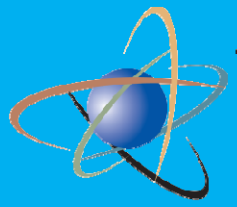

Reprocessing And Recycling: Design And Operational Requirements

U.S. Nuclear Regulatory Commission Reprocessing Workshop

October 19th and 20th, 2010

Albuquerque, NM

NRC Regulatory Approach

- Three general areas, with ALARA
  - Prescriptive requirements
  - Risk informed/performance based
  - Minimum criteria or areas for review
- Minimum criteria include, among others:
  - Design criteria, GDC/BDCs
  - Technical specifications
  - Training and qualifications of personnel
- These support redundancy, diversity, and defense in depth, and safety functions

What Are GDC/BDC?

The NRC establishes minimum requirements for proposed facilities or applications of licensed radioactive materials that provide:

- assurance that important to safety SSCs will have the ability and reliability to perform their intended safety functions
- assurance that uncertainties and errors, from design and analysis, and unknowns, are adequately addressed
- adequate defense in depth
- redundancy and diversity
- assurances that balance of plant and unanalyzed situations do not negatively impact safety

SSC = Structure, System, or Component

NRC regulations frequently identify these minimum requirements by terminology:

- General Design Criteria (GDC) or Baseline Design Criteria (BDC)
- Where used, GDC and BDC are essentially synonymous, although the GDC term is more prevalent in the regulations and tends to be more specifically stated.

Currently …

- Reprocessing and recycling (R&R) facilities are production facilities
- Regulated under 10 CFR Part 50
  - GDC in 50.34 and Appendix A
    - Analogs might apply to R&R facilities
  - Other sections of Part 50 imply additional GDC (e.g., Appendix F, Appendix I, Appendix S)
- GDC specific to R&R are needed to address the large quantities and types of radionuclides at these facilities

Part 50: Previously Proposed Appendix P

- 50.34(a)(3) (i) footnote: “GDC for chemical processing facilities are being developed”
- “General Design Criteria for Fuel Reprocessing Plants”
  - 39 Federal Register 26293, July 18th, 1974
  - Indefinitely deferred on April 19th, 1984 until needed for NRC’s regulation of a reprocessing facility (49 Federal Register 16699, April 19th, 1984).
- 27 GDC in 7 categories

Part 50: Previously Proposed Appendix Q

- 50.34(a)(3) (i) footnote: “GDC for chemical processing facilities are being developed”
- “Design Criteria for Protection of Fuel Reprocessing Plants and Licensed Material Therein”
  - 39 Federal Register 26296, July 18th, 1974
  - Indefinitely deferred on April 19th, 1984 until needed for NRC’s regulation of a reprocessing facility (49 Federal Register 16699, April 19th, 1984).
- 19 GDC in 3 categories

NRC Staff Review and Status

- Reviewed the existing GDCs/BDCs and relevant documents
  - Regulations have no thresholds for applying existing GDCs/BDCs
- Identified
  - 10 potential categories of GDCs/BDCs
  - 77 potential areas within the ten categories
- Found significant fraction of areas could become draft GDCs

Ten Potential Draft GDC/BDC Categories

- Overall/General
- Multiple Confinement and Containment Barriers, and Systems
- Process Safety Features
- Nuclear Criticality Safety
- Radiological Protection
- Physical Security
- MC&A
- Fuel and Radioactive Waste
- Siting
- Decommissioning

Some Samples Of Potential Areas For GDCs/BDCs

- Quality standards/records
- Minimize risk from R&R
- Fire and explosion protection
- Negative pressure differential
- Flammable gas monitoring and control
- Habitability
- Seismic Protection
- Emergency process heat removal
- Control Room
- Criticality Safety Monitoring and Alarm
- ALARA
- Shielding
- Waste Management
- Aircraft Impact
- Design for Eventual Decommissioning

Technical Specifications

- Required for reprocessing facilities
  - By law – AEA – Atomic Energy Act
  - Part 50.36 has specifics for reprocessing
- Extensive documentation for Tech Specs
  - For Part 50 and reactor facilities
  - FRN 10815, May 2, 1973, "Technical Specifications for Fuel Reprocessing Plants"
- No technical specifications in Part 70
  - Uses ISA and IROFS
- GDPs (Part 76) have Technical Safety Requirements (TSRs) which are similar to technical specifications

Technical Specifications

- Derived from safety analyses to protect people from uncontrolled releases (50.36 – 50.36a for effluents)
- Five Categories
  - Safety limits (event level - uncertainty allowances etc.) and limiting control settings (alarm/correction level – margin for alarm/response uncertainties/inaccuracies and system responses)
  - Limiting conditions for operations (minimum equipment performance)
  - Surveillance requirements (inspect, test, maintain)
  - Design features (e.g., types of steels, geometry)
  - Administrative controls (e.g., minimal staffing, calibration)
- Include both technical (engineered) and administrative matters

Operator Training

- AEA requires NRC to
  - Establish criteria for operators of production and utilization facilities
  - Determine the qualifications of individuals applying for licenses
  - Issue licenses, as appropriate
- Codified in 10 CFR Part 55
- As with Part 50, regulations and associated guidance now focus more on power reactors
- Appropriate level for R&R facilities needs to be determined, and included in Part 55 revision or new R&R regulation

