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Revision A**

**Compliance Assessment of the AP1000® Plant to IAEA Safety Standards No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards**

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**TABLE OF CONTENTS**

LIST OF ACRONYMS AND ABBREVIATIONS [vii](#_heading=h.qrxm9fu4ijxy)

EXECUTIVE SUMMARY [x](#_heading=h.bmqmi78wpmah)

1 Introduction 1-1

1.1 Overview and purpose of document 1-1

1.1.1 Introduction to IAEA safety standards and related publications [1-1](#_heading=h.losf7h6d7p73)

1.1.2 IAEA Document Compliance Assessment Scope for this document [1-2](#_heading=h.s1ys3h1nw5jq)

1.1.3 Other AP1000 Plant Compliance Assessments to IAEA Documentation [1-2](#_heading=h.drkf4klctroo)

1.1.4 Structure of this document for compliance assessments [1-2](#_heading=h.w877pxf9tgb5)

1.2 Basis for compliance assessment 1-3

1.3 Ap1000 plant description 1-3

1.3.1 Overview [1-3](#_heading=h.q1a14v1l9ez3)

1.3.2 Facility Design Features for radiation protection [1-4](#_heading=h.uol52986bnfj)

1.3.3 Shielding from radiation effects [1-4](#_heading=h.m4t3z7v2mpi)

1.3.4 Ventilation [1-5](#_heading=h.wyc9jjeniq2z)

1.4 Discussion of Radiation Protection and Safety of Radiation Sources: International Basic Safety Standard in AP1000 Standard Design and Reference Plant 1-6

1.5 Compliance Assessment Summary of Results 1-8

1.6 Conclusions 1-16

1.7 Identified Potential Risks To Be Addressed 1-2

2 Compliance assessment for IAEA Safety Reference levels 2-1

2.1 Compliance assessment Classification Label 2-1

2.2 General Requirements for Protection and safety 2-2

2.2.1 Requirement 1: Application of the principles of radiation protection [2-2](#_heading=h.p8pxjzmknz1o)

2.2.2 Requirement 2: Establishment Of A Legal And Regulatory Framework [2-5](#_heading=h.oxnyvlbadbbf)

2.2.3 Requirement 3: Responsibilities of the regulatory body [2-10](#_heading=h.aeap6lhvy2ku)

2.2.4 Requirement 4: Responsibilities for protection and safety [2-13](#_heading=h.6fhaf2w4u79x)

2.2.5 Requirement 5: Management for protection and safety [2-16](#_heading=h.xw7y2ri6khwu)

2.3 Planned exposure situations 2-19

2.3.1 Requirement 6: Graded approach [2-22](#_heading=h.yjd01t9nm92z)

2.3.2 Requirement 7: Notification and authorization [2-24](#_heading=h.xeiuduhfth03)

2.3.3 Requirement 8: Exemption and clearance [2-26](#_heading=h.ifyom1uvxkdb)

2.3.4 Requirement 9: Responsibilities of registrants and licensees in planned exposure situations [2-27](#_heading=h.wmdd3e4zj4iy)

2.3.5 Requirement 10: Justification of practices [2-29](#_heading=h.q2f2zcv69imb)

2.3.6 Requirement 11: Optimization of protection and safety [2-31](#_heading=h.b20j7ycvbdtg)

2.3.7 Requirement 12: Dose limits [2-33](#_heading=h.d9y7dsw50epx)

2.3.8 Requirement 13: Safety assessment [2-35](#_heading=h.5fhkl790c68q)

2.3.9 Requirement 14: Monitoring for verification of compliance [2-40](#_heading=h.mwif1qw37s1s)

2.3.10 Requirement 15: Prevention and mitigation of accidents [2-43](#_heading=h.1gbfjww0ueh2)

2.3.11 Requirement 16: Investigations and feedback of information on operating experience [2-49](#_heading=h.vsziybej9mw9)

2.3.12 Requirement 17: Radiation generators and radioactive sources [2-51](#_heading=h.flyv9efmgke7)

2.3.13 Requirement 18: Human imaging using radiation for purposes other than medical diagnosis, medical treatment or biomedical research [2-55](#_heading=h.5iwvfggmprvl)

2.3.14 Requirement 19: Responsibilities of the regulatory body specific to occupational exposure [2-59](#_heading=h.fxyz3lte5p6v)

2.3.15 Requirement 20: Requirements for monitoring and recording of occupational exposures [2-60](#_heading=h.wpp340qrs17g)

2.3.16 Requirement 21: Responsibilities of employers, registrants and licensees for the protection of workers [2-61](#_heading=h.f3xrgb31cxo2)

2.3.17 Requirement 22: Compliance by workers [2-65](#_heading=h.42yiilh5yil2)

2.3.18 Requirement 23: Cooperation between employers and registrants and   
licensees [2-66](#_heading=h.112tbtugbkwi)

2.3.19 Requirement 24: Arrangements under the radiation protection   
programme [2-67](#_heading=h.64klplhrlt6m)

2.3.20 Requirement 25: Assessment of occupational exposure and workers’ health surveillance [2-75](#_heading=h.d8yfm1h3br6w)

2.3.21 Requirement 26: Information, instruction and training [2-79](#_heading=h.mdzcvo548qwm)

2.3.22 Requirement 27: Conditions of service [2-80](#_heading=h.xzfxq68j9kxs)

2.3.23 Requirement 28: Special arrangements for protection and safety for female workers and for persons under 18 years of age undergoing training [2-81](#_heading=h.f5tj6sf85q6e)

2.3.24 Requirement 29: Responsibilities of the government and the regulatory body specific to public exposure [2-83](#_heading=h.yirweyrltq9t)

2.3.25 Requirement 30: Responsibilities of relevant parties specific to public   
exposure [2-86](#_heading=h.cxxqfb7c0nmw)

2.3.26 Requirement 31: Radioactive waste and discharges [2-92](#_heading=h.te24cixfyt6o)

2.3.27 Requirement 32: Monitoring and reporting [2-95](#_heading=h.wvxqwhp94fsw)

2.3.28 Requirement 33: Consumer products [2-98](#_heading=h.i5u8bta2o9x1)

2.3.29 Requirement 34: Responsibilities of the government specific to medical   
exposure [2-101](#_heading=h.lcmwbcl75on8)

2.3.30 Requirement 35: Responsibilities of the regulatory body specific to medical exposure [2-103](#_heading=h.2n2jaxw223q)

2.3.31 Requirement 36: Responsibilities of registrants and licensees specific to medical exposure [2-104](#_heading=h.t6mzsxws6zi6)

2.3.32 Requirement 37: Justification of medical exposures [2-107](#_heading=h.yrxmw0qs9np4)

2.3.33 Requirement 38: Optimization of protection and safety [2-110](#_heading=h.2tvo9ri2wue4)

2.3.34 Requirement 39: Pregnant or breast-feeding female patients [2-116](#_heading=h.qht7iommp66h)

2.3.35 Requirement 40: Release of patients after radionuclide therapy [2-118](#_heading=h.ue4jbz13way)

2.3.36 Requirement 41: Unintended and accidental medical exposures [2-119](#_heading=h.vdye9rpvh0go)

2.3.37 Requirement 42: Reviews and records [2-121](#_heading=h.l8mewuppc40y)

2.4 Emergency exposure situations 2-124

2.4.1 Requirement 43: Emergency management system [2-124](#_heading=h.wxx44wd7p3rt)

2.4.2 Requirement 44: Preparedness and response for an emergency [2-126](#_heading=h.5rvogskqyueo)

2.4.3 Requirement 45: Arrangements for controlling the exposure of emergency workers [2-131](#_heading=h.b0folzxewmmq)

2.4.4 Requirement 46: Arrangements for the transition from an emergency exposure situation to an existing exposure situation [2-133](#_heading=h.rbbhzhs24i9d)

2.5 Existing exposure situations 2-134

2.5.1 Requirement 47: Responsibilities of the government specific to existing exposure situations [2-136](#_heading=h.efjjwzxkuu9l)

2.5.2 Requirement 48: Justification for protective actions and optimization of protection and safety [2-138](#_heading=h.665ieemod718)

2.5.3 Requirement 49: Responsibilities for remediation of areas with residual radioactive material [2-139](#_heading=h.deut2wqf7pt0)

