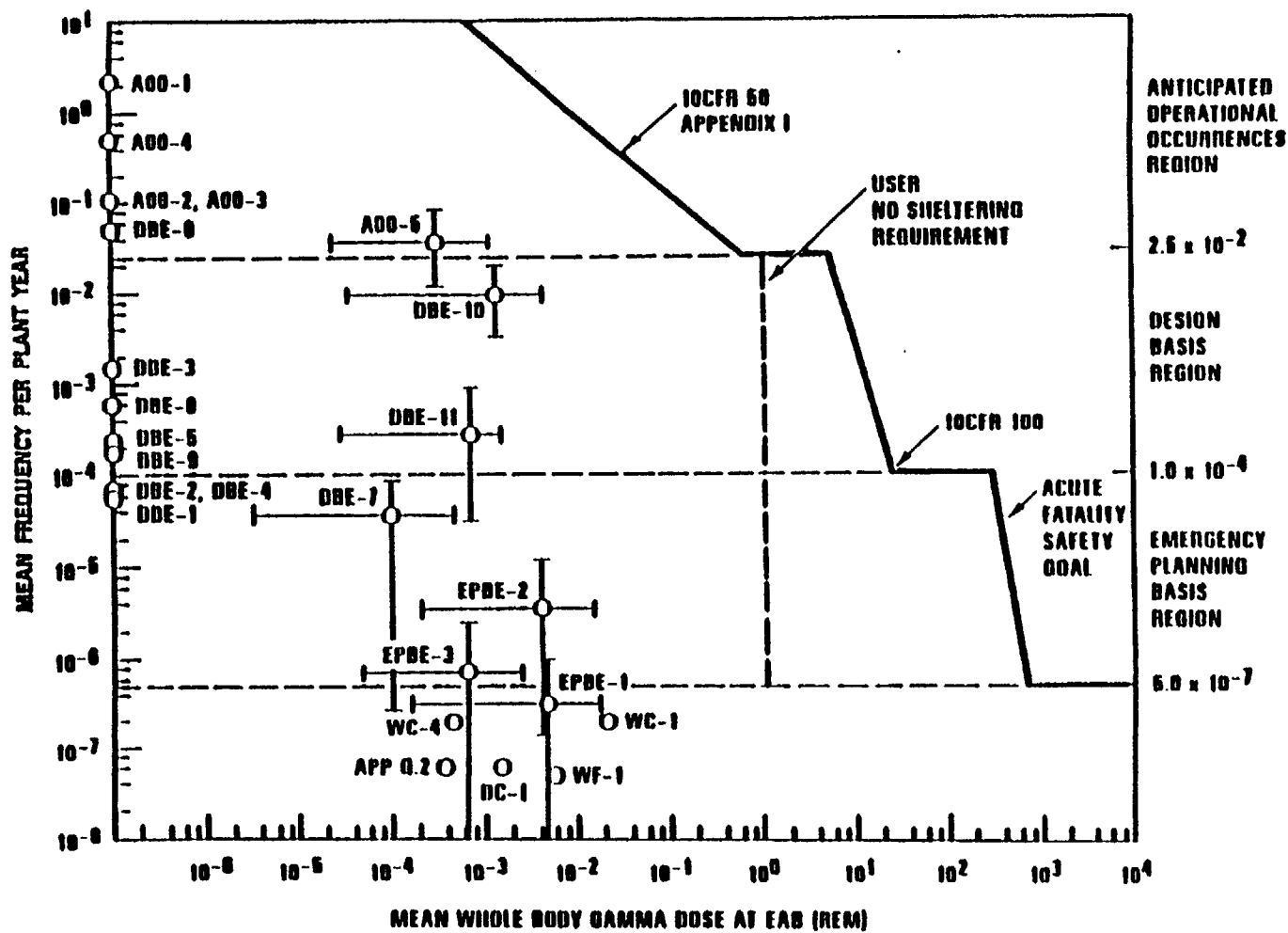
MHTGR Licensing Basis Event Selection Method

- Define region boundaries
- Compare risk assessment results to region dose limits
- Identify as AOOs families of events in AOO region that could exceed Appendix I of 10CFR50 *if certain equipment or design features had not been selected*
- Identify as DBEs families of events in DBE region that could exceed 10CFR100 *if certain equipment or design features had not been selected*

MHTGR Licensing Basis Event Selection Method (continued)

