

# Standard Format & Content for the Safety Analysis Report

## U.S. Practices

By Brian K. Grimes

Prepared for Argonne/IAEA  
Research Reactor Workshop  
September 2004

# IAEA Safety Series 35-G1

## NUREG-1537 Part 1

- Safety Guide on Safety Assessment of Research Reactors and Preparation of the Safety Analysis Report 35-G1-1993 (Appendix 1: about 50 pages)
- Guidelines for preparing and reviewing applications for the licensing of non-power reactors NUREG-1537 Part 1 (about 140 pages plus Appendixes)
- Topics covered substantially the same

# NUREG 1537 Part 1 Topics

- 1 Facility description
- 2 Site Characteristics
- 3 Design of structures, systems and components
- 4 Reactor description
- 5 Reactor coolant systems
- 6 Engineered safety features
- 7 I&C systems

# NUREG 1537 Part 1 Topics - 2

- 8 Electrical power systems
- 9 Auxiliary systems
- 10 Experimental facilities
- 11 Radiation protection program and waste management
- 12 Conduct of operations
- 13 Accident analyses
- 14 Technical specifications

# NUREG 1537 Part 1 Topics - 3

- 15 Financial Qualifications
- 16 Other license considerations (medical use)
- 17 Decommissioning
- 18 HEU to LEU conversions

# Functions Served by SAR

- Complete description of facility
- Documents design bases
- Demonstrates that health and safety will be protected and applicable regulations will be met
- Documents the planned conduct of facility operation
- Includes technical specifications

# SAR and Technical Specifications

- Safety analysis report: provides NRC the basis on which to reach conclusions and issue license
- Technical specifications: ongoing agreement on how facility will be managed and operated

# License Amendments

- Applicable parts of the Format and Content guide should be used for license amendments
  - ◆ license renewal
  - ◆ power increase
  - ◆ excess reactivity increase
  - ◆ major core configuration change
- More recent regulation changes must also be addressed

# Facility Description (IAEA A.1 & A.2)

- Summary of principal safety considerations
- General facility description
- Shared facilities and equipment
- Comparison with other facilities
- Summary of operations
- Facility modifications and history

# Site Characteristics (IAEA A.3)

- Geography and demography
- Industrial and transportation
- Meteorology
- Hydrology
- Geology, Seismology

# Structures, Systems, Components (IAEA A.4)

- Design Criteria
  - ◆ normal, transients, accidents
  - ◆ safety system redundancy
  - ◆ design provisions for testing
  - ◆ fire protection
  - ◆ quality standards (fuel fabrication)
  - ◆ constraints for system availability

# Structures, Systems, Components - 2 (IAEA A.4)

- Other Design Criteria
  - ◆ Wind
  - ◆ Flooding
  - ◆ Earthquake
- Design bases for important components and systems

# Reactor (IAEA A.5)

- Reactor characteristics
- Core physical design and analyses
- Tank or pool design
- Biological shield
- Nuclear design
  - ◆ Normal operating configurations
  - ◆ Core physics parameters
  - ◆ Operating limits
- Thermal-Hydraulic design

# Reactor Coolant Systems (IAEA A.6)

- Summary description
- Primary coolant system functional requirements and design bases
- Secondary coolant system (if any)
- Primary coolant cleanup system
- Makeup water system
- Nitrogen-16 control (delay) system
- Auxiliary systems using primary coolant

# Engineered Safety Features (IAEA A.7)

- For some research reactors, no engineered safety systems may be required to mitigate consequences of accidents
- Confinement and HVAC systems required to change configuration in the event of an accident
- Containment
- Emergency core cooling system

# Instrumentation & Control Systems (IAEA A.8)

- Summary description
- Design bases and standards
- Reactor control system
- Reactor protection system
- ESF actuation systems
- Control console
- Radiation monitoring systems

# Electrical Power Systems (IAEA A.9)

- Normal power systems
- Emergency power systems (generators, batteries)
  - ◆ radiation monitors and recorders
  - ◆ lighting, communication
  - ◆ reactor shutdown monitors and recorders
  - ◆ placing experiments in safe condition

# Auxiliary Systems (IAEA A.10)

- Heating, ventilation, air conditioning
- Handling and storage of fuel
- Fire protection systems and programs
- Communication systems
- Control of byproduct material
- Other auxiliary systems (cover gas control)

# Experimental Facilities and Utilization (IAEA A.11)

- Principal features and purposes of facilities
  - ◆ in-core facilities
  - ◆ in-reflector facilities
  - ◆ automatic transfer
  - ◆ beam ports
  - ◆ thermal columns
  - ◆ irradiation rooms
  - ◆ cold neutron source

# Experimental Facilities and Utilization -2 (IAEA A.11)

- Detailed analysis of each facility
  - ◆ potential core interactions
  - ◆ integrity of facility
  - ◆ radiological considerations
  - ◆ safety instrumentation
  - ◆ analyses of any cryogenic materials

# Experimental Facilities and Utilization - 3 (IAEA A.11)

- Experiment review
  - ◆ administrative experiment approval procedures (classification, approval authority)
  - ◆ experiment review committee role
  - ◆ experiment parameters to be incorporated in technical specifications (most serious potential facility accident could be an experiment malfunction)

# Radiation Protection Program and Waste Management (IAEA A.12)

- Methods for quantitative assessment of doses
- Assess exposures for the full range of operations
- Describe radiation protection program, including ALARA
- Describe radiation sources
- Radiation monitoring and surveying

# Radiation Protection Program and Waste Management - 2 (IAEA A.12)

- Radiation dosimetry and exposure control
- Contamination control
- Environmental monitoring
- Radioactive waste management program
- Effluent release points and controls

# Conduct of Operations (IAEA A.13)

- Organization (responsibility, staffing, personnel selection and training)
- Review and audit oversight
  - ◆ committee composition and qualifications
  - ◆ review and audit functions
  - ◆ charter and rules
- Use of procedures, required actions

# Conduct of Operations -2 (IAEA A.13)

- Routine and special reports to the regulatory body
- Records
- Emergency preparedness (IAEA A.20)
  - ◆ event classifications (only classes of events that could occur at the facility)
- Security
- Quality assurance (IAEA A.18)

# Conduct of Operations - 3 (IAEA A.13)

- Operator training and requalification (detailed guidance provided in Section 12.10)
- Commissioning plan (IAEA A.15)
- Environmental reports (IAEA A.14)

# Accident Analyses (IAEA A.16)

- Accidents with significant radiological consequences
- Accidents categorized and grouped
- Quantitatively analyze limiting cases in each group and compare to acceptance criteria

# Accident Analyses - 2 (IAEA A.16)

- Maximum hypothetical accident
  - ◆ fraction of fuel melts
  - ◆ fueled experiment melts
- Insertion of excess reactivity
- Loss of coolant
- Loss of flow
- Mishandling or malfunction of fuel
- Experiment malfunction

# Technical Specifications (IAEA A.17)

- TS are a separate document that reflect the results of analyses in the Safety Analysis Report
- U.S. practice: TS are proposed by the operating organization, but adopted by the NRC
- TS become part of the license to operate the facility
- Detailed guidance: Appendix 14.1

# Other SAR Sections in U.S. Guidance

- Financial qualifications
- Other considerations (medical use)
- Decommissioning (IAEA A.19) and possession-only license amendments
- High-enriched to low-enriched uranium conversions