2.5.4 Requirement 50: Public exposure due to radon indoors [2-145](#_heading=h.v1x8x8o3bdwp)

2.5.5 Requirement 51: Exposure due to radionuclides in commodities [2-147](#_heading=h.2zr5eolcbdab)

2.5.6 Requirement 52: Exposure in workplaces [2-148](#_heading=h.vfguqsmv7gs9)

3 References 3-1

**LIST OF ACRONYMS AND ABBREVIATIONS**

| AC | Alternating current |
| --- | --- |
| ADS | Automatic Depressurization System |
| ALARA | As Low As Reasonably Achievable |
| ALWR | Advanced Light Water Reactor |
| ANSI | American National Standards Institute |
| AOO | Anticipated Operational Occurrence |
| AOP | Abnormal Operating Procedure |
| ASME | American Society of Mechanical Engineers |
| ATWS | Anticipated Transients Without Scram |
| CAV | Cumulative Absolute Velocity |
| CCS | Component Cooling Water System |
| CDF | Core Damage Frequency |
| CFR | Code of Federal Regulations |
| CMT | Core Makeup Tank |
| CNS | Containment System |
| COM | Compliance |
| CVS | Chemical and Volume Control System |
| CWO | Compliance with Objective |
| DAS | Diverse Actuation System |
| DBA | Design Basis Accident |
| DBE | Design Basis Event |
| DC | Direct Current |
| DCD | Design Control Document |
| DDS | Data Display and Processing System |
| DEC | Design Extension Condition |
| DiD | Defense-in-Depth |
| DNB | Departure from Nucleate Boiling |
| DOS | Standby Diesel Fuel Oil System |
| D-RAP | Design Reliability Assurance Program |
| EAB | Exclusion Area Boundary |
| ECS | Non-Class 1E Main AC Power System |
| EDS | Non-Class 1E and UPS Power System |
| EOF | Emergency Operations Facility |
| EP | External party |
| EPRI | Electric Power Research Institute |
| EUR | European Utility Requirements |
| EURATOM | European Atomic Energy Community |
| FEED | Front-End Engineering and Desing |
| FWS | Main and Startup Feedwater System |
| GDA | Generic Design Assessment |
| GDC | General Design Criterion |
| HCLPF | High-Confidence, Low Probability of Failure |
| HSI | Human-System Interface |
| HVAC | Heating, Ventilating and Air Conditioning |
| HX | Heat Exchanger |
| I&C | Instrumentation and Control |
| IAEA | International Atomic Energy Agency |
| IDS | Class 1E DC and UPS Power System |
| IEEE | Institute of Electrical and Electronics Engineers |
| INPO | Institute of Nuclear Power Operations |
| IRWST | In-Containment Refueling Water Storage Tank |
| IVR | In-Vessel Retention |
| LOCA | Loss-of-Coolant Accident |
| LRF | Large Release Frequency |
| LPZ | Low Population Zone |
| MC | Metal Containment |
| MCR | Main Control Room |
| MSS | Main Steam System |
| NAN | Not Assessable Now |
| NAP | Not Applicable |
| NEI | Nuclear Energy Institute |
| NOC | Non-Compliance |
| NR | Not a requirement |
| NRC | Nuclear Regulatory Commission |
| OCS | Operations and Control Centers System |
| OR | Owner |
| PAR | Passive Autocatalytic Recombiner |
| PCCAWST | Passive Containment Cooling Ancillary Water Storage Tank |
| PCCWST | Passive Containment Cooling Water Storage Tank |
| PCS | Passive Containment Cooling Water System |
| PGA | Peak Ground Acceleration |
| PIE | Postulated Initiating Event |
| PLS | Plant Control System |
| PMS | Protection and Safety Monitoring System |
| POS | Project, Owner, or Site Specific |
| PRA | Probabilistic Risk Assessment |
| PRHR | Passive Residual Heat Removal |
| PSA | Probabilistic Safety Assessment |
| PWR | Pressurized Water Reactor |
| PXS | Passive Core Cooling System |
| QA | Quality Assurance |
| QMS | Quality Management System |
| R/A | Reliability/Availability |
| RCA | Radiologically Controlled Area |
| RCCA | Rod Cluster Control Assembly |
| RCP | Reactor Coolant Pump |
| RCPB | Reactor Coolant Pressure Boundary |
| RCS | Reactor Coolant System |
| RG | Regulatory Guide |
| RHWG | Reactor Harmonisation Working Group |
| RLE | Review Level Earthquake |
| RMS | Radiation Monitoring System |
| RNS | Normal Residual Heat Removal System |
| RSR | Remote Shutdown Room |
| RTNSS | Regulatory Treatment of Nonsafety-related Systems |
| SAMG | Severe Accident Management Guidelines |
| SFP | Spent Fuel Pool |
| SFS | Spent Fuel Pool Cooling System |
| SG | Steam Generator |
| SGTR | Steam Generator Tube Rupture |
| SRL | Safety Reference Level |
| SSC | Structures, Systems, and Components |
| SWS | Service Water System |
| TSC | Technical Support Center |
| UK | United Kingdom |
| URD | Utility Requirements Document |
| US | United States |
| VAS | Radiologically Controlled Area Ventilation System |
| VBS | Nuclear Island Nonradioactive Ventilation System |
| VES | Main Control Room Emergency Habitability System |
| VFS | Containment Air Filtration System |
| VLS | Containment Hydrogen Control System |
| VWS | Central Chilled Water System |
| VXS | Annex/Auxiliary Building Nonradioactive Heating and Ventilation System |
| VZS | Diesel Generator Building Heating and Ventilation System |
| WENRA | Western European Nuclear Regulators’ Association |
| ZOS | Onsite Standby Power System |

**EXECUTIVE SUMMARY**

The objective of the International Atomic Energy Agency (IAEA) Safety Standard No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards – General Safety Requirements is to provide safety requirements, instructions and guides on radiation protection and safety. All these activities result in improvement for safety in IAEA countries. Fulfilling these requirements ensure that all relevant measures for protection and safety from harmful effects of ionizing radiation has been made. These standards apply to facilities and activities that give rise to radiation risks, including nuclear installations, the use of radiation and radioactive sources, the transport of radioactive material and the management of radioactive waste. The IAEA safety standards reflect an international consensus on what constitutes a high level of safety for protecting people and the environment from harmful effects of ionizing radiation, because its effects may have global impact.

The objective of this particular publication is to establish the general safety requirements to be met during siting, design, manufacture, construction, assembly, commissioning, operation, maintenance and decommissioning.

The AP1000 plant design meets all design related IAEA GSR Part 3 with no identified non-compliances. The requirements are mostly applicable to operating facilities (including nuclear power plants) with Owner/Licensee/Government/Regulatory body responsibilities. Some of the requirements apply to medicine, aviation and aerospace which is why they are not applicable to AP1000 technology.

Table 1-1 in Section 1.4 provides a summary of the AP1000 plant compliance assessment to the IAEA Safety Standard No. GSR Part 3. The compliance categories are defined in Section 2.1. The detailed justification of compliance is provided in the identified Sections 2.2 – 2.5.

# Introduction

## Overview and purpose of document

### Introduction to IAEA safety standards and related publications

Radioactivity is a natural phenomenon and natural sources of radiation are features of the environment. Radiation and radioactive substances have many beneficial applications, ranging from power generation to uses in medicine, industry and agriculture. The radiation risks to workers and the public and to the environment that may arise from these applications have to be assessed and, if necessary, controlled. Activities such as the medical uses of radiation, the operation of nuclear installations, the production, transport and use of radioactive material, and the management of radioactive waste must therefore be subject to standards of safety. Regulating safety is a national responsibility. However, radiation risks may transcend national borders, and international cooperation serves to promote and enhance safety globally by exchanging experience and by improving capabilities to control hazards, to prevent accidents, to respond to emergencies and to mitigate any harmful consequences. States have an obligation of diligence and duty of care, and are expected to fulfil their national and international undertakings and obligations [1].

The IAEA safety standards reflect an international consensus on what constitutes a high level of safety for protecting people and the environment from harmful effects of ionizing radiation. These Standards are based on ten safety principles stated in the original document. “The fundamental safety objective is to protect people and the environment from harmful effects of ionizing radiation.” This objective must be achieved without unduly limiting the operation of facilities or the conduct of activities that give rise to radiation risks. Therefore, the system of protection and safety aims to assess, manage and control exposure to radiation so that radiation risks, including risks of health effects and risks to the environment, are reduced to the extent reasonably achievable [1].

The principal users of safety standards in IAEA Member States are regulatory bodies and other relevant national authorities. The IAEA safety standards are also used by co-sponsoring organizations and by many organizations that design, construct and operate nuclear facilities, as well as organizations involved in the use of radiation and radioactive sources. The IAEA safety standards are applicable, as relevant, throughout the entire lifetime of all facilities and activities — existing and new — utilized for peaceful purposes and to protective actions to reduce existing radiation risks. They can be used by States as a reference for their national regulations in respect of facilities and activities.

With a view to ensuring the protection of people and the environment from harmful effects of ionizing radiation, the IAEA safety standards establish fundamental safety principles, requirements and measures to control the radiation exposure of people and the release of radioactive material to the environment, to restrict the likelihood of events that might lead to a loss of control over a nuclear reactor core, nuclear chain reaction, radioactive source or any other source of radiation, and to mitigate the consequences of such events if they were to occur. The standards apply to facilities and activities that give rise to radiation risks, including nuclear installations, the use of radiation and radioactive sources, the transport of radioactive material and the management of radioactive waste. Presented IAEA standard apply to radiation protection and safety in wide range meaning of radiation risk [1].

For further information see the IAEA website <https://www.iaea.org>.

### IAEA Document Compliance Assessment Scope for this document

This document provides a compliance assessment of the AP1000 plant design to the following IAEA documents that are applicable to operating/existing plants:

* General Safety Requirements Part 3 No. GSR Part 3, *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards*, International Atomic Emergency Agency (IAEA), Vienna, 2014 [1].

### Other AP1000 Plant Compliance Assessments to IAEA Documentation

Westinghouse has also performed the following compliance assessments:

* APP-GW-GL-062, Assessment of AP1000 Compliance with IAEA GS-R-3, The Management Systems for Facilities and Activities Safety Requirements, 2006 [2],
* APP-GW-GL-067, Revision 0, Assessment of AP1000 Compliance with IAEA Safety Standard No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for Safety of Radiation Sources, 1996 [3],
* APP-GW-GL-068, Revision B, Assessment of AP1000 Compliance with IAEA Safety Standard, General Safety Requirements Part 5, Predisposal Management of Radioactive Waste [4],
* APP-GW-GL-069, Revision 0, AP1000 Comparison to IAEA Safety Standard No. GS-R-2, Preparedness and Response for a Nuclear or Radiological Emergency [5], compliance assessment to the previous revision of IAEA Safety Standard No. GSR Part 7, *Preparedness and Response for a Nuclear or Radiological Emergency – General Safety Requirements*,
* APP-GW-GL-704, Revision 1, AP1000 Plant Comparison to IAEA Safety Standard No. GSR Part 4 – Safety Assessment for Facilities and Activities [6].

Westinghouse is currently updating and/or adding to the list of AP1000 compliance assessments against IAEA standards.

### Structure of this document for compliance assessments

#### Compliance assessment introduction for *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards* – part of IAEA Safety Standards for protecting people and the environment.

General Safety Requirements Part 3, No. GSR Part 3, *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards*, provide general information about radiation and threats connected with that. It explains the need for implementing protection and safety standards, including global responsibility in this area. This document formulates requirements which shall be fulfilled for safe exploitation of radiation sources in wide range of applications. The IAEA Safety Reference reflects expected practices to be implemented in the IAEA countries and specifically focus on radiation protection and safety.

For the Safety Reference Levels [1], a line-by-line compliance assessment is performed and documented in Section 2. Section 2.1 identifies the compliance labels applied in the assessment. Section 2.2 – 2.5 contain a compliance assessment with identification of the conformity and provides a short justification using the basis for compliance assessment described in Section 1.2.

## Basis for compliance assessment

The standard AP1000 plant design is the design documented in APP-GW-GL-700, Rev. 19, “AP1000 Plant Design Control Document” [7], herein referred to the as the Design Control Document (DCD). This standard AP1000 plant design is used as the basis for the compliance assessment as it provides one consistent reference document with sufficient information to demonstrate the safety approach for the AP1000 plant design, analysis, and licensing basis in the United States (U.S), which is approved by the U.S. Nuclear Regulatory Commission (NRC).

The Reference Plant design for future AP1000 units is the Vogtle Unit 4 design. There are design and licensing updates for Vogtle Unit 4 that have occurred since the issuance of the DCD [7]. However, the DCD [7] provides documentation that supports the safety approach of the AP1000 plant design for the Reference Plant and future AP1000 plant designs for the purpose of demonstrating compliance with requirements related to overall design methodology, performance goals, safety analysis methodology and basis for future licensing documentation. The DCD [7] also provides a single reference document, available as a public, non-proprietary document, for supporting information for this compliance assessment.

A probabilistic safety assessment (PSA) consists of a systematic and comprehensive evaluation of the risks. This exercise is referred to as ‘probabilistic risk assessment’ in the U.S. regulatory context. These two names are equivalent. The design Probabilistic Risk Assessment (PRA) for the standard AP1000 plant is documented in APP-GW-GL-022 Rev. 8 [8]. The design PRA [8] provides a basis to demonstrate the PRA approach and methodology implemented in informing the standard AP1000 plant design. For the Reference Plant, there is a Vogtle Unit 3 & 4 specific PRA that has been developed implementing updates to the AP1000 plant design from the standard AP1000 plant design to the Vogtle Unit 4 design and site-specific aspects of the Vogtle 3 & 4 AP1000 units. The design PRA [8] is used in this compliance assessment to provide consistent documentation to the DCD [7] and because it adequately demonstrates the PRA methodology and PRA basis for the key design decisions in the overall AP1000 plant design.