- Identify as DBEs families of events with upper or lower bound frequency in DBE region
- Identify as EPBEs the dose-dominant families of events in EPBE region
- Compare overall risk assessment to 51FR28044 safety goals
- Assure that residual risk is negligible

Example: MHTGR Specific LBEs



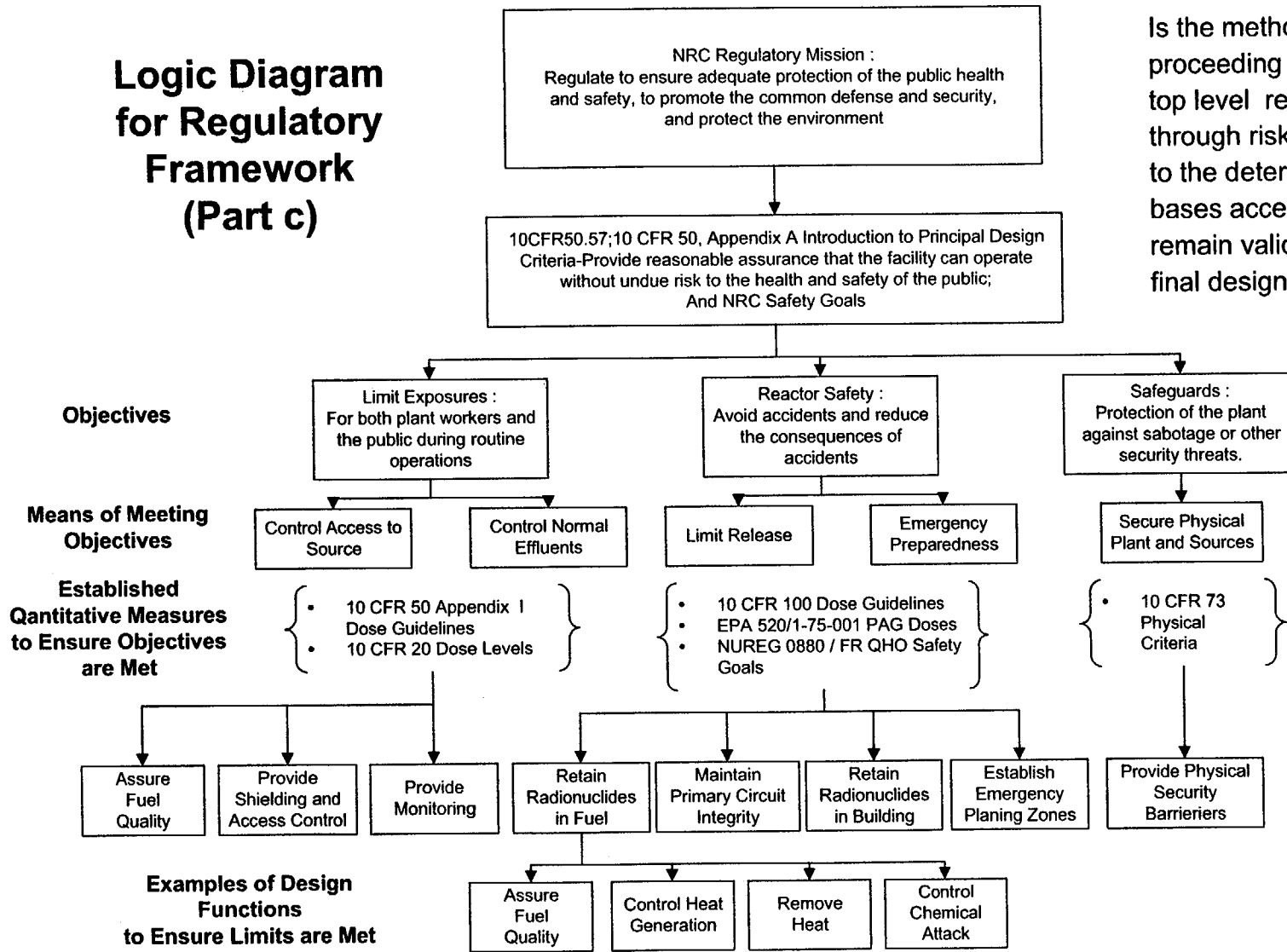
MHTGR 10CFR100 Design Criteria

- PRA insights lead to determination of required functions to meet 10CFR100 doses for DBEs
 - Functional design criteria written as equivalent to GDCs for HTGRs
 - Other design criteria also developed for the other Top Level Regulatory Criteria, e.g.,
 - for normal operation and AOOs: “Appendix I” design criteria
 - for accidents beyond the design basis: “PAG” design criteria

MHTGR Identified Safety Functions

Logic Diagram for Regulatory Framework (Part c)

Is the methodology for proceeding from the top level regulatory criteria through risk assessment to the deterministic licensing bases acceptable and can it remain valid through final design approval?



