International Guidelines for Nuclear Safety • Operations • Third-Party Liability at Nuclear Power Plants

PUBLISHED ON BEHALF OF THE NUCLEAR POOLS' FORUM

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Introductory Note

These Guidelines have been developed by a working group representing nuclear insurers. Due to the importance of achieving and maintaining the highest possible level of nuclear safety for insurance purposes at Nuclear Power Stations, they have been approved by the following members of the Nuclear Pools' Forum:

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Introduction

The International Nuclear Insurance Pools have developed a series of International Engineering Inspection Guidelines to achieve quality risk surveys and to inform our insured about nuclear insurers' expectations. This latest set of Guidelines addresses Nuclear Safety, Operations and Third-Party Liability topics that the Pools have traditionally incorporated in insurance inspections where third-party liability insurance is in place.

For efficient reference, each section of these Guidelines addresses Strategic Issues, backed by References to international standards and insurance-specific criteria. This approach was taken in order to achieve consistent high quality insurance inspections (surveys) without repeating the large body of work that is presently contained in current standards and criteria. In some cases, however, specific insurance interests that are extra-regulatory in nature are discussed in expanded Strategic Issues sections.

Disclaimers of Liability

The members of the Nuclear Pools' Forum make no claims, promises, guarantees or warrantees as to the accuracy, completeness or adequacy of any information published in the ***International Guidelines for Nuclear Safety • Operations • Third-Party Liability at Nuclear Power Plants.***

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Cover Photograph: Qinshan III Nuclear Power Plant, courtesy of China Nuclear Insurance Pool and Third Qinshan Nuclear Power Co. Ltd.

Section I — Nuclear Safety

Objective: The objective of Section I is to assess the quality of barriers that are designed to reduce the risks, to workers and third parties, from the nuclear hazard during both operations and accident conditions.

1.1 Barriers

1.1.1 Fuel Performance

The strategic issues to be addressed are:

- Fuel Assemblies Usage and Lead Test Assemblies
- Enrichments and Burn-Up Rates
- On-Line Leakage Monitoring
- Fuel Leakage History
- Fuel leakage Causes and Corrective Actions
- Fuel Performance Anomalies and Corrective Actions
- Fuel inspections for New Fuel and at Refueling Outages
- Chemistry Performance
- Formal Decision Protocol and Procedures Concerning Response to Fuel Failures

References:

1. *Analysis of Differences in Fuel Safety Criteria for WWER and Western PWR Nuclear Power Plants*; IAEA TECDOC Series No. 1381
2. *Design of the Reactor Core for Nuclear Power Plants Safety Guide*; IAEA Safety Standards Series No. NS-G-1.12
3. Appendix A to *10CFR Part 50--General Design Criteria for Nuclear Power Plants*
4. *Basic Safety Principals for Nuclear Power Plants*; 75-NSAG-3 Rev. 1
5. *WENRA Reactor Safety Levels*, January 2008

1.1.2 Leak Tightness

The strategic issues to be addressed are:

- Leak Detection Technology Applied
- Monitoring of Thermal Ageing
- Monitoring and Evaluation of Reactor Vessel Fracture Toughness
- Materials Issues (i.e. Alloy 600)
- Primary System Leakage History and Trends
- Technologies Applied to the Monitoring of Primary System leakage
- Action Thresholds such as Technical Specifications and Administrative Limits
- Non-Destructive Examination and Physical Plant Inspections

References:

1. Appendix A to *10 CFR Part 50--General Design Criteria for Nuclear Power Plants*
2. *Assessment and Management of Ageing of Major Nuclear power Plant Components Important to Safety Primary Piping in PWRs*; IAEA TECDOC Series No. 1361
3. *Basic Safety Principals for Nuclear Power Plants*; 75-NSAG-3 Rev. 1
4. *WENRA Reactor Safety Levels*, January 2008

1.1.3 Containment Integrity

The strategic issues to be addressed are:

- Containment Integrated Leakage Rate Testing (ILRT) and Local Leak Rate Testing (LLRT) Results and Trends
- Structural Integrity Test Results
- ILRT and LLRT Frequency
- Containment Stress and Tension Monitoring
- Containment Material Condition (i.e. corrosion)
- Corrective Actions
- Distribution of LLRT Results
- Action Thresholds such as Technical Specifications and Administrative Limits

References:

1 *Basic Safety Principals for Nuclear Power Plants*; 75-NSAG-3 Rev. 1

2 Appendix A to *10 CFR Part 50--General Design Criteria for Nuclear Power Plants*

3 *Assessment and Management of Aging of Major Nuclear Power Plant Components Important to Safety: Metal Components of BWR Containment Systems*; IAEA TECDOC Series No. 1181

4 *Performance-Based Containment Leak-Test Program*; US NRC Regulatory Guide 1.163

5 *WENRA Reactor Safety Levels*, January 2008

1.2 Safety Concept and Accident Mitigation

1.2.1 Probabilistic Safety Assessment (PSA)

The strategic issues to be addressed are:

- Scope of PSA Analysis; Operating Reactor; Shutdown Reactor
- Range of Initiating Events Included in the Analysis (internal events, external events, fire initiating events)
- PSA Core Damage Frequency (CDF) and Large Early Release Frequency (LERF) Values
- Cut Set(s) for Most Limiting CDF and LERF Scenarios
- Ranking of Accident Scenarios and System Influences
- Top Operator Actions
- Development of Level I and Level II PSA
- Plant Operational CDF Profile
- PSA Usage (safety monitor, prioritize modifications, work control, etc.)
- Administrative Approval Protocol for CDF Values (Plant Configuration Changes and PSA Thresholds)
- Safety Improvements Suggested by PSA
- Quality Assurance and Validation
- PSA and Plant Configuration Control

References:

1 *WENRA Reactor Safety Levels*, January 2008

1.2.2 Core Protection

The strategic issues to be addressed are:

- Core Protection Strategies
- Power Supplies
- Design Margins
- Design Basis
- Safety System Availability and Key Performance Indicators
- Simulator Capability
- Brittle Fracture Considerations

References:

1 *WENRA Reactor Safety Levels*, January 2008

1.2.3 Fire Protection

The strategic issues to be addressed are:

- The Fire Protection Program
- The Fire Hazards Analysis
- Fire Safe Shutdown
- Fire PSA
- Separation of redundant systems important for the safe shutdown particularly main and emergency control rooms
- Availability of Fire Protection for Critical Plant Areas and Functions as Identified in the fire PSA, Fire Safe Shutdown Analysis and Core Protection Assessments
- Manual fire fighting, training and drills
- Monitoring of Fire Protection Program performance
- Exceptions and Waivers

References:

1 *International Guidelines for the Fire Protection of Nuclear Power Plants*, 4th. edition 2006

2 *Protection against Internal Fires and Explosions in the Design of Nuclear Power Plants*, IAEA Safety Standards Series No. NS-G-1.7, IAEA, Vienna (2004).

1.2.4 Fire Safe Shutdown

The strategic issues to be addressed are:

- Availability of Alternate Shutdown Controls (i.e. Emergency Control Room)
- Operator Manual Actions
- Training and Drills
- Exceptions and Waivers

References:

1 *WENRA Reactor Safety Levels*, January 2008

1.2.5 Beyond Design Basis Considerations

The strategic issues to be addressed are:

- Development of Protection Strategies and Procedures
- Simulator Capabilities
- Training and Drills

References:

1 *WENRA Reactor Safety Levels*, January 2008

1.2.6 Performance Indicators

The strategic issues to be addressed are:

- Development of Performance Indicators for Physical Equipment and Program Performance (WANO and Internal)
- Oversight and Accountability
- System Health Assessments

References:

1 *WENRA Reactor Safety Levels*, January 2008

1.3 Oversight and Corrective Actions

1.3.1 Quality Assurance

The strategic issues to be addressed are:

- Organizational Structure, Accountability and Independence
- Conduct of Audits
- Organizational Responsiveness to QA
- Communications to Senior Management

References:

1 *WENRA Reactor Safety Levels*, January 2008

1.3.2 Self Assessment

The strategic issues to be addressed are:

- Self Assessment Program Established
- Program Ownership and Accountability

References:

1 *WENRA Reactor Safety Levels*, January 2008

1.3.3 Corrective Actions

The strategic issues to be addressed are:

- Data Capture and Analysis of Events, Including Near Misses
- Corrective Action Program Established to Identify, Evaluate, and Achieve Corrective Actions
- Documentation
- Ownership and Accountability
- Determination of Root Causes

References:

1 *WENRA Reactor Safety Levels*, January 2008

1.3.4 Third Party Assessments

The strategic issues to be addressed are:

- Results of Evaluations Conducted by WANO, Regulatory Authorities, IAEA, etc.
- Site Corrective Actions
- Repeat Conditions
- Third Party Performance Indicators

References:

1 *WENRA Reactor Safety Levels*, January 2008

Section II — Operations

Objective: The objective of Section II is to assess the quality of programs and management systems that are important to favorable plant performance and minimizing risks.

2.1 Organization, Administration and Staffing

2.1.1 Safety Culture

The strategic issues to be addressed are:

- Formalized Safety Culture Policies
- Evidence of Safety Culture as a Priority
- Open Reporting Culture
- Material Support for Safety Culture Initiatives

References:

1 *WENRA Reactor Safety Levels*, January 2008

2.1.2 Human Performance

The strategic issues to be addressed are:

- Error Prevention Training
- Implementation of Human Performance Tools
- Supervisor Field Time and Coaching Feedback
- Integration of Human Performance Improvement and Corrective Action Program

References:

1 *WENRA Reactor Safety Levels*, January 2008

2.2 Programs and Functional Areas

2.2.1 Shift Operations

The strategic issues to be addressed are:

- Performance Metrics
- Conduct of Operations
- Staffing and Qualifications
- Training Programs, Including Simulator Training and Emergency Exercises
- Communication, Including Shift Handover Protocol

References:

1 *WENRA Reactor Safety Levels*, January 2008

2.2.2 Radioactive Waste

The strategic issues to be addressed are:

- Storage Facilities
- Arrangements for Receipt, Assay, Sorting, Volume Reduction and Packaging of Waste
- Performance Metrics
- Material Condition
- ALARA Implementation

References:

1 *WENRA Reactor Safety Levels*, January 2008

2.2.3 Work Management

The strategic issues to be addressed are:

- Performance Metrics
- Schedule Performance and Backlogs
- Deferred Work and Modifications
- Coordination with Safety Priorities (PSA)

References:

1 *WENRA Reactor Safety Levels*, January 2008

2.2.4 Training

The strategic issues to be addressed are:

- Identification of Job Training Needs
- Performance Metrics
- Schedule Adherence
- Facilities
- Training Records
- Visitor Briefings

References:

1 *WENRA Reactor Safety Levels*, January 2008

2.2.5 Records Management

The strategic issues to be addressed are:

- Formalized Retention Program
- Facilities and Technology (including data-migration management)

No References

2.2.6 Security

The strategic issues to be addressed are:

- Physical Barriers
- Supervision of Barriers
- Control of Personnel, Visitors and Contractors
- Control of Goods Into and Out from the Plant
- Entrance and Exit Control of Persons
- Security Screening of Persons
- Data Security
- Guards and Watchmen Service
- Supervision and Maintenance of Security Systems
- Support from Authorities
- Security during Outages
- Exceptions and Waivers

References:

1 *The Physical Protection of Nuclear Material and Nuclear Facilities*, INFCIRC/225/Rev.4, IAEA