There are some cases where the justification for compliance with the requirement is improved by reference to the latest Reference Plant documentation. When this is applicable, it is included in the compliance assessment.

## Ap1000 plant description

### Overview

The AP1000 plant is a 3400-MWth pressurized water reactor (PWR) with passive safety features and extensive plant simplifications that enhance construction, operation, maintenance, and safety. One of the key design approaches in the AP1000 plant is to use passive features to mitigate design basis accidents (DBAs). In addition to redundancy, these features incorporate diversity based on probabilistic risk assessment (PRA, also called Probabilistic Safety Assessment or PSA) insights. Active defense-in-depth (DiD) features provide investment protection, reduce the demands on the passive features and support the aggressive PRA targets.

The AP1000 plant is designed to achieve a high safety and performance record. It is conservatively based on proven PWR technology, but with an emphasis on passive safety features. Consistent with current practice, DiD systems are used as the first level of defense against more probable events. As the second level of defense, the AP1000 plant uses passive safety systems to further enhance plant safety and to satisfy utility requirements (e.g., EUR and Electric Power Research Institute [EPRI] Utility Requirements Document [URD]). Safety systems use natural driving forces such as pressurized gas, gravity flow, natural circulation flow, and convection. Safety systems do not use active components (such as pumps, fans or diesel generators) and are designed to function without safety-grade support systems (such as alternating current [AC] power; component cooling water; service water; and heating, ventilating and air conditioning [HVAC]). The number and complexity of operator actions required to control the safety systems are minimized; the approach is to eliminate operator action rather than automate it.

The AP1000 plant design provides adequate protection of public health and safety with respect to radiation sources. The AP1000 design follows ALARA (As-Low-As-Reasonably Achievable) policy. Provisions and designs for maintaining personnel exposures ALARA are presented in the following paragraphs:

* Design structures, systems and components for reliability and maintainability, thereby effectively reducing the maintenance requirements on radioactive components,
* Design structures, systems and components to reduce the radiation fields, thereby allowing operation, maintenance and inspection activities to be performed in the minimum design radiation field,
* Design structures, systems and components to reduce access, repair and removal times, thereby effectively reducing the time spent in radiation fields during operation, maintenance, and inspection,
* Design structures, systems and components to accommodate remote and semi-remote operation, maintenance and inspection, thereby effectively reducing the time spent in radiation fields.

### Facility Design Features for radiation protection

Chapter 12, subsection 12.3.1. of the Design Control Document (DCD) describes specific design features for maintaining personnel exposure as low as reasonably achievable (ALARA). The referenced section contains explanation of each of the features implemented for protection from harmful effects of ionizing radiation.

### Shielding from radiation effects

The objective of the plant radiation shielding is to minimize personnel and population exposures, while maintaining a program of controlled personnel access to and occupancy of radiation areas. Radiation levels are within the requirements of 10 CFR 50 during design basis accidents and ALARA within the requirements of 10 CFR 20 during normal operation. Shielding and equipment layout and design are considered in providing confidence that exposures are kept ALARA during anticipated personnel activities in areas of the plant containing radioactive materials. The nuclear radiation shielding is designed to provide personnel protection and is based on the following operating states:

* Normal, full-power operation,
* Shutdown operation,
* Spent resin transfer,
* Emergency operations (for required access to safety-related equipment).

The shielding design objectives for the plant during these operating states are:

* Ensure radiation exposure to plant operating personnel, contractors, administrators, visitors, and site boundary occupants is ALARA and within the limits of 10 CFR 20,
* Provide sufficient personnel access and occupancy time to allow normal anticipated maintenance, inspection, and safety-related operations required for each plant equipment and instrumentation area,
* Reduce potential equipment neutron activation and mitigate the effects of radiation on materials,
* Provide sufficient shielding for the control room so that for design basis accidents (DBAs) the direct dose plus the inhalation dose (calculated in Chapter 15) does not exceed the limits of 10 CFR 50, Appendix A, General Design Criterion 19.

Shielding is provided to attenuate direct radiation through walls and penetrations and scattered radiation to less than the upper limit of the radiation zone for each area shown in Figure 12.3.-1. of the DCD prepared for the AP1000 plant. Materials used in shielding typically include lead, steel, water, and concrete. The material used for most of the plant shielding is ordinary concrete with a bulk density of approximately 2243 kg/m3 (140 lb/ft3). Whenever poured-in-place concrete has been replaced by concrete blocks, an equivalent shielding basis as determined by the density of the concrete block is selected. Steel is used as shielding in the chemical and volume control system and other modules, as well as around the reactor vessel flange at the floor of the refueling cavity. Water is used as the primary shield material for areas above the spent fuel storage area and refueling cavity during refueling operations. General shielding design may be found in subsection 12.3.2 of the DCD. The referenced section contains explanation of shielding features of the AP1000 design with division for specific areas of the plant.

### Ventilation

The plant heating, ventilating, and air-conditioning systems are designed to provide a suitable environment for personnel and equipment during normal operation. The system is designed to meet the requirements of 10 CFR 20 and 10 CFR 50. Design criteria for the plant HVAC systems include the following:

* During normal operation the average and maximum airborne radioactivity levels to which plant personnel are exposed in restricted areas of the plant are ALARA and within the limits specified in 10 CFR 20. The average and maximum airborne radioactivity levels in unrestricted areas of the plant during normal operation, are ALARA and within the limits of 10 CFR 20.
* During normal operations the dose from concentrations of airborne radioactive material in unrestricted areas beyond the site boundary is ALARA and within the limits specified in 10 CFR 20 and 10 CFR 50, Appendix I.

To accomplish the design objectives and minimize the spread of airborne radioactive contamination AP1000 has implemented relevant design features. These design features are described in Chapter 12, subsection 12.3.3 of the DCD.

## Discussion of Radiation Protection and Safety of Radiation Sources: International Basic Safety Standard in AP1000 Standard Design and Reference Plant

The AP1000 plant is designed with administrative programs and procedures to maximize the incorporation of good engineering practices and lessons learned to accomplish As Low As Reasonably Achievable (ALARA) objectives as described in DCD [7] Chapter 12. The ALARA philosophy is applied in the AP1000 plant design. The design is reviewed for ALARA considerations and updated and modified as experience from operating plants is applied. ALARA reviews include the plant design and integrated layout, considering shielding, ventilation, and monitoring instrument designs as they relate to traffic control, security, access control, and health physics.

Similarly, routing of pipe containing radioactive fluids is reviewed as part of the design effort. This confirms that lines expected to contain significant radiation sources are adequately shielded and properly routed to minimize exposure of personnel.

Many of the engineers and supervisors assigned to the AP1000 design have performed similar design work or service work on other nuclear power plants. Through this experience, they have acquired knowledge of the radiation protection aspects which are applied to the AP1000 design. Nuclear plant operating experience is incorporated through Nuclear Regulatory Commission (NRC) inspection and enforcement bulletins, information notices, and other documents. Independent reviews are conducted by the Electric Power Research Institute (EPRI) and Utility Steering Committee and its subcommittees. Knowledge of radiation protection and ALARA is applied to the AP1000 design. This allows integration of experience and ALARA considerations from plant operators and plant designers and promotes incorporation of recent operating and service experience and lessons learned.

Radiation Protection Design Features are described in DCD [7] subsection 12.1.3. This section includes the figures of AP1000 Radiation Zones on Normal Operation, Shutdown, and in Post Accident Conditions. The radiation analyses used to develop the AP1000 plant radiation zoning significantly affect the outcome shown in the DCD and the overall plant zoning. Westinghouse analyses performed for the U.S. contain a conservative bias (assuming such situations as 0.25 percent fuel defects), and are not consistent with typical operating conditions, expected radiation fields, or operating experience from existing plants. This conservative methodology is used to bound a variety of operating conditions. However more realistic methodologies are used in other jurisdictions.

The AP1000 was designed attending the US-NRC regulatory framework. This regulatory framework is mainly collected in the following: Title 10, Part 20, of the Code of Federal Regulations (10 CFR Part 20), "Standards for Protection Against Radiation"; 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities"; and Appendix I to 10 CFR Part 50, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

In relation to Assuring that Occupational Radiation Exposures Are As-Low-As-Reasonably Achievable in AP1000 design:

* AP1000 design compliance with 10 CFR 20 is confirmed for the design and operation of the facility following the guidelines of Regulatory Guides 1.8, 8.8, and 8.10. Compliance with Regulatory Guides is addressed as discussed in DCD [7] subsection 12.1.3 The design of AP1000 meets the guidelines of Regulatory Guide 8.8, Sections C.2 and C.4, which address facility, equipment, and instrumentation design features. Features of the plant that are examples of compliance with Regulatory Guide 8.8 are delineated in Section 12.3.
* As explained in DCD [7] subsection 12.1.3 the operational considerations of ALARA, as well as the related policies, programs and operational procedures that grant compliance with occupational exposure are to be addressed under the responsibility of the Licensee (the Nuclear Power Plant Operator), this includes the operational considerations included in Standard Review Plan (NUREG-0800), Regulatory Guides that will be addressed include: 8.2, 8.7, 8.9, 8.13, 8.15, 8.20, 8.25, 8.26, 8.27, 8.28, 8.29, 8.34, 8.35, 8.36, and 8.38.

It must be noted that NRC Regulation on Radiation Protection has not been updated to the ICRP Publication 103, reference [9], see attachment included to this assessment with a more detailed explanation. However, the US-NRC believes that NRC's current regulatory framework continues to adequately protect the health and safety of nuclear industry workers, the public, and the environment.

**The AP1000 Standard Design** contained in the DCD [7] and Vogtle Reference plant for Bulgaria Project **Licensing Basis are based on this US-NRC Regulatory Framework. However, this will not be considered as Non-Compliance for the project,** since the extensive use of ALARA considerations in the Design, and existing analysis, shows that the reduction of some limits is achievable with the current design once Operational Radiation Programs are set in place.

As an example:

NRC’s current 10CFR20.1201 sets Occupational dose limits total effective dose equivalent for adults to 50 mSv (5 rem), and at the same time sets current requirements for ALARA which appear inside 10 CFR20 subsection related to Radiation Protection Programs 10 CFR 20.1101(b) and 10 CFR 20.1101(d). This is higher than current 20 mSv limit in references [1],[9],[10]. However, it needs to be stated that given previous ALARA considerations, the United States (and western European Countries, with the same type of reactors) have been successful in reducing individual exposures so that only a very limited number of individuals exceeded 20 mSv (2 rem) in a year. Nevertheless, this **will be dealt conservatively as a Compliance for the projects at which it is required, in this case some specific calculation would be needed to reconcile with such limits**. Also, as in AP1000 “Compliance Assessment of the AP1000 Plant to EUR Revision E Key Issues” reference [11], it is explained that individual dose for the AP1000 plant would meet the target for individual effective dose of 5 mSv/year.

All the previous is backed-up by NUREG‐0173, an available source of historical dose data; its application to the AP1000 plant is documented in AP1000 ALARA Guidelines Manual, reference [12].