Example: MHTGR Equipment Safety Classification

- As an example: Safety related systems, structures, and components (SSC) are those selected to perform required functions to meet 10CFR100 doses for DBEs
 - providing extra attention for equipment that would be required to operate for accidents in order to protect offsite public
 - correspond to “10CFR100” design criteria
 - do not correspond to other design criteria
 - do not need special attention for normal operation, or for very rare accidents

Example: MHTGR Method for Equipment Safety Classification

- Identify radionuclide retention functions required for DBEs to meet 10CFR100 doses
- For each required function, select from candidate SSCs a set as safety related that over the spectrum of DBEs assures consequences are in compliance with 10CFR100

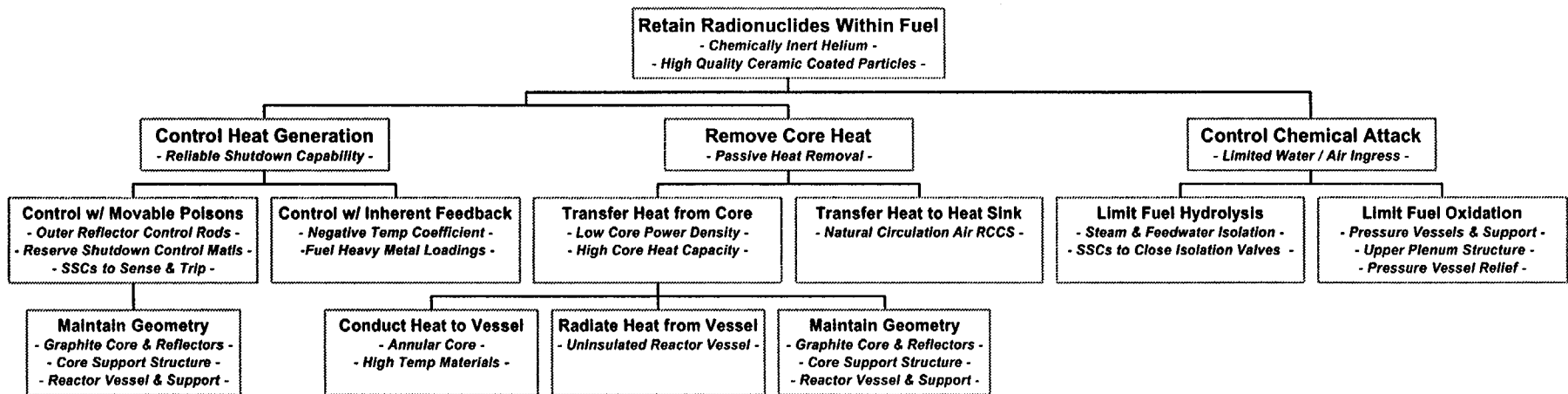
Example 1: Selection of Safety Related Equipment for Removal of MHGTR Core Heat

| SSC Available & Solely Sufficient to Remove Core Heat During DBE? | | | | | | |
|--|--------------|--------------|--------------|--------------|---------------|------------------------|
| SSC | DBE 1 | DBE 4 | DBE 5 | DBE 7 | DBE 10 | Safety Related? |
| Main Loop Cooling | No | No | No | No | No | |
| Shutdown Cooling System | No | No | Yes | No | No | |
| Reactor Cavity Cooling System | Yes | Yes | Yes | Yes | Yes | Yes |
| Reactor Cavity & Surroundings | Yes | Yes | Yes | Yes | Yes | |

Example 1: Selection of MHTGR Safety Related Equipment for Control of Heat Generation

| SSC Available & Solely Sufficient to Control Heat Generation - DBE? | | | | | | | |
|--|--------------|--------------|--------------|--------------|--------------|--------------|------------------------|
| SSC | DBE 2 | DBE 3 | DBE 4 | DBE 5 | DBE 6 | DBE 7 | Safety Related? |
| Control Rods | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Reserve Shutdown Equipment | Yes | Yes | Yes | Yes | No | No | Yes |