2 *Engineering Safety Aspects of the Protection of Nuclear Power Plants against Sabotage*, IAEA Nuclear Security Series No. 4

2.3 Physical Plant

2.3.1 Material Condition

The strategic issues to be addressed are:

- Facility Tour Observations
- Housekeeping
- Leaks
- Labeling
- Equipment Deficiencies

No References

2.3.2 Modernization

The strategic issues to be addressed are:

- Life Cycle Management Plan
- Modernization Schedule
- Alignment with PSA, IAEA

References:

1 *WENRA Reactor Safety Levels*, January 2008

2.3.3 Foreign Material Exclusion (FME)

The strategic issues to be addressed are:

- Formal Policies and Procedures
- Accountability and Ownership

References:

1 *WENRA Reactor Safety Levels*, January 2008

2.4 Operating Performance

2.4.1 Performance Indicators

The strategic issues to be addressed are:

- WANO and Internal Indicators
- Corrective Actions Applied to Unfavorable Performance Indicators or Trends
- Goals

No References

2.4.2 INES

The strategic issues to be addressed are:

- INES Events
- Corrective Actions

No References

2.4.3 Operating Experience (OPEX)

The strategic issues to be addressed are:

- Formalized Program to Collect, Analyze and Communicate Internal and External Operational Experience
- OPEX Program Linked to the Corrective Actions Program to Formally Disposition-Applicable OPEX Issues
- OPEX Program Linked to the Safety Review Process
- OPEX Program Broad Scope
- Participation in Owner's Groups; Industry Benchmarking, etc.

References:

1 *WENRA Reactor Safety Levels*, January 2008

2.5 Periodic Surveillance Testing

The strategic issues to be addressed are:

- Organization and Responsibilities
- Scope of Periodic Surveillance Testing
- Implementing Procedures
- Scheduling
- Control of Testing
- Test Equipment Control
- Records Management
- Corrective Action
- Data Analysis

References:

1 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 7.0 Revision 2; Operational Surveillance Testing

2 *WENRA Reactor Safety Levels*, January 2008

Section III — Third Party Liability

Objective: The objective of Section III is to assess the quality of selected activities and programs that have demonstrated importance to Third Party Liability (TPL) risks.

3.1 Emergency Preparedness

3.1.1 Emergency Preparedness Facilities

The strategic issues to be addressed are:

- Short and Long-term Emergency Response Command Centers (i.e., Technical Support Center -- TSC and Emergency Operations Facility -- EOF)
- Design and Material Condition of Emergency Response Facilities
- Fire and Rescue Facilities and Tactical Damage Mitigation Facilities
- Public Notification (e.g. sirens)

References:

1 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 6.0 Revision 1; Emergency Planning

3.1.2 Drills

The strategic issues to be addressed are:

- Drill Schedules
- Involvement of Outside Organizations
- Periodic Proficiency Training for Individuals and Groups
- Drill Scenarios Should Include Main Control Room Evacuation and Use of Emergency Shutdown Facilities
- Post-Drill Critiques and Corrective Actions

References:

1 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 6.0 Revision 1; Emergency Planning

3.1.3 Emergency Plan

The strategic issues to be addressed are:

- Notification to Nuclear Insurers
- Basis Established from National Law and Regulation
- Clear Definition of Authorities and Responsibilities
- Organizational Interfaces
- Clear Decision Points and Criteria Necessary to Support a Graded Approach to the Emergency Response
- Establishment of a Formal Emergency Response Organization (ERO) Team and Backup Team
- Formal ERO Activation Protocol
- Formal Training and Periodic Proficiency Drills for Emergency Plan Sub-sections

References:

1 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 6.0 Revision 1; Emergency Planning

3.2 Radiological Environmental Monitoring

3.2.1 Plant Isotopes

The strategic issues to be addressed are:

- Determine the Presence of Radiological Isotopes Resulting from Plant Operations That Have Been Identified in the Environment Greater Than the Lower Level of Detection (LLD)
- Critical Dose Pathway (considering release pathway, isotope, environmental pathway, receptor and organ)

References:

1 *ANI/MAELU Engineering Bulletin 96-01*; Environmental Risk Guideline

2 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 5.2 Revision 2; Radiological Environmental Monitoring

3.2.2 Dose Model

The strategic issues to be addressed are:

- An Environmental-based Dose Model Should Be Developed to Assure Public Dose Is Maintained within Legal Limits (The dose model should be periodically reviewed and updated.)