Also, in the case of occupational exposure of the eye lens, the lowered limit of 20 mSv applied differs. This has been object of study since limits on effective dose could have been insufficient to match this requirement however:

* Radiation protection services in nuclear power plants tend to shield the sources rather than the individuals to protect the workers, (e.g. is not usual to use protective lead aprons). In this way the radiation fields to which workers are exposed, in most situations, are uniform, both for the lens and the whole body and therefore, the dosimeter placed in the chest would provide a good estimate of both the effective dose and the dose equivalent to the lens.
* The dosimetric magnitudes Hp(10) and/or Hp(0.07) are adequate to control the dose to the lens, Hp(3).
* The source term of Nuclear Power Plants is composed mainly of low energy beta emitters (<0.7 MeV), these emissions have low impact on the dose to the lens.
* Activities considered at risk by the IAEA for irradiation to the lens are not carried out in the plants in operation. This aspect is not expected to be modified at least until the dismantling work, where additional precautions might be needed. The working practices and protective equipment used in nuclear power plants in operation (eye protection goggles and in highly contaminated areas respiratory protection equipment) ensure attenuation of high energy beta particles.
* Dosimetric records indicate that the operational doses received in industry are low enough that, together with the measures already adopted by the Nuclear Sector within the framework of industrial regulations relating to risk prevention and protection measures against environmental pollution commonly used in installations, allow the new lens dose limit not to be compromised.

The collective annual doses have been calculated in APP‐SSAR‐GSC‐565 [13]. These have been updated since the values presented in DCD Chapter 12. The collective annual doses demonstrate that the AP1000 plant design meets the collective dose target of 0.5 man Sv/year per unit.

Also, some differences in the regulation exist regarding public exposure; not with the Dose Limit which in both cases is set to 1 mSv effective dose, but in other areas such as the dose limits for the lens of the eye.

## Compliance Assessment Summary of Results

The AP1000 plant design meets all design related IEA General Safety Requirement Part 3, Radiation Protection and Safety of Radiation Sources issues, since identified potential risks are not considered as non-compliant. This has been explained in sections 1.4 and 1.7 of this document. Part of the requirements do not apply to the nuclear power plants (not applicable to the technology) and they are not considered. Part of the requirements is related to establishing rules, regulations and good practices that are primarily the work of the Government / Regulatory body. A large part of the requirements is related to operation of the technology that includes nuclear power plants and responsibility belong to the Owner / Licensee. Only a few of the requirements are related to the design of the AP1000 and these points contain relevant description. It is worth noting that Westinghouse is taking prime responsibility for safety during design development, which includes taking care of protection from harmful effects of ionizing radiation.

The purpose of this task during Front-End Engineering and Design (FEED) is the identification of potential design risks and priorities for assessment work to be performed in a future project phase.

The High Level Risk Assessment of this standard is found in sections 1.6 and 1.7 of this document, attending to the compliance statements in section 2 of this document. The following risk categories are assigned:

1. Low risk: Compliance with regulation, codes, and standards is expected to be demonstrated without requiring a design change or requiring new design analyses.
2. Medium risk: Compliance with regulation, codes, and standards is expected to be demonstrated without requiring a design change but requiring new design analyses.
3. High risk: Compliance with regulation, codes, and standards is expected to require a design change and potentially new design analyses.

The category assigned to each regulation, code or standard will be justified, and any identified gaps will

be discussed.

Table 1-1 provides a summary of the AP1000 plant compliance assessment to the IAEA General Safety Requirements on Radiation Protection and Safety of Radiation Sources. The compliance categories are defined in Section 2.1. The detailed justification of compliance is provided in the identified Sections 2.2 – 2.5.

| Table 1-1: Summary of AP1000 Plant Compliance to IAEA General Safety Requirements Part 3 No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards. | | | | |
| --- | --- | --- | --- | --- |
| **IAEA Safety Requirement** | | **Compliance** | **Summary** | **Section** |
| **GENERAL REQUIREMENTS FOR PROTECTION AND SAFETY** | | | | |
| 1 | Application of the principles of radiation protection | COM, CWO, OR, EP | The AP1000 design is compliant with these requirements which are considered as design requirements. The non-compliance has not been identified.  This is the responsibility of the Owner / Licensee or/and external parties.  As explained in section 1.4 of this assessment, current AP1000 design is capable of fulfilling this requirement with appropriate radiation programs in place, even though these limits differ from the ones used in 10 CFR 20. Some differences in the standard are present regarding public exposure; not regarding the Dose Limit which in both cases is set to 1 mSv effective dose, but in areas such as the dose limits for the lens of the eye. Nevertheless Westinghouse is confident that the AP1000 plant can meet the dose limits provided in this standard by performing additional calculations based on appropriate assumptions. Thus conservatively, these are considered as CWO since at some point there could be potentially the need to make additional analyses. | 2.2.1 |
| 2 | Establishment of a legal and regulatory framework | EP | This is the responsibility of the Government. | 2.2.2 |
| 3 | Responsibilities of the regulatory body | EP | This is the responsibility of the Regulatory body. | 2.2.3 |
| 4 | Responsibilities for protection and safety | OR, EP, NR | This is the responsibility of the Owner / Licensee / other external parties. | 2.2.4 |
| 5 | Management for protection and safety | OR, EP | This is the responsibility of the Owner / Licensee/ other external parties. | 2.2.5 |
| **PLANNED EXPOSURE SITUATIONS** | | | | |
| 6 | Graded approach | COM, OR, EP | The AP1000 design is compliant with these requirements which are considered as design requirements. The non-compliance has not been identified.  This is the responsibility of the Owner / Licensee / other external parties. | 2.3.1 |
| 7 | Notification and authorization | OR | This is the responsibility of the Owner / Licensee. | 2.3.2 |
| 8 | Exemption and clearance | EP | This is the responsibility of the other external parties. | 2.3.3 |
| 9 | Responsibilities of registrants and licensees in planned exposure situations | OR | This is the responsibility of the Owner / Licensee. | 2.3.4 |
| 10 | Justification of practices | EP, NAP, NR | This is the responsibility of the Owner / Licensee / Government / Regulatory Body.  One of the points included in this requirement is an explanatory statement and some of others have been qualified as not applicable to the technology. | 2.3.5 |
| 11 | Optimization of protection and safety | OR, EP | This is the responsibility of the Owner / Licensee / Government / Regulatory Body. | 2.3.6 |
| 12 | Dose limits | CWO, OR, EP | This is the responsibility of the Owner / Licensee / Government / Regulatory Body.  As explained in section 1.4 of this assessment, current AP1000 design is capable of fulfilling this requirement with appropriate radiation programs in place, even though these limits differ to the ones used in 10 CFR 20. Some differences in the standard are present in regarding public exposure; not with the Dose Limit which in both cases is set to 1 mSv effective dose, but in areas such as the dose limits for the lens of the eye. Nevertheless Westinghouse is confident that the AP1000 plant can meet the dose limits provided in this standard by performing additional calculations based on appropriate assumptions. Thus conservatively, these are considered as CWO since at some point there could be potentially the need to make additional analyses. | 2.3.7 |
| 13 | Safety assessment | OR, EP | This is the responsibility of the Owner / Licensee / Regulatory Body.  The future operator will be supported by Westinghouse in performing the site-specific safety assessments, starting with the preliminary safety analysis report supporting the application for a construction licensee. This preliminary safety analysis demonstrates that AP1000 design is safe technology and meets all established requirements. | 2.3.8 |
| 14 | Monitoring for verification of compliance | OR, EP | This is the responsibility of the Owner / Licensee / Regulatory Body. | 2.3.9 |
| 15 | Prevention and mitigation of accidents | COM, OR | The AP1000 design is compliant with these requirements which are considered as design requirements. The non-compliance has not been identified.  This is the responsibility of the Owner / Licensee. | 2.3.10 |
| 16 | Investigations and feedback of information on operating experience | OR | This is the responsibility of the Owner / Licensee. | 2.3.11 |
| 17 | Radiation generators and radioactive sources | NAP | This is not applicable to the technology. | 2.3.12 |
| 18 | Human imaging using radiation for purposes other than medical diagnosis, medical treatment or biomedical research | NAP | This is not applicable to the technology. | 2.3.13 |
| 19 | Responsibilities of the regulatory body specific to occupational exposure | EP | This is the responsibility of the Government / Regulatory body. | 2.3.14 |
| 20 | Requirements for monitoring and recording of occupational exposures | EP | This is the responsibility of the Regulatory body. | 2.3.15 |
| 21 | Responsibilities of employers, registrants and licensees for the protection of workers | CWO, OR, EP, NR | This is the responsibility of the Owner / Licensee or/and other external parties.  As explained in section 1.4 of this assessment, current AP1000 design is capable of fulfilling this requirement with appropriate radiation programs in place, even though these limits differ to the ones used in 10 CFR 20. Thus conservatively, this is considered as CWO since at some point there could be potentially the need to make additional analyses. | 2.3.16 |
| 22 | Compliance by workers | OR | This is the responsibility of the Owner / Licensee. | 2.3.17 |
| 23 | Cooperation between employers and registrants and licensees | OR, EP | This is the responsibility of the Owner / Licensee. | 2.3.18 |
| 24 | Arrangements under the radiation protection programme | OR, EP | This is the responsibility of the Owner / Licensee. | 2.3.19 |
| 25 | Assessment of occupational exposure and workers’ health surveillance | OR, EP | This is the responsibility of the Owner / Licensee. | 2.3.20 |
| 26 | Information, instruction and training | OR, EP | This is the responsibility of the Owner / Licensee. | 2.3.21 |
| 27 | Conditions of service | OR, EP | This is the responsibility of the Owner / Licensee. | 2.3.22 |
| 28 | Special arrangements for protection and safety for female workers and for persons under 18 years of age undergoing training | OR, EP | This is the responsibility of the Owner / Licensee.  One of the point included in this requirement is an explanatory statement. | 2.3.23 |
| 29 | Responsibilities of the government and the regulatory body specific to public exposure | OR, EP | This is the responsibility of the Government / Regulatory body. | 2.3.24 |
| 30 | Responsibilities of relevant parties specific to public exposure | COM, CWO, OR | The AP1000 design is compliant with these requirements which are considered as design requirements. The non-compliance has not been identified.  This is the responsibility of the Owner / Licensee.  As explained in section 1.4 of this assessment, current AP1000 design is capable of fulfilling this requirement with appropriate radiation programs in place, even though these limits differ to the ones used in 10 CFR 20. Thus conservatively, this is considered as CWO since at some point there could be potentially the need to make additional analyses. | 2.3.25 |
| 31 | Radioactive waste and discharges | COM, OR, EP | The AP1000 design is compliant with these requirements which are considered as design requirements. The non-compliance has not been identified.  This is the responsibility of the Owner / Licensee / external parties. | 2.3.26 |
| 32 | Monitoring and reporting | OR, EP | This is the responsibility of the Owner / Licensee / Regulatory Body / other External Parties. | 2.3.27 |
| 33 | Consumer products | NAP | The requirement is not applicable to the technology. | 2.3.28 |
| 34 | Responsibilities of the government specific to medical exposure | NAP | The requirement is not applicable to the technology. | 2.3.29 |
| 35 | Responsibilities of the regulatory body specific to medical exposure | NAP | The requirement is not applicable to the technology. | 2.3.30 |
| 36 | Responsibilities of registrants and licensees specific to medical exposure | NAP | The requirement is not applicable to the technology. | 2.3.31 |
| 37 | Justification of medical exposures | NAP | The requirement is not applicable to the technology. | 2.3.32 |
| 38 | Optimization of protection and safety | NAP | The requirement is not applicable to the technology. | 2.3.33 |
| 39 | Pregnant or breast-feeding female patients | NAP | The requirement is not applicable to the technology. | 2.3.34 |
| 40 | Release of patients after radionuclide therapy | NAP | The requirement is not applicable to the technology. | 2.3.35 |
| 41 | Unintended and accidental medical exposures | NAP | The requirement is not applicable to the technology. | 2.3.36 |
| 42 | Reviews and records | NAP | The requirement is not applicable to the technology. | 2.3.37 |
| **EMERGENCY EXPOSURE SITUATIONS** | | | | |
| 43 | Emergency management system | OR, EP | This is the responsibility of the Owner / Licensee / Government. | 2.4.1 |
| 44 | Preparedness and response for an emergency | CWO, OR, EP | This is the responsibility of the Owner / Licensee / Government / external parties.  Specific calculations for accident analyses will need to be developed to fulfill IAEA Safety Standards No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards expectations. | 2.4.2 |
| 45 | Arrangements for controlling the exposure of emergency workers | OR, EP | This is the responsibility of the Owner / Licensee / Government. | 2.4.3 |
| 46 | Arrangements for the transition from an emergency exposure situation to an existing exposure situation | OR, EP | This is the responsibility of the Owner / Licensee / Government / external parties. | 2.4.4 |
| **EXISTING EXPOSURE SITUATIONS** | | | | |
| 47 | Responsibilities of the government specific to existing exposure situations | EP | This is the responsibility of the Government / Regulatory body / other external parties.  One of the point included in this requirement is an explanatory statement. | 2.5.1 |
| 48 | Justification for protective actions and optimization of protection and safety | EP | This is the responsibility of the Government / Regulatory body / other external parties. | 2.5.2 |
| 49 | Responsibilities for remediation of areas with residual radioactive material | OR, EP, NR | This is the responsibility of the Government / Regulatory body / other external parties.  One of the points included in this requirement is an explanatory statement. | 2.5.3 |
| 50 | Public exposure due to radon indoors | NAP | The requirement is not applicable to the technology. | 2.5.4 |
| 51 | Exposure due to radionuclides in commodities | NAP | The requirement is not applicable to the technology. | 2.5.5 |
| 52 | Exposure in workplaces | OR, EP, NAP | This is the responsibility of the Owner / Licensee and/or other external parties.  Some points included in this requirement are not applicable to the technology. | 2.5.6 |