Example Summary: Relation of Safety Related Equipment to MHTGR Safety Functions



Example: Safety Related Design Summary

- The MHTGR Framework provided deterministic conditions derived from the probabilistically selected DBEs that rely solely on the safety related equipment to meet specific regulatory review criteria
 - blends probabilistic with deterministic to ensure that safety related equipment is a necessary and sufficient set without adding unnecessary requirements

Contemporary HTGR Framework Proposal

- Preceding Framework Description Demonstrates Opportunities Which Can Be Built Upon:
 - The ability to provide a top-down approach that clearly establishes a suitable standard for assessing safety of Gas Reactors
 - The approach incorporates and retains the defense-in-depth philosophy
 - The approach benefits from the advances in probabilistic tools that highlight design significant functions and guides the application of deterministic requirements.

Contemporary HTGR Framework Proposal

- Establishing a Framework Results in Efficiencies and Appropriate Focus:
 - Provides a Structured Review for other Elements Necessary for Design Acceptance
 - Emergency planning and containment function
 - Ensures appropriate application procedure and SAR format
 - Guide Inspection, Test, Analysis Acceptance Criteria (ITAAC) selection and approval
 - Ensures and Verifies current regulations are met and provides a foundation for new requirements or exemption requests.

Framework Next Steps

- Continue In-Depth Discussions and Establish a Framework for a Contemporary HTGR
 - Establish Top-Down Objectives and Criteria
 - Establish a Frequency-Consequence Picture
 - Establish a Probabilistic/Deterministic Event Selection Method
 - Establish a SSC Probabilistic/Deterministic Identification Method
 - Establish Structured Approaches to Other Topics

Framework Next Steps

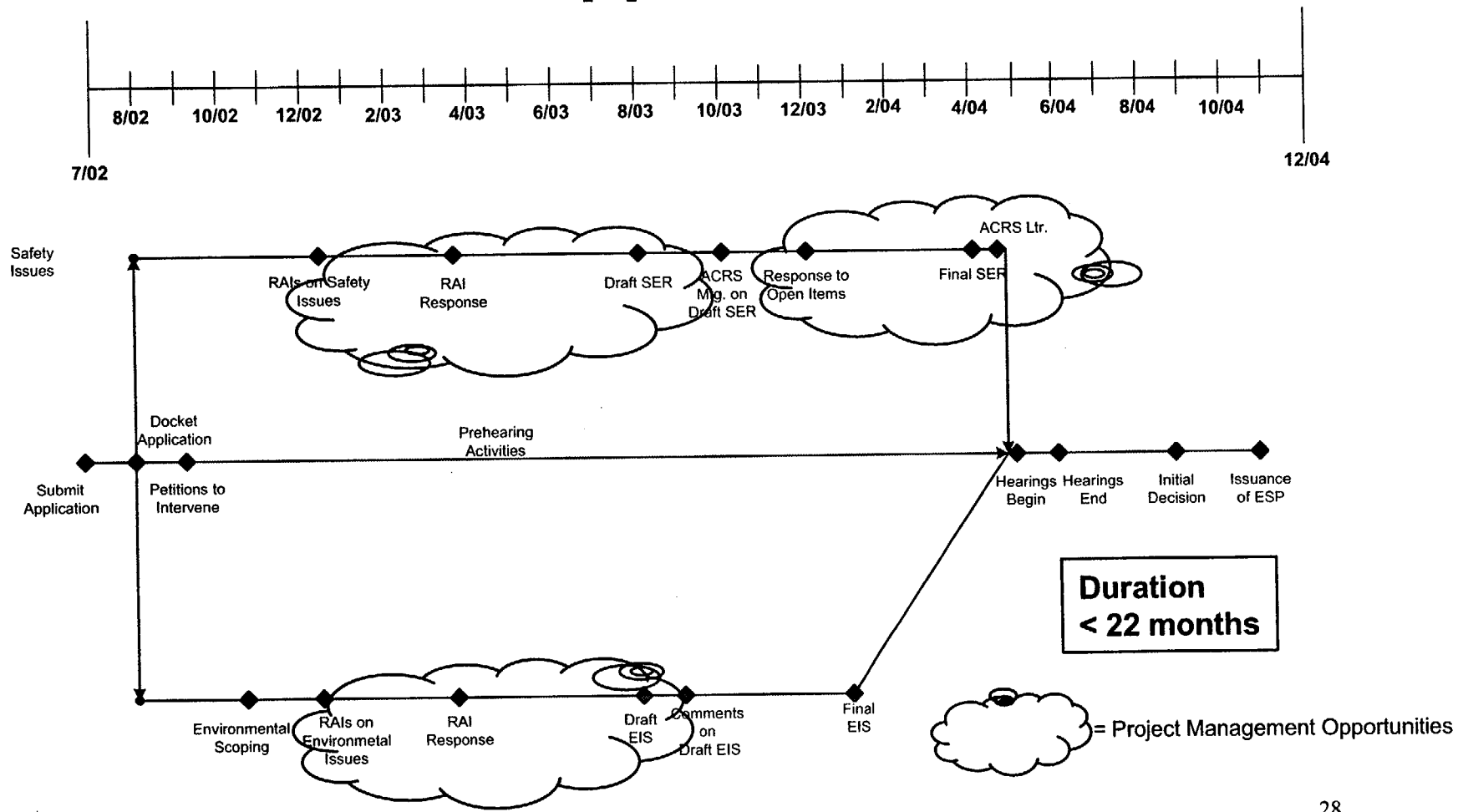
- Develop schedule and forum for discussions that support:
 - Input into Exelon's RSA Demo Plant Decision
 - Establish Staff Bases for Commission Policy Statement by December 2001
 - Establish Appropriate HTGR Framework for Future PBMR License Applications and Staff Reviews
 - Input into Exelon's USA Application Decisions