Potential Questions For Discussion

- Should there be a minimal set of GDC applicable to R&R facilities?
- Do any standard criteria apply universally (e.g., SNF burnup, time after discharge)?
- Should the NRC consider different GDCs for different types of R&R technology applied?
- What is the appropriate level of detail for GDCs?
- Should the NRC include emergency planning requirements similar to Part 50, Appendix E? Should there be an Emergency Planning Zone around R&R facilities?
- What issues, areas/categories, or considerations should the NRC evaluate for technical specifications?
- Should the NRC consider any additional or different requirements for R&R facility operators as compared to current practice with reactor operators?
- Are there specific training requirements for specific R&R facility areas or by hazard/risk/safety significance?
- Are there any thresholds for applying criteria and requirements (e.g., GDC, technical specifications, training)?

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Protecting People and the Environment

Background Slides

Potential Categories And Areas For GDC/BDC

Relevant Sources For Potential GDCs/BDCs

Regulations:

- Part 20: Basic radiation protection/principles
- Part 50: Licenses Production Facilities
- Part 52: Design Certification etc. for Part 50
- Part 70: Licenses SNM/materials
- Part 72: Licenses

Proposed Regulations:

- Part 50: Proposed Appendix P
- Part 50: Proposed Appendix Q

Other Documents:

- NEI White Paper
- NUREG-1909

Potential GDCs/BDCs Categories for Reprocessing Facilities

- General Overall Categories
- Multiple Confinement/ Containment Barriers and Systems
- Nuclear Criticality Safety
- Material Control and Accountability (MC&A)
- Siting
- Process Safety Features
- Radiological Protection
- Physical Security
- Fuel and Radioactive Waste
- Decommissioning

Draft Category: Overall/General Potential Areas For GDCs/BDCs

- Quality standards/records
- Minimize risk from R&R
- Fire and explosion protection
- Negative pressure differential
- Flammable gas monitoring and control
- Habitability
- Seismic Protection
- Emergency process heat removal
- Control Room
- Criticality Safety Monitoring and Alarm
- ALARA
- Shielding
- Waste Management
- Aircraft Impact
- Design for Eventual Decommissioning

Draft Category: Confinement & Containment Potential Areas For GDCs/BDCs

- Design or Design Basis
- Leakage Rate Monitoring and Testing
- Inspection and Testing
- Negative pressure differential
- Pressure Differential
- Negative Pressure Differential
- Penetrating Confinement and Containment Areas
- Flammable Gas Monitoring & Control
- Flammable Gas Monitoring & Control in Process Ullage & Vent
- Habitability Monitoring & Control
- System Heat Removal
- Atmosphere Cleanup

Draft Category: Process Safety Features Potential Areas For GDCs/BDCs

- Safety System Functions
- Reliability and Testability
- Safety System Independence
- Failure Modes
- Separation of Safety & Control Systems
- Process Boundary
- Inspection & Testing of Process Boundary
- Residual Heat Removal
- Emergency Process Heat Removal
- Inspection & Testing of Heat Removal Systems
- Control Rooms and Control Areas
- Chemical Protection
- Waste Management
- Electrical Power Systems

Draft Category: Criticality Safety Potential Areas For GDCs/BDCs

- Prevent Criticality
- Neutron Absorbers
- Criticality Safety Monitoring and Alarm
- Monitor and Control Potential Accumulation of Fissile Materials
- Control Methods
- Adequate Criticality Safety Margins
- Safety Control

Draft Category: Rad Protection Potential Areas For GDCs/BDCs

- ALARA
- Radiation Shielding
- Design and Operate to Minimize Contamination of Facility and Its Environment
- Waste Management
- Access Control
- Radiation Monitoring and Alarm Systems
- Criticality Safety Monitoring and Alarm
- Effluent Monitoring and Control
- Shielding

Draft Category: Physical Security Potential Areas For GDCs/BDCs

- Physical Barriers
- Plant Isolation
- Protective Lighting
- Personnel package and vehicle control
- Equipment Design and Placement
- Shipping and Receiving
- Surveillance Capability
- Emergency Monitoring Capability
- Intrusion Alarm System
- Essential Communications
- Cybersecurity
- Shielding

Draft Category: MC&A Potential Areas For GDCs/BDCs

- Material Control Areas
- Process and Related Equipment
- Waste Accountability Capability
- Computerized Data Processing Capability
- Measurement Capability
- Storage of Special Nuclear Material, Fissile Material, and Other Isotopes of Interest

Draft Category: Fuel and Radwaste Potential Areas For GDCs/BDCs

- Radioactive Waste Streams Output
- Waste Forms
- Special Nuclear Material and Radioactive Waste Storage

Draft Category: Siting Potential Areas For GDCs/BDCs

- Site Selection
- Protection Against Wind-Borne Missiles
- Seismic Protection
- Protection Against all Other Natural Phenomena Hazards

Draft Category: Decommissioning Potential Areas For GDCs/BDCs

- Design, Construct and Operate to facilitate eventual decommissioning
- Material Time Limitation
- Material Inventory and Type Limitations
- Decommissioning Plan and Objectives