## Conclusions

Given the analyses performed in Section 2, the IAEA Safety Standards No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards is classified as Medium Risk since compliance with regulation is expected to be demonstrated but will require some additional analysis. In particular Medium Risk Classification is based on the topics described in Subsection 1.7.

These topics are related to:

* Differences in framework between IAEA and the United States (NRC). These differences are analyzed more detailed in subsection 1.4 and 1.7 of this report, and might in some specific cases require some additional analyses, but are not expected to lead to any major design changes,
* Some minor design changes might be requested for some plant and effluent monitors, however since they are considered as minor, we maintain the classification as medium risk.

The AP1000 plant is designed with administrative programs and procedures to maximize the incorporation of good engineering practices and lessons learned to accomplish ALARA objectives. This has been reviewed and verified by US-NRC Reviews of Standard Design Certification, the beginning of the Operation at Vogtle Unit 3, China Operating Plants, as well as by the Generic Design Assessment in the United Kingdom (UK).

Thus, the AP1000 design should be able to accommodate the IAEA Standard, with some specific dose analyses that need to be performed for compliance, and some minor changes in some radiation and effluent monitors.

## Identified Potential Risks To Be Addressed

The analyses of section 2 show that the following requirement and sub-requirements need to be considered in the risk assessment:

**Requirements related to different expected Occupational dose as explained in subsection 1.4:**

* Requirement 1: Application of the principles of radiation protection,
* Requirement 12: Dose limits,
* Requirement 19: Responsibilities of the regulatory body specific to occupational exposure
* Requirement 21: Responsibilities of employers, registrants and licensees for protection of workers.

Compliance with dose limits and dose constraints for occupationally exposed workers and members of the public has to be demonstrated. As explained in subsection 1.4 of this assessment, the current AP1000 design is capable of fulfilling this requirement with appropriate radiation programs in place, even though these limits differ from the ones used in 10 CFR 20. Thus conservatively, this is considered as CWO since at some point there could be potentially the need to make additional analyses.

**Other requirements based on differences between US-NRC radiation protection regulatory framework and IAEA for Radiation Protection:**

* Requirement 29: Responsibilities of the government and the regulatory body specific to public exposure,
* Requirement 30: Responsibilities of relevant parties specific to public exposure,
* Requirement 44: Preparedness and response for an emergency.

Realistic assessment of the doses to members of the public and for comparison with dose constraints due to releases has to be done. A specific calculation will be needed for releases in normal operation and emergency conditions, even though some feasibility studies of compliance were performed previously.

# Compliance assessment for IAEA Safety Reference levels

This section provides the detailed assessment of the standard AP1000 plant design described in Section 1.2. Compliance is assessed by the compliance assessment classifications identified in 2.1 and a justification is provided to support the compliance assessment.

## Compliance assessment Classification Label

The following classifications are applied in the compliance assessment of the WENRA Safety Reference Levels:

| **Classification Label** | **Compliance Assessment Label** | **Meaning** |
| --- | --- | --- |
| COM | Compliance | The design meets the requirement as stated. |
| CWO | Compliance with Objective | The design meets the objective of the requirement, although there may be differences in approach or terminology. |
| EP | External party | This requirement is the responsibility of the external party such as Government, Regulatory Body or other External Institutions. |
| NAP | Not Applicable | The requirement is not applicable to the technology. |
| NOC | Non-Compliance | The design does not meet the requirement. |
| NR | Not a requirement | This is an explanatory statement. |
| OR | Owner | This requirement is the responsibility of the Owner and/or Licensee. |
| POS | Project or Site-specific Scope | This requirement requires project or site-specific scope to be performed to meet the requirement.  The responsibility party for this scope will be defined in a project-specific DOR; the scope could be the responsibility of the designer, Owner, or other third party. |

## General Requirements for Protection and safety

**APPLICATION OF THE PRINCIPLES OF RADIATION PROTECTION**

### Requirement 1: Application of the principles of radiation protection

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Parties with responsibilities for protection and safety shall ensure that the principles of radiation protection are applied for all exposure situations.** | COM, OR, EP | Westinghouse has conducted the AP1000 design development under its recognized Quality Management System (QMS) and has taken prime responsibility for safety during the design development. A primary objective for the AP1000 design is to achieve a very low risk of harm to people and the environment. The AP1000 design includes measures to reduce risk to people and the environment over the phases of the plant lifecycle. These measures are discussed in the DCD. DCD Chapter 2 discusses siting aspects. DCD chapters 3 through 10 discuss design, manufacturing and construction aspects. DCD Chapter 11 discusses radioactive waste management aspects. DCD Chapter 12 discusses radiation protection. DCD Chapter 14 discusses commissioning aspects. DCD Chapter 15 discusses Accident Analyses, DCD Chapter 18 discusses Human Factors Engineering and DCD Chapter 19 discusses Probabilistic Risk Assessment. The as low as reasonably achievable (ALARA) policy is applied during the design of the AP1000 plant to minimize occupational and public radiological effects. The design is reviewed as per ALARA considerations and updated based on experience from existing operating plants. ALARA reviews include the plant design and integrated layout, considering shielding, HVAC, and monitoring instrument designs as they relate to traffic control, security, access control and health physics. DCD Chapter 12 further discusses the application of ALARA principles in the design of the AP1000 plant. Also, DCD chapter 13 provides information about conduct of operation, which describes operation in normal, abnormal and emergency conditions.  This is the responsibility of the Owner/Licensee and/or external parties. |
| 2.8. | For planned exposure situations, each party with responsibilities for protection and safety shall ensure, when relevant requirements apply to that party, that no practice is undertaken unless it is justified. | COM, OR, EP | Westinghouse takes into account justification of practice and pursuits the measures appropriate to exposure risk and radiation hazard.  This is the responsibility of the Owner/Licensee and/or other external parties. |
| 2.9. | For emergency exposure situations and existing exposure situations, each party with responsibilities for protection and safety shall ensure, when relevant  requirements apply to that party, that protective actions or remedial actions are justified and are undertaken in such a way as to achieve the objectives set out in a protection strategy. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 2.10. | For all exposure situations, each party with responsibilities for protection and safety shall ensure, when relevant requirements apply to that party, that protection and safety is optimized9. | COM, OR, EP | AP1000 design complies with 10 CFR 20, and Regulatory Guides 1.8, 8.8, and 8.10. These guidelines outline the practices of as low as reasonably achievable (ALARA) for nuclear power plants. The ALARA policy is applied to minimize occupational and public radiological effects. The design is reviewed for ALARA considerations and updated as experience from operating plants is applied. ALARA reviews include the plant design and integrated layout, considering shielding, HVAC, and monitoring instrument designs as they relate to traffic control, security, access control and health physics. DCD Chapter 12 further discusses the application of ALARA principles in the design of the AP1000 plant and by following ALARA policy confirms that radiation protection and safety is optimized.  This is the responsibility of the Owner/Licensee and/or other external parties. |
| 2.11. | For planned exposure situations other than for medical exposure, each party with responsibilities for protection and safety shall ensure that, when relevant requirements apply to that party, specified dose limits are not exceeded. | CWO, OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties.  As explained in section 1.4 of this assessment, current AP1000 design is capable of fulfilling this requirement with appropriate radiation programs in place, even though these limits differ to the ones used in 10 CFR 20. Some differences in the standard are present in relation with the public exposure, not with the Dose Limit which in both cases is set to 1 mSv effective dose, such as the dose limits for the lens of the eye. Nevertheless Westinghouse is confident that the AP1000 plant can meet the dose limits provided in this standard by performing additional calculations based on appropriate assumptions. Thus conservatively, these are considered as CWO since at some point there could be potentially the need to make additional analyses. |
| 2.12. | The application of the requirements for the system of protection and safety shall be commensurate with the radiation risks associated with the exposure situation. | COM, OR, EP | Westinghouse recognizes the radiation risks associated with its own technology and has established commensurate system of protection with relevant radiation protection features in the design. AP1000 design pursues the radiation protection principle of optimization. The design complies with 10 CFR 20, and Regulatory Guides 1.8, 8.8, and 8.10. These guidelines outline the practices of as low as reasonably achievable (ALARA) for nuclear power plants. The ALARA policy is applied to minimize occupational and public radiological effects. The design is reviewed as per ALARA considerations and updated based on experience from existing operating plants. ALARA reviews include the plant design and integrated layout, considering shielding, HVAC, and monitoring instrument designs as they relate to traffic control, security, access control and health physics. DCD Chapter 12 further discusses the application of ALARA principles in the design of the AP1000 plant and by following ALARA policy confirms that radiation protection and safety is optimized. Also, DCD Chapter 11 sheds a light on Radiation Monitoring and Effluents and DCD Chapter 13 provides information about conduct of operation, which describes operation in normal, abnormal and emergency conditions.  This is the responsibility of the Owner/Licensee and/or other external parties. |