PBMR Part 52 Process Plan

Early Site Permit Process

- Established in 10CFR52 Part A
- Provides for final determinations on the environmental and safety suitability of a site for the described purposes.
- Results all binding in the final COL proceeding
- Application contains three main parts:
 - Site Safety Analysis Report
 - Environmental Report
 - Emergency Planning Report
- Site Selection Process Considerations

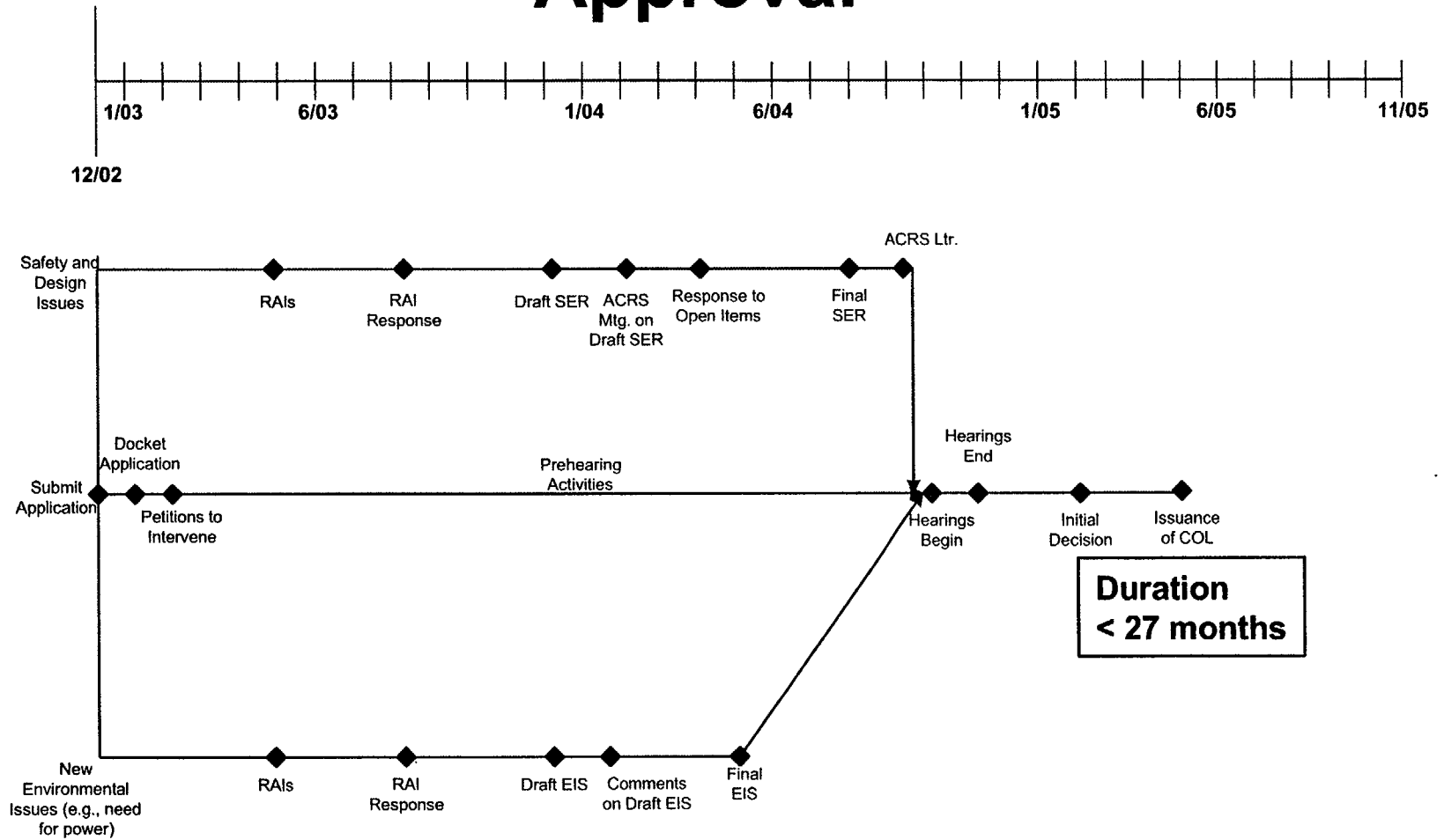
Steps for ESP Application Review and Approval