References:

1 *ANI/MAELU Engineering Bulletin 96-01*, Environmental Risk Guideline

2 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 5.2 Revision 2; Radiological Environmental Monitoring

3.2.3 Performance

The strategic issues to be addressed are:

- Environmental Monitoring Results Should Be Trended and Compared against Pre-Operational Values
- A System of Performance Indicators Should Be Established. These Should Include: Sample Collection, Equipment Operability and Program Certification.

References:

1 *ANI/MAELU Engineering Bulletin 96-01*; Environmental Risk Guideline

2 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 5.2 Revision 2; Radiological Environmental Monitoring

3.2.4 Program Verification

The strategic issues to be addressed are:

- The Environmental Monitoring Program Should Be Independently Certified
- Quality Assurance Program
- Periodic Independent Third-Party Verification of Laboratory Results

References:

1 *ANI/MAELU Engineering Bulletin 96-01*; Environmental Risk Guideline

2 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 5.2 Revision 2; Radiological Environmental Monitoring

3.2.5 Site Groundwater Monitoring

The strategic issues to be addressed are:

- Current Hydrology Study
- Representative Sample Wells
- Corrective Actions to Address Identified Active Leakage
- Remediation as Appropriate

References:

1 *ANI Nuclear Liability Insurance Guideline 07-01*; Potential for Unmonitored and Unplanned Off-Site Releases of Radioactive Material

2 *ANI/MAELU Engineering Bulletin 96-01*; Environmental Risk Guideline

3.3 Radiological Effluent Monitoring

3.3.1 Performance Indicators

The strategic issues to be addressed are:

- Radiological Effluent Releases Should Be Trended
- Corrective Actions Should Be Taken in Response to Adverse Trends or Abnormal Isotopic Indication
- Response to Failure or Unavailability of Monitoring Equipment
- Programmatic Indicators Should be Developed for the Effluent Treatment Plant's Design, Condition, and Construction Materials and Techniques

References:

1 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 5.1 Revision 3; Effluent Monitoring

2 *ANI/MAELU Engineering Bulletin 96-01*; Environmental Risk Guideline

3.3.2 Effluent Controls

The strategic issues to be addressed are:

- All Release Points Accounted For
- All Release Points Monitored or Modeled
- A Formal Protocol for the Authorization and Conduct of Radiological Effluent Releases
- Operability and Availability of Monitoring Systems
- Timely Corrective Actions if Monitoring Systems Out of Service
- ALARA Principles Should Be Applied to Radiological Effluent Release Processes
- Dose Estimates Should Be Calculated Prior to Initiating Radiological Effluent Releases
- All Plant Radiological Effluent Release Points Should Be Monitored. Miscellaneous Release Points Should Be Modeled, or Bounded by Calculation.
- Potential Cross-Contamination between Contaminated and Non-Contaminated Systems Should Be Monitored

References:

3 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 5.1 Revision 3; Effluent Monitoring

4 *ANI/MAELU Engineering Bulletin 96-01*; Environmental Risk Guideline

3.3.3 Unplanned and Unmonitored Releases

The strategic issues to be addressed are:

- All Unplanned and Unmonitored Releases Should Be Investigated and the Appropriate Corrective Actions Taken
- Dose Estimates Should Be Developed for All Such Releases, Including Effluent Treatment Plant Leakage

References:

1 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 5.1 Revision 3; Effluent Monitoring