**RESPONSIBILITIES OF THE GOVERNMENT10**

### Requirement 2: Establishment Of A Legal And Regulatory Framework

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government shall establish and maintain a legal and regulatory framework for protection and safety and shall establish an effectively independent regulatory body with specified responsibilities and functions.** | EP | This is the responsibility of the Government. |
| 2.13. | The government shall establish and maintain an appropriate and effective legal and regulatory framework for protection and safety in all exposure situations11. This framework shall encompass both the assignment and the discharge of governmental responsibilities, and the regulatory control of facilities and activities that give rise to radiation risks. The framework shall allow for the fulfilment of international obligations. | EP | This is the responsibility of the Government. |
| 2.14. | The government shall ensure that adequate arrangements are in place for the protection of people and the environment, both now and in the future, against harmful effects of ionizing radiation, without unduly limiting the operation of facilities or the conduct of activities that give rise to radiation risks. This shall include arrangements for the protection of people of present and future generations and populations remote from present facilities and activities. | EP | This is the responsibility of the Government. |
| 2.15. | The government shall establish legislation that, among other things:  (a) Provides the statutory basis for requirements for protection and safety for all exposure situations;  (b) Specifies that the prime responsibility for protection and safety rests with the person or organization responsible for facilities and activities that give rise to radiation risks;  (c) Specifies the scope of its applicability;  (d) Establishes and provides for maintaining an independent regulatory body with clearly specified functions and responsibilities for the regulation of  protection and safety;  (e) Provides for coordination between authorities with responsibilities relevant to protection and safety for all exposure situations. | EP | This is the responsibility of the Government. |
| 2.16. | The government shall ensure that the regulatory body is effectively independent, in making decisions relating to protection and safety, of persons and organizations using or promoting the use of radiation and radioactive  material, so that it is free from any undue influence by interested parties and from any conflicts of interest; and shall ensure that it has functional separation from entities having responsibilities or interests that could unduly influence its decision making. | EP | This is the responsibility of the Government. |
| 2.17. | The government shall ensure that the regulatory body has the legal authority, competence and resources necessary to fulfil its statutory functions and responsibilities. | EP | This is the responsibility of the Government. |
| 2.18. | The government shall ensure that a graded approach is taken to the regulatory control of radiation exposure, so that the application of regulatory requirements is commensurate with the radiation risks associated with the exposure situation. | EP | This is the responsibility of the Government. |
| 2.19. | The government shall establish mechanisms to ensure that: (a) The activities of the regulatory body are coordinated with those of other governmental authorities, in accordance with para. 2.15, and with national and international organizations that have related responsibilities;  (b) Interested parties are involved as appropriate in regulatory decision making processes or regulatory decision aiding processes. | EP | This is the responsibility of the Government. |
| 2.20. | The government shall ensure that arrangements are in place at the national level for making decisions relating to protection and safety that fall outside the authority of the regulatory body. | EP | This is the responsibility of the Government. |
| 2.21. | The government shall ensure that requirements are established for:  (a) Education, training, qualification and competence in protection and safety of all persons engaged in activities relevant to protection and safety;  (b) The formal recognition12 of qualified experts;  (c) The competence of organizations that have responsibilities relating to protection and safety. | EP | This is the responsibility of the Government. |
| 2.22. | The government shall ensure that arrangements are in place for the provision of the education and training services required for building and maintaining the competence of persons and organizations that have responsibilities relating to protection and safety. | EP | This is the responsibility of the Government. |
| 2.23. | The government shall ensure that arrangements are in place for the provision of technical services relating to protection and safety, such as services for personal dosimetry, environmental monitoring and the calibration of monitoring and measuring equipment. | EP | This is the responsibility of the Government. |
| 2.24. | The government shall ensure that arrangements are in place for the safe decommissioning of facilities [16], the safe management of radioactive waste [17, 18] and the safe management of spent fuel. | EP | This is the responsibility of the Government.  DCD Chapter 11 describes the standard AP1000 plant waste management systems, plant design considerations to minimize operational radwaste generation, estimates of operational radwaste generation and associated activities, and high-level radwaste management strategies. Also, it is worth mentioning that waste minimization is an inherent part of AP1000 plant waste management. The basic AP1000 plant design principles minimize the creation of radwaste during operations and decommissioning. Also, Westinghouse is in the process of establishing decommissioning procedure which wasn’t a requirement in United States plant, but it is a requirement in Europe. |
| 2.25. | The government shall ensure that the transport of radioactive material is in accordance with the IAEA Regulations for the Safe Transport of Radioactive Material (the IAEA Transport Regulations) [19] and with any applicable international conventions, taking into consideration other internationally endorsed standards and recommendations derived from the IAEA Transport Regulations.13 | EP | This is the responsibility of the Government. |
| 2.26. | The government shall ensure that arrangements are in place for regaining control over radioactive sources that have been abandoned, lost, misplaced, stolen or otherwise transferred without proper authorization. | EP | This is the responsibility of the Government. |
| 2.27. | The government shall ensure that infrastructural arrangements are in place for the interfaces between safety and the security of radioactive sources. | EP | This is the responsibility of the Government. |
| 2.28. | In establishing the legal and regulatory framework for protection and safety, the government:  (a) Shall fulfil its respective international obligations;  (b) Shall allow for participation in relevant international arrangements, including international peer reviews;  (c) Shall promote international cooperation to enhance safety globally. | EP | This is the responsibility of the Government. |

**RESPONSIBILITIES OF THE REGULATORY BODY**

### Requirement 3: Responsibilities of the regulatory body

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The regulatory body shall establish or adopt regulations and guides for protection and safety and shall establish a system to ensure their implementation.** | EP | This is the responsibility of the Regulatory body. |
| 2.29. | The regulatory body shall establish requirements for the application of the principles of radiation protection specified in paras 2.8–2.12 for all exposure situations and shall establish or adopt regulations and guides for protection and safety. | EP | This is the responsibility of the Regulatory body. |
| 2.30. | The regulatory body shall establish a regulatory system for protection and safety that includes [15]:  (a) Notification and authorization;  (b) Review and assessment of facilities and activities;  (c) Inspection of facilities and activities;  (d) Enforcement of regulatory requirements;  (e) The regulatory functions relevant to emergency exposure situations and existing exposure situations;  (f) Provision of information to, and consultation with, parties affected by its decisions and, as appropriate, the public and other interested parties. | EP | This is the responsibility of the Regulatory body. |
| 2.31. | The regulatory body shall adopt a graded approach to the implementation of the system of protection and safety, such that the application of regulatory requirements is commensurate with the radiation risks associated with the exposure situation. | EP | This is the responsibility of the Regulatory body. |
| 2.32. | The regulatory body shall ensure the application of the requirements for education, training, qualification and competence in protection and safety of all persons engaged in activities relevant to protection and safety. | EP | This is the responsibility of the Regulatory body. |
| 2.33. | The regulatory body shall ensure that mechanisms are in place for the timely dissemination of information to relevant parties, such as suppliers of and users of sources, on lessons learned for protection and safety from regulatory experience and operating experience, and from incidents and accidents and the related findings. The mechanisms established shall, as appropriate, be used to provide relevant information to other relevant organizations at the national and international level. | EP | This is the responsibility of the Regulatory body. |
| 2.34. | The regulatory body, in conjunction with other relevant authorities, shall specify requirements for acceptance and for performance, by regulation or by the application of published standards, for any manufactured or constructed source, device, equipment or facility that, when in use, has implications for protection and safety. | EP | This is the responsibility of the Regulatory body. |
| 2.35. | The regulatory body shall make provision for establishing, maintaining and retrieving adequate records relating to facilities and activities. These records shall include: —Registers of sealed sources and radiation generators14; —Records of doses from occupational exposure; —Records relating to the safety of facilities and activities; —Records that might be necessary for the shutdown and decommissioning or closure of facilities; —Records of events, including non-routine releases of radioactive material to the environment; —Inventories of radioactive waste and of spent fuel. | EP | This is the responsibility of the Regulatory body. |
| 2.36. | The regulatory body shall establish mechanisms for communication and discussion that involve professional and constructive interactions with relevant parties for all protection and safety related issues. | EP | This is the responsibility of the Regulatory body. |
| 2.37. | The regulatory body, in consultation with the health authority, shall ensure that provisions are in place for ensuring protection and safety in the handling of deceased persons or human remains that are known to contain sealed or unsealed radioactive sources, either as a result of radiological procedures for medical treatment of patients or as a consequence of an emergency. | EP | This is the responsibility of the Regulatory body. |
| 2.38. | The regulatory body shall establish, implement, assess and strive to continually improve a management system that is aligned with the goals of the regulatory body and that contributes to the achievement of those goals. | EP | This is the responsibility of the Regulatory body. |

**RESPONSIBILITIES FOR PROTECTION AND SAFETY**

### Requirement 4: Responsibilities for protection and safety

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The person or organization responsible for facilities and activities that give rise to radiation risks shall have the prime responsibility for protection and safety. Other parties shall have specified responsibilities for protection and safety.** | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties.  The Owner should, as requested by one of the main principles of radiation protection, claim the justification of the practice. The responsibility for judging the justification rests on governments or national authorities/regulators to ensure an overall benefit to society and thus not necessarily to particular individual. |
| 2.39. | The person or organization responsible for any facility or activity that gives rise to radiation risks shall have the prime responsibility for protection and safety, which cannot be delegated. | OR | This is the responsibility of the Owner/Licensee. |
| 2.40. | The principal parties responsible for protection and safety are: (a) Registrants or licensees, or the person or organization responsible for facilities and activities for which notification only is required; (b) Employers, in relation to occupational exposure; (c) Radiological medical practitioners, in relation to medical exposure; (d) Those persons or organizations designated to deal with emergency exposure situations or existing exposure situations. | NR | This is an explanatory statement, not a requirement. |
| 2.41. | Other parties shall have specified responsibilities in relation to protection and safety. These other parties include: (a) Suppliers of sources, providers of equipment and software, and providers of consumer products; (b) Radiation protection officers; (c) Referring medical practitioners; (d) Medical physicists; (e) Medical radiation technologists; (f) Qualified experts or any other party to whom a principal party has assigned specific responsibilities; (g) Workers other than workers listed in (a)–(f) in this paragraph; (h) Ethics committees. | NR | This is an explanatory statement, not a requirement. |
| 2.42. | The relevant principal parties shall establish and implement a protection and safety programme that is appropriate for the exposure situation. The protection and safety programme: (a) Shall adopt objectives for protection and safety in accordance with the requirements of these Standards; (b) Shall apply measures for protection and safety that are commensurate with the radiation risks associated with the exposure situation and that are adequate to ensure compliance with the requirements of these Standards. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 2.43. | The relevant principal parties shall ensure that, in the implementation of the protection and safety programme: (a) The measures and resources that are necessary for achieving the objectives for protection and safety have been determined and are duly provided; (b) The programme is periodically reviewed to assess its effectiveness and its continued fitness for purpose; (c) Any failures or shortcomings in protection and safety are identified and corrected, and steps are taken to prevent their recurrence; (d) Arrangements are made to consult with interested parties; (e) Appropriate records are maintained. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 2.44. | The relevant principal parties and other parties having specified responsibilities in relation to protection and safety shall ensure that all personnel engaged in activities relevant to protection and safety have appropriate education, training and qualification so that they understand their responsibilities and can perform their duties competently, with appropriate judgement and in accordance with procedures. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties.  Westinghouse has conducted the AP1000 design development under its recognized QMS and has taken prime responsibility for safety during the design development. Well recognized QMS is a method for effective fulfillment of requirements for protection and safety in the managements system on a technology design level. The relevant qualification and training for design personnel are in place. |
| 2.45. | The relevant principal parties shall permit access by authorized representatives of the regulatory body to carry out inspections of their facilities and activities and of their protection and safety records, and shall cooperate in the conduct of inspections. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 2.46. | The relevant principal parties shall ensure that qualified experts are identified and are consulted as necessary on the proper observance of these Standards. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |

**MANAGEMENT REQUIREMENTS**

### Requirement 5: Management for protection and safety

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The principal parties shall ensure that protection and safety are effectively integrated into the overall management system of the organizations for which they are responsible.** | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| **Protection and safety elements of the management system** | | | |
| 2.47. | The principal parties shall demonstrate commitment to protection and safety at the highest levels within the organizations for which they are responsible. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 2.48. | The principal parties shall ensure that the management system15 is designed and applied to enhance protection and safety by: (a) Applying the requirements for protection and safety coherently with other requirements, including requirements for operational performance, and coherently with guidelines for security;  (b) Describing the planned and systematic actions necessary to provide adequate confidence that the requirements for protection and safety are fulfilled;  (c) Ensuring that protection and safety are not compromised by other requirements;  (d) Providing for the regular assessment of performance for protection and safety, and the application of lessons learned from experience;  (e) Promoting safety culture. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 2.49. | The principal parties shall ensure that protection and safety elements of the management system are commensurate with the complexity of and the radiation risks associated with the activity. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 2.50. | The principal parties shall be able to demonstrate the effective fulfilment of the requirements for protection and safety in the management system. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| **Safety culture** | | | |
| 2.51. | The principal parties shall promote and maintain safety culture by: (a) Promoting individual and collective commitment to protection and safety at all levels of the organization;  (b) Ensuring a common understanding of the key aspects of safety culture within the organization;  (c) Providing the means by which the organization supports individuals and teams in carrying out their tasks safely and successfully, with account taken of the interactions between individuals, technology and the organization;  (d) Encouraging the participation of workers and their representatives and other relevant persons in the development and implementation of policies, rules and procedures dealing with protection and safety;  (e) Ensuring accountability of the organization and of individuals at all levels for protection and safety;  (f) Encouraging open communication with regard to protection and safety within the organization and with relevant parties, as appropriate;  (g) Encouraging a questioning and learning attitude, and discouraging complacency, with regard to protection and safety;  (h) Providing means by which the organization continually seeks to develop and strengthen its safety culture. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties.  Westinghouse is promoting safety culture throughout the working environment. In the case of AP1000 as an example by preparing documents like the DCD which is directly related to improving safety. All the Westinghouse company structure is based on slogan “Safety first”. Westinghouse fosters a safety culture not only through policies and procedures, but also through communication of industry best practice such as Institute of Nuclear Power Operations (INPO) principles for a strong nuclear safety culture. |
| **Human factors** | | | |
| 2.52. | The principal parties and other parties having specified responsibilities in relation to protection and safety, as appropriate, shall take into account human factors and shall support good performance and good practices to prevent human and organizational failures, by ensuring among other things that:  (a) Sound ergonomic principles are followed in the design of equipment and the development of operating procedures, so as to facilitate the safe operation and use of equipment, to minimize the possibility that operator errors could lead to accidents, and to reduce the possibility that indications of normal conditions and abnormal conditions could be misinterpreted.  (b) Appropriate equipment, safety systems and procedural requirements are provided, and other necessary provision is made:   1. To reduce, as far as practicable, the possibility that human errors or inadvertent actions could give rise to accidents or to other incidents leading to the exposure of any person; 2. To provide means for detecting human errors and for correcting them or compensating for them; 3. To facilitate protective actions and corrective actions in the event of failures of safety systems or failures of measures for protection and safety. | OR | This is the responsibility of the Owner/Licensee and/or other external parties.  Chapter 18 of the DCD prepared for the AP1000 plant has taken into consideration Human Factors Engineering at design process for which Westinghouse is responsible. |

## Planned exposure situations

**Scope**

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
| 3.1. | The requirements for planned exposure situations apply to the following practices: (a) The production, supply, provision and transport of radioactive material and of devices that contain radioactive material, including sealed sources and unsealed sources, and of consumer products; (b) The production and supply of devices that generate radiation, including linear accelerators, cyclotrons, and fixed and mobile radiography equipment; (c) The generation of nuclear power, including any activities within the nuclear fuel cycle that involve or that could involve exposure to radiation or exposure due to radioactive material; (d) The use of radiation or radioactive material for medical, industrial, veterinary, agricultural, legal or security purposes, including the use of associated equipment, software or devices where such use could affect exposure to radiation; (e) The use of radiation or radioactive material for education, training or research, including any activities relating to such use that involve or could involve exposure to radiation or exposure due to radioactive material; (f) The mining and processing of raw materials that involve exposure due to radioactive material;  (g) Any other practice as specified by the regulatory body. | NR | This is an explanatory statement, not a requirement. |
| 3.2. | The requirements for planned exposure situations apply to exposure due to sources within practices16, as follows: (a) Facilities that contain radioactive material and facilities that contain radiation generators, including nuclear installations, medical radiation facilities, veterinary radiation facilities, facilities for the management of radioactive waste, installations for the processing of radioactive material, irradiation facilities, and mineral extraction and mineral processing facilities that involve or could involve exposure to radiation or exposure due to radioactive material; (b) Individual sources of radiation, including sources within the types of facility mentioned in para. 3.2(a), as appropriate, in accordance with the requirements of the regulatory body. | NR | This is an explanatory statement, not a requirement. |
| 3.3. | The requirements for planned exposure situations apply for any occupational exposure, medical exposure or public exposure due to any practice or due to a source within a practice as specified in paras 3.1 and 3.2. | NR | This is an explanatory statement, not a requirement. |
| 3.4. | Exposure due to natural sources is, in general, considered an existing exposure situation and is subject to the requirements in Section 5. However, the relevant requirements in Section 3 for planned exposure situations apply to:  (a) Exposure due to material17 in any practice specified in para. 3.1 where the activity concentration in the material of any radionuclide in the uranium decay chain or the thorium decay chain is greater than 1 Bq/g or the activity concentration of 40K is greater than 10 Bq/g;  (b) Public exposure due to discharges or due to the management of radioactive waste arising from a practice involving material as specified in (a) above; (c) Exposure due to 222Rn and to 222Rn progeny and due to 220Rn and to 220Rn progeny in workplaces in which occupational exposure due to other radionuclides in the uranium decay chain or the thorium decay chain is controlled as a planned exposure situation;  (d) Exposure due to 222Rn and to 222Rn progeny where the annual average activity concentration of 222Rn in air in workplaces remains above the reference level established in accordance with para. 5.27 after the fulfilment of the requirement in para. 5.28. | NR | This is an explanatory statement, not a requirement. |
| GENERIC REQUIREMENTS | | | |
| 3.5. | No person or organization shall adopt, introduce, conduct, discontinue or cease a practice, or shall, as applicable, mine, extract, process, design, manufacture, construct, assemble, install, acquire, import, export, supply, provide, distribute, loan, hire, receive, site, locate, commission, possess, use, operate, maintain, repair, transfer, decommission, disassemble, transport, store or dispose of a source within a practice other than in accordance with the requirements of these Standards. | NR | This is an explanatory statement, not a requirement. |

### Requirement 6: Graded approach

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The application of the requirements of these Standards in planned exposure situations shall be commensurate with the characteristics of the practice or the source within a practice, and with the likelihood and magnitude of exposures.** | COM, OR, EP | AP1000 design pursues the radiation protection principle of optimization. The design complies with 10 CFR 20, and Regulatory Guides 1.8, 8.8, and 8.10. These guidelines outline the practices of as low as reasonably achievable (ALARA) for nuclear power plants. The ALARA policy is applied to minimize occupational and public radiological effects. The design is reviewed for ALARA considerations and updated as experience from operating plants is applied. ALARA reviews include the plant design and integrated layout, considering shielding, HVAC, and monitoring instrument designs as they relate to traffic control, security, access control and health physics. DCD Chapter 12 further discusses the application of ALARA principles in the design of the AP1000 plant and by following ALARA policy confirms that radiation protection and safety is optimized. Also, DCD Chapter 11 sheds a light on Radiation Monitoring and Effluents and DCD Chapter 13 provides information about conduct of operation, which describes operation in normal, abnormal and emergency conditions.  Westinghouse has conducted the AP1000 design development under its recognized QMS and has taken prime responsibility for safety during the design development. A primary objective for the AP1000 design is to achieve a very low risk of harm to people and the environment. The AP1000 design includes measures to reduce risk to people and the environment over the phases of the plant lifecycle. These measures are discussed in the DCD. The AP1000 plant is designed following the ALARA policy, ensuring radiation protection during commissioning and operation of the plant. Organizational measures for radiation protection are the responsibility of the Owner.  It is the responsibility of the Owner/Licensee and/or other external parties to apply these standards, depending on specific requirement. After the commissioning of the AP1000 plant, the responsibility for the facility is primarily taken by the Owner/Licensee, including operation, radiation protection during the operation, supervision of employees, shutdown of the plant and decommissioning process. |
| 3.6. | The application of the requirements of these Standards shall be in accordance with the graded approach and shall also conform to any requirements specified by the regulatory body. Not all the requirements of these Standards are relevant for every practice or source, or for all the actions specified in para. 3.5. | COM, OR, EP | Westinghouse has conducted the AP1000 design development under its recognized QMS and has taken prime responsibility for safety during the design development. A primary objective for the AP1000 design is to achieve a very low risk of harm to people and the environment. The AP1000 design includes measures to reduce risk to people and the environment over the phases of the plant lifecycle. These measures are discussed in the DCD.  The regulatory body requirements are project specific, since every regulatory body establishes its own requirements which compliance is assessed within AP1000 design. Westinghouse is responsible for the AP1000 plant design to be compatible with established standards/regulations/directives.  It is the responsibility of the Owner/Licensee and/or external parties to apply these standards, depending on specific requirement, starting from the moment of commission of the AP1000 plant. |