Combined Construction/Operating License Process

- Established in 10CFR52 Part C
- Provides for final determinations on the overall suitability of the PBMR specific design for the previously approved site.
- Closes any conditions of the ESP in the final COL proceeding
- The application includes proposed Inspection, Test, Analysis Acceptance Criteria (ITAAC) . When approved in the COL, these ITAAC are certified complete during construction as prerequisites for final operating authority.

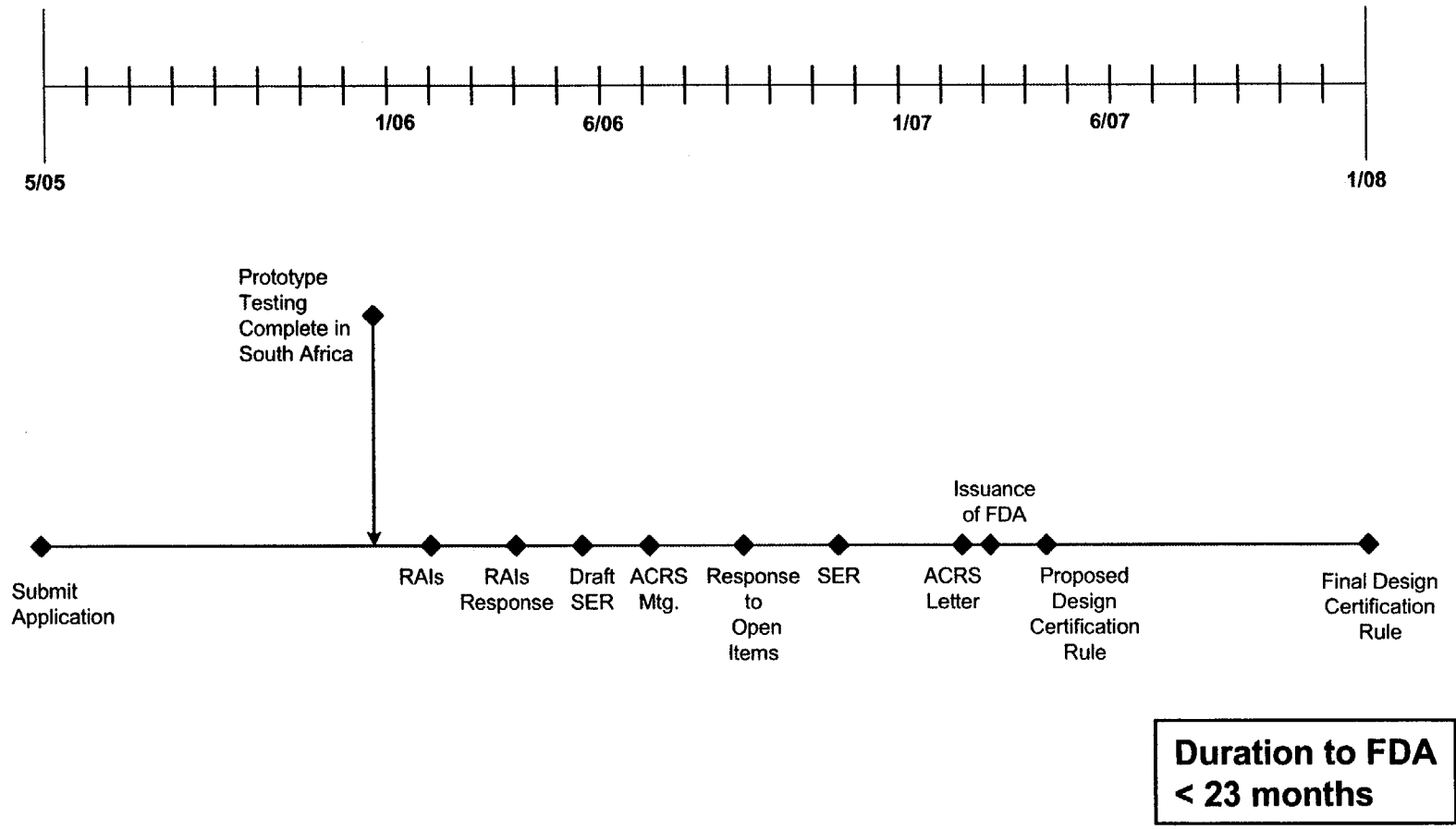
Steps for COL Application Review and Approval