2 *ANI/MAELU Engineering Bulletin 96-01*; Environmental Risk Guideline

3.4 Radiological Protection

3.4.1 Dose Management

The strategic issues to be addressed are:

- Internal and External Dosimetry
- Measures Should Be Taken to Maintain Personnel Doses ALARA (As Low As Reasonably Achievable)
- All Dose Anomalies Should Be Investigated
- Work Management in Radiological Areas
- Signposting

References:

1 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 8.3 Revision 4; Radiation Protection – ALARA (As Low As Reasonably Achievable)

2 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 8.4 Revision 5; Radiation Protection - External Dosimetry

3 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 8.5 Revision 4; Radiation Protection – Bioasay

4 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 8.6 Revision 4; Radiation Protection - Respiratory Protection

5 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 8.9 Revision 4; Radiation Protection – Radiation Work Permits

3.4.2 Radioactive Material Controls

The strategic issues to be addressed are:

- Plant Contaminated Spaces Should Be Minimized
- Contaminated Materials Should Be Segregated
- Plant Access and Egress for Both Personnel and Materials Should Be Monitored

References:

1 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 8.7 Revision 4; Radiation Protection - Contamination Control

3.4.3 Radiological Programs

The strategic issues to be addressed are:

- Organization, Qualifications and Responsibilities
- Policies and Procedures
- Radiological Surveillance
- Data Analysis

References:

1 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 8.1 Revision 4; Radiation Protection - Organization, Qualifications and Responsibilities

2 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 8.2 Revision 5; Radiation Protection - Policies and Procedures

3 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 8.8 Revision 3; Radiation Protection – Radiological Surveillance

4 *ANI Engineering Inspection Criteria for Nuclear Liability Insurance*; Section 8.10 Revision 3; Radiation Protection – Data Analysis

3.5 Legal and Licensing

3.5.1 Legal Basis

The strategic issues to be addressed are:

- National Law, Legislative Acts, Administrative Decrees, etc., Which Form the Legal Basis for Operation of the NPP
- Formation of the NPP License Including Technical Operational Conditions (I.E. technical specifications)
- Other Legal Requirements such as Environmental and Industrial Legal Obligations
- Recognition of International Treaties

No References

3.5.2 Regulatory

The strategic issues to be addressed are:

- Description of the Main Nuclear Regulatory Authority
- Independence of the Nuclear Regulatory Authority
- Peer Review of the Regulatory Process (e.g. WENRA)
- Regulatory Inspections and Enforcement Actions
- Regulatory Activity by Other Bodies Such As Environmental and Industrial Authorities

No References

3.5.3 License Conditions

The strategic issues to be addressed are:

- Term of NPP License
- Periodic Regulatory Reviews
- License Restrictions and Conditions
- NPP's Licensed Commitments
- Reportable Events and Improvement Notices

No References

3.5.4 Claims

The strategic issues to be addressed are:

- Claims Activity
- Occurrence of Events That May Be Claim-related
- Legal Environment

No References

3.6 Local Environment

3.6.1 Natural Phenomena

The strategic issues to be addressed are:

- Risk Related to Natural Phenomena (i.e., earthquake, flood, tsunami, tornado, typhoon, etc.)
- Historical Occurrences
- Plant Design Basis with Respect to External Event Phenomena

No References

3.6.2 Ultimate Heatsink

The strategic issues to be addressed are:

- NPP Cooling Source (ocean, lake, river)
- Risks Related to Interruption of NPP Cooling Source
- Backup Cooling Sources (fire reservoirs, emergency core-cooling reservoirs, wells)

No References

3.6.3 Population Centers

The strategic issues to be addressed are:

- Proximity and Size of Population Centers to NPP
- Proximity of Public Drinking Water Sources to NPP

No References

3.6.4 High-Value Off-Site Property

The strategic issues to be addressed are:

- Proximity of High-Value Off-Site Property to NPP
- Hazards Presented by Off-Site Property

No References