

PBMR Systems Design Approach and Status

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Overview of Presentation

- Overall PBMR Design Phases & Status
- Systems Design Approach
 - PBMR System Categories
 - Vertical slice of systems design process, using Fuel Handling & Storage System as an example

Overall Design Phases

- **Conceptual Design Phase:** To provide proof of concept.
- **Basic Design Phase:** To provide technical & commercial feasibility data to investors and other stakeholders.
- **Detailed Design Phase:** To provide a detailed, constructible design.

The project is currently approaching the end of the Basic Design Phase.



↑
Current Status 10/25/2001

Systems Design Approach

- The plant systems are designed using the process described in the “Engineering Management Plan,” Document No. 000370-120.
- This is illustrated by a vertical slice of the systems design process using the Fuel Handling & Storage System as an example.
- PBMR System categories as follows.

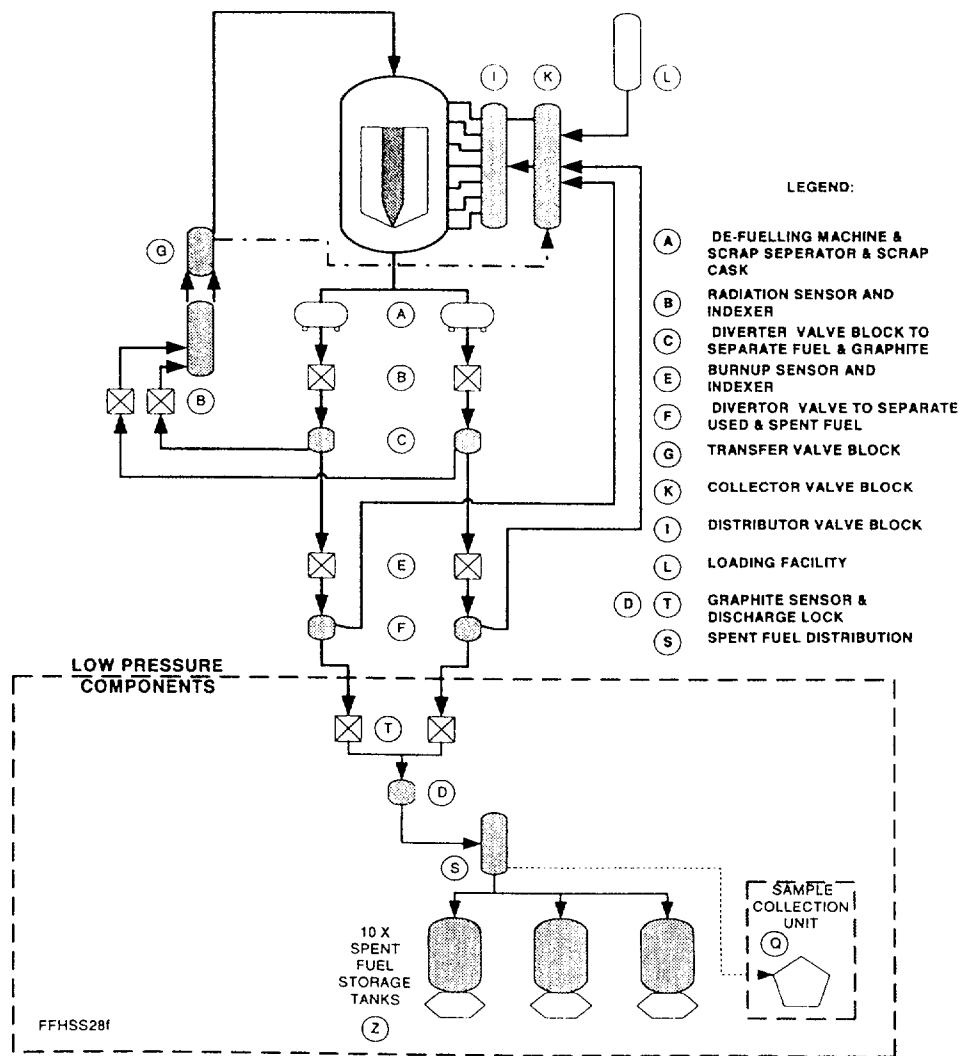
PBMR System Categories

- Reactor Pressure Vessel
- Automation
- Electrical/I&C
- Helium Gas
- Plant Services
- Civil / Buildings / Infrastructure
- Water Cooling
- Main Power
- Radiological Waste
- Fuel Handling & Storage
 - **Fuel Handling and Storage System**
- Plant Support

FUEL HANDLING SYSTEM

SPHERE FLOW DURING NORMAL OPERATION

HIGH PRESSURE OPERATION



Fuel Handling & Storage System System Design Considerations

- Requirements & Specifications
- Applicable Documents & Models
- Requirements
 - System Definition
 - Characteristics
 - Performance
 - Modes and States
 - Functions

Fuel Handling & Storage System

(Cont'd)

- Interface Requirements
- Physical Characteristics
- Availability
- Reliability
- Maintainability
- Environmental Condition
 - Seismic Loading
 - External thermal & hydraulic conditions
 - Vibration
 - EMI
 - Transportation shocks and vibrations
 - Storage
 - Transportability

Fuel Handling & Storage System

(Cont'd)

- Design & construction
- Documentation
- Logistics
- Personnel & Training
- Major Components Characteristics
 - Sub-systems
 - Fuel & Graphite Circulating
 - Spent Fuel Storage
 - Fresh Fuel Storage & Feed

Fuel Handling & Storage System (Cont'd)

- Sub-Systems (cont'd)
 - Graphite Replenishing
 - Used Fuel & Graphite Storage & Feed
 - First Core Graphite Loading
 - Spent Fuel & Last Core Removal
 - Gas Evacuation
 - Fuel Handling & Storage Control
 - FHSS Logistical Support

Fuel Handling & Storage System (Cont'd)

- Functional Analysis (input to process flow diagram)
- Integrated Logistical Support Plan
 - Summary of System Characteristics
 - System overview
 - Operational profile and parameters
 - Maintenance parameters

Fuel Handling & Storage System

(Cont'd)

- Reliability program
 - Availability predictions
 - Redundancy
- Maintainability program
- Testing Program
- Human Factors Engineering
- Safety Engineering

Fuel Handling & Storage System

(Cont'd)

- Customer/Contractor ILS Planning Process
- Plan for Support
- Maintenance concepts
 - System Characteristics
 - Repair Levels & Functions at each level
 - Condition Monitoring
 - Preventive Maintenance
 - On-site Repair

Fuel Handling & Storage System

(Cont'd)

- Repair Levels & Functions at each level
(cont'd)
 - Workshop
 - Regional (off-site)
 - Factory
- Requirements and Policies
 - Spares & Stores
 - Personnel
- Design Codes & Standards
- Design Review

Fuel Handling & Storage System (Cont'd)

- Design Reports
 - Process Flow Analysis
 - Simulation Requirements
 - Simulation Data
 - Simulation Results
 - Different modes and states
 - Analysis of effect of external parameters
 - Level of Confidence
 - Appendices

Fuel Handling & Storage System

(Cont'd)

- Thermo Hydraulic Control Strategy
- System Simulink Input Report
- System Transient Analysis Report
- CFD Simulation of Spent Fuel Tanks
- Thermal Hydraulic Design Report
- Thermo Hydraulic Flownet Input Report
- Fuelnet Simulator Input Report
- Development Specification
- Industrialization Plan

SUMMARY

- A comprehensive, consistent and rigorous review process used in developing the System design
- Design principles, processes and considerations are similar to other Nuclear design projects
- Fuel Handling and Storage System design documentation is available for NRC examination