Design Certification Process

- Established in 10CFR52 Part B
- Provides for final determinations on the overall suitability of a standard design for use on any suitable site. Each design certification is codified by rule in 10CFR52 for future reference.
- Can be coupled with a previously approved ESP site in a COL application, resulting in a simplified review of remaining site and applicant-specific attributes.

Steps for Design Certification Review and Approval



Legal and Financial Topics

Non-Technical Issues

- Current legal and regulatory requirements are crafted primarily around the regulated utility market with a focus on LWR technology.
- Deregulated markets that contain merchant plant owners create the need for different requirements.
- Advanced technologies, including small, modular plants create the need for different requirements.
- The regulatory framework should be appropriately modified to address these issues to allow proper consideration of new, advanced reactors in the national energy mix.

Merchant Plant Topics

- Anti-Trust Review
- Decommissioning Funding Assurance
- Financial Qualifications

Small, Modular, Passive Topics

- Decommissioning Funding Formula
- Secondary Financial Protection
- Emergency Planning
- Annual Fees
- Operator Staffing

Small, Modular, Passive Topics (con't)

- Uranium Fuel Cycle for Gas Reactors
- Number of Licenses Needed

Future Meeting Plans, Schedule, Objectives, Project Management

PBMR Pre-Application Activity Schedule

| ID | Task Name | Start | Finish | 2002 | | | | | | | | | | | | | | |
|----|---|--------------|--------------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | | | | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun |
| 1 | Pre-Application Project Management | Thu 04/26/01 | Fri 12/14/01 | [Gantt bar spanning from April to December] | | | | | | | | | | | | | | |
| 2 | Organization | Thu 04/26/01 | Fri 05/18/01 | [Gantt bar from April to May] | | | | | | | | | | | | | | |
| 3 | Forum | Thu 04/26/01 | Fri 05/04/01 | [Gantt bar from April to May] | | | | | | | | | | | | | | |
| 4 | Resolution Process | Thu 04/26/01 | Fri 05/18/01 | [Gantt bar from April to May] | | | | | | | | | | | | | | |
| 5 | Schedule | Thu 04/26/01 | Fri 05/11/01 | [Gantt bar from April to May] | | | | | | | | | | | | | | |
| 6 | Technical Orientation / Fundamentals | Fri 09/07/01 | Fri 12/14/01 | [Gantt bar from September to December] | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | |
| 8 | Develop Licensing Framework | Thu 04/26/01 | Fri 10/19/01 | [Gantt bar from April to October] | | | | | | | | | | | | | | |
| 9 | Mission Linkages | Thu 04/26/01 | Fri 06/15/01 | [Gantt bar from April to June] | | | | | | | | | | | | | | |
| 10 | Risk Chart | Thu 04/26/01 | Fri 06/15/01 | [Gantt bar from April to June] | | | | | | | | | | | | | | |
| 11 | Lic Bases Events Method | Fri 05/18/01 | Fri 07/20/01 | [Gantt bar from May to July] | | | | | | | | | | | | | | |
| 12 | GDC / Function Method | Fri 05/18/01 | Fri 07/20/01 | [Gantt bar from May to July] | | | | | | | | | | | | | | |
| 13 | SSCs Method | Fri 06/15/01 | Fri 08/17/01 | [Gantt bar from June to August] | | | | | | | | | | | | | | |
| 14 | Applicable Regulations Criteria | Fri 06/15/01 | Fri 08/31/01 | [Gantt bar from June to August] | | | | | | | | | | | | | | |
| 15 | TS Approach | Fri 07/13/01 | Fri 09/14/01 | [Gantt bar from July to September] | | | | | | | | | | | | | | |
| 16 | SAR Format | Fri 08/17/01 | Fri 10/19/01 | [Gantt bar from August to October] | | | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | | | | | | | |
| 18 | Licensing Plan | Thu 04/26/01 | Fri 06/29/01 | [Gantt bar from April to June] | | | | | | | | | | | | | | |
| 19 | ESP | Thu 04/26/01 | Fri 06/15/01 | [Gantt bar from April to June] | | | | | | | | | | | | | | |
| 20 | COL | Fri 05/04/01 | Fri 06/22/01 | [Gantt bar from May to June] | | | | | | | | | | | | | | |
| 21 | Design Cert. | Fri 05/18/01 | Fri 06/29/01 | [Gantt bar from May to June] | | | | | | | | | | | | | | |
| 22 | Schedule/Cost Est. | Thu 04/26/01 | Fri 06/29/01 | [Gantt bar from April to June] | | | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | | | | | | |
| 24 | Legal / Financial Regulations | Thu 04/26/01 | Fri 05/18/01 | [Gantt bar from April to May] | | | | | | | | | | | | | | |
| 25 | Confirm Reasonable Approach | Thu 04/26/01 | Fri 05/18/01 | [Gantt bar from April to May] | | | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | | | | | | | |
| 27 | Computer Codes Validation Philosophy and Process | Wed 06/06/01 | Fri 08/17/01 | [Gantt bar from June to August] | | | | | | | | | | | | | | |
| 28 | Bases for Including Codes for V & V | Wed 06/06/01 | Fri 07/20/01 | [Gantt bar from June to July] | | | | | | | | | | | | | | |
| 29 | Process, Planning, and Schedule | Fri 07/20/01 | Fri 08/17/01 | [Gantt bar from July to August] | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | |
| 31 | Fuel Licensing Discussions | Wed 06/06/01 | Fri 05/24/02 | [Gantt bar from June to May 2002] | | | | | | | | | | | | | | |
| 32 | Approach to Fuel Performance Criteria/Testing/Logistics | Wed 06/06/01 | Fri 08/17/01 | [Gantt bar from June to August] | | | | | | | | | | | | | | |
| 33 | Approach to Performance Analysis and Test Schedule | Fri 08/17/01 | Fri 12/21/01 | [Gantt bar from August to December] | | | | | | | | | | | | | | |
| 34 | Fuel Licensing Plan | Fri 01/18/02 | Fri 05/24/02 | [Gantt bar from January to May 2002] | | | | | | | | | | | | | | |
| 35 | | | | | | | | | | | | | | | | | | |
| 36 | ID Applicable Regulations | Fri 08/17/01 | Fri 12/21/01 | [Gantt bar from August to December] | | | | | | | | | | | | | | |
| 37 | Perform Assessment | Fri 08/17/01 | Fri 12/21/01 | [Gantt bar from August to December] | | | | | | | | | | | | | | |
| 38 | | | | | | | | | | | | | | | | | | |
| 39 | | | | | | | | | | | | | | | | | | |
| 40 | | | | | | | | | | | | | | | | | | |
| 41 | PBMR Licensing Feasibility Report | Tue 05/08/01 | Fri 09/28/01 | [Gantt bar from May to September] | | | | | | | | | | | | | | |
| 42 | US Draft | Tue 05/08/01 | Tue 05/08/01 | [Gantt bar at May 8, 2001] | | | | | | | | | | | | | | |
| 43 | Final Report | Fri 09/28/01 | Fri 09/28/01 | [Gantt bar at September 28, 2001] | | | | | | | | | | | | | | |