### Requirement 7: Notification and authorization

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Any person or organization intending to operate a facility or to conduct an activity shall submit to the regulatory body a notification and, as appropriate, an application for authorization.** | OR | This is the responsibility of the Owner/Licensee. |
| *Notification* | | | |
| 3.7. | Any person or organization intending to carry out any of the actions specified in para. 3.5 shall submit a notification to the regulatory body of such an intention18. Notification alone is sufficient provided that the exposures expected to be associated with the practice or action are unlikely to exceed a small fraction, as specified by the regulatory body, of the relevant limits, and that the likelihood and magnitude of potential exposures and any other potential detrimental consequences are negligible. Notification is required for consumer products only with respect to manufacture, maintenance, import, export, provision, distribution and, in some cases, disposal. | OR | This is the responsibility of the Owner/Licensee. |
| *Authorization: Registration or licensing* | | | |
| 3.8. | Any person or organization intending to carry out any of the actions specified in para. 3.5 shall, unless notification alone is sufficient, apply to the regulatory body for authorization18, which shall take the form of either registration19 or licensing. | OR | This is the responsibility of the Owner/Licensee. |
| 3.9. | Any person or organization applying for authorization:  (a) Shall submit to the regulatory body the relevant information necessary to support the application;  (b) Shall refrain from carrying out any of the actions specified in para. 3.5 until the registration or the licensee has been issued;  (c) Shall assess the nature, likelihood and magnitude of the expected exposures due to the source and shall take all necessary measures for protection and safety;  (d) Shall, if there is a possibility for an exposure to be greater than a level as specified by the regulatory body, have a safety assessment made and submitted to the regulatory body as part of the application; (e) Shall, as required by the regulatory body, have an appropriate prospective assessment made for radiological environmental impacts, commensurate with the radiation risks associated with the facility or activity. | OR | This is the responsibility of the Owner/Licensee. |

### Requirement 8: Exemption and clearance

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government or the regulatory body shall determine which practices or sources within practices are to be exempted from some or all of the requirements of these Standards. The regulatory body shall approve which sources, including materials and objects, within notified practices or authorized practices may be cleared from regulatory control.** | EP | This is the responsibility of the Government/Regulatory body. |
| *Exemption* | | | |
| 3.10. | The government or the regulatory body shall determine which practices or sources within practices are to be exempted from some or all of the requirements of these Standards, including the requirements for notification, registration or licensing, using as the basis for this determination the criteria for exemption specified in Schedule I or any exemption levels specified by the regulatory body on the basis of these criteria. | EP | This is the responsibility of the Government/Regulatory body.  Schedule I can be found in document named “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards” which was published by IAEA. |
| 3.11. | Exemption shall not be granted for practices deemed to be not justified. | EP | This is the responsibility of the Government/Regulatory body. |
| *Clearance* | | | |
| 3.12. | The regulatory body shall approve which sources, including materials and objects, within notified or authorized practices may be cleared from regulatory control, using as the basis for such approval the criteria for clearance specified in Schedule I or any clearance levels specified by the regulatory body on the basis of these criteria. By means of this approval, the regulatory body shall ensure that sources that have been cleared from regulatory control do not again become subject to the requirements for notification, registration or licensing unless it so specifies. | EP | This is the responsibility of the Regulatory body.  Schedule I can be found in document named “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards” which was published by IAEA. |

### Requirement 9: Responsibilities of registrants and licensees in planned exposure situations

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
| **Registrants and licensees shall be responsible for protection and safety in planned exposure situations.** | | | |
| 3.13. | Registrants and licensees shall bear the responsibility for setting up and implementing the technical and organizational measures that are necessary for protection and safety for the practices and sources for which they are authorized. Registrants and licensees may designate suitably qualified persons to carry out tasks relating to these responsibilities, but they shall retain the prime responsibility for protection and safety. Registrants and licensees shall document the names and responsibilities of persons designated to ensure compliance with the requirements of these Standards. | OR | This is the responsibility of the Owner/Licensee. |
| 3.14. | Registrants and licensees shall notify the regulatory body of any intention to introduce modifications to any practice or source for which they are authorized, whenever the modifications could have significant implications for protection and safety, and they shall not carry out any such modification unless it is specifically authorized by the regulatory body. | OR | This is the responsibility of the Owner/Licensee. |
| 3.15. | Registrants and licensees: (a) Shall establish clear lines of responsibility and accountability for protection and safety for the sources for which they are authorized, and shall establish organizational arrangements for protection and safety;  (b) Shall ensure that any delegation of responsibilities by a principal party is documented;  (c) Shall, for the sources for which they are authorized and for which a safety assessment is required in para. 3.9(d), conduct such a safety assessment and keep it up to date in accordance with para. 3.35;  (d) Shall, for the sources for which they are authorized and for which the regulatory body requires a prospective assessment to be made for radiological environmental impacts (see para. 3.9(e)), conduct such an assessment and keep it up to date;  (e) Shall assess the likelihood and magnitude of potential exposures, their likely consequences and the number of individuals who may be affected by them;  (f) Shall have in place operating procedures and arrangements for protection and safety that are subject to periodic review and updating under a management system; (g) Shall establish procedures for reporting on and learning from accidents and other incidents;  (h) Shall establish arrangements for the periodic review of the overall effectiveness of the measures for protection and safety; (i) Shall ensure that adequate maintenance, testing and servicing are carried out as necessary so that sources remain capable of fulfilling their design requirements for protection and safety throughout their lifetime;  (j) Shall ensure safe management of and control over all radioactive waste that is generated, and shall dispose of such waste in accordance with the regulatory requirements. | OR | This is the responsibility of the Owner/Licensee. |

### Requirement 10: Justification of practices

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government or the regulatory body shall ensure that only justified practices are authorized.** | EP | This is the responsibility of the Government/Regulatory body. |
| 3.16. | The government or the regulatory body, as appropriate, shall ensure that provision20 is made for the justification of any type of practice21 and for review of the justification, as necessary, and shall ensure that only justified practices are authorized. | EP | This is the responsibility of the Government/Regulatory body. |
| 3.17. | The following practices are deemed to be not justified:  (a) Practices, except for justified practices involving medical exposure22, that result in an increase in activity, by the deliberate addition of radioactive substances or by activation23, in food, feed, beverages, cosmetics or any other commodity or product intended for ingestion, inhalation or percutaneous intake by, or application to, a person;  (b) Practices involving the frivolous use of radiation or radioactive substances in commodities or in consumer products such as toys and personal jewellery or adornments, which result in an increase in activity, by the deliberate addition of radioactive substances or by activation23;  (c) Human imaging using radiation that is performed as a form of art or for publicity purposes. | NR | This is an explanatory statement, not a requirement. |
| 3.18. | Human imaging using radiation that is performed for occupational, legal or health insurance purposes24, and is undertaken without reference to clinical indication, shall normally be deemed to be not justified. If, in exceptional circumstances, the government or the regulatory body decides that the justification of such human imaging for specific practices is to be considered, the requirements of paras 3.61–3.64 and 3.66 shall apply. | NAP | This requirement is not applicable to the technology. |
| 3.19. | Human imaging using radiation for theft detection purposes shall be deemed to be not justified. | NAP | This requirement is not applicable to the technology. |
| 3.20. | Human imaging using radiation for the detection of concealed objects for anti-smuggling purposes shall normally be deemed to be not justified. If, in exceptional circumstances, the government or the regulatory body decides that the justification of such human imaging is to be considered, the requirements of paras 3.61–3.67 shall apply. | NAP | This requirement is not applicable to the technology. |
| 3.21. | Human imaging using radiation for the detection of concealed objects that can be used for criminal acts that pose a national security threat shall be justified only by the government. If the government decides that the justification of such human imaging is to be considered, the requirements of paras 3.61–3.67 shall apply. | NAP | This requirement is not applicable to the technology. |

### Requirement 11: Optimization of protection and safety

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government or the regulatory body shall establish and enforce requirements for the optimization of protection and safety, and registrants and licensees shall ensure that protection and safety is optimized.** | OR, EP | Responsibility of the Government/Regulatory body and the Owner/Responsibility.  Westinghouse has conducted the AP1000 design development under its recognized QMS and has taken prime responsibility for safety during the design development. In accordance to ALARA (As-Low-As-Reasonably Achievable) policy which is described in Chapter 12 of the DCD prepared for the AP1000 plant, Westinghouse ensures that radiation protection and safety is optimized.  Quote ‘optimized’ means that optimization of protection and safety has been applied and the result of that process has been implemented. |
| 3.22. | The government or the regulatory body:  (a) Shall establish and enforce requirements for the optimization of protection and safety;  (b) Shall require documentation addressing the optimization of protection and safety; (c) Shall establish or approve constraints25 on dose and on risk, as appropriate, or shall establish or approve a process for establishing such constraints, to be used in the optimization of protection and safety. | EP | This is the responsibility of the Government/Regulatory body. |
| 3.23. | Registrants and licensees shall ensure that protection and safety is optimized. | OR | This is the responsibility of the Owner/Licensee. |
| 3.24. | For occupational exposure and public exposure26, registrants and licensees shall ensure that all relevant factors are taken into account in a coherent way in the optimization of protection and safety to contribute to achieving the following objectives:  (a) To determine measures for protection and safety that are optimized for the prevailing circumstances, with account taken of the available options for protection and safety as well as the nature, likelihood and magnitude of exposures;  (b) To establish criteria, on the basis of the results of the optimization, for the restriction of the likelihood and magnitudes of exposures by means of measures for preventing accidents and for mitigating the consequences of those that do occur. | OR | This is the responsibility of the Owner/Licensee.  AP1000 design pursues the radiation protection principle of optimization. The design complies with 10 CFR 20, and Regulatory Guides 1.8, 8.8, and 8.10. These guidelines outline the practices of as low as reasonably achievable (ALARA) for nuclear power plants. The ALARA policy is applied to minimize occupational and public radiological effects. The design is reviewed as per ALARA considerations and updated based on experience from existing operating plants. ALARA reviews include the plant design and integrated layout, considering shielding, HVAC, and monitoring instrument designs as they relate to traffic control, security, access control and health physics. DCD Chapter 12 further discusses the application of ALARA principles in the design of the AP1000 plant and by following ALARA policy confirms that radiation protection and safety is optimized. Also, DCD Chapter 11 sheds a light on Radiation Monitoring and Effluents and DCD Chapter 13 provides information about conduct of operation, which describes operation in normal, abnormal and emergency conditions. |
| 3.25. | For occupational exposure and public exposure, registrants and licensees shall ensure, as appropriate, that relevant constraints are used in the optimization of protection and safety for any particular source within a practice.25 | OR | This is the responsibility of the Owner/Licensee.  AP1000 design pursues the radiation protection principle of optimization. The design complies with 10 CFR 20, and Regulatory Guides 1.8, 8.8, and 8.10. These guidelines outline the practices of ALARA for nuclear power plants. The ALARA policy is applied to minimize occupational and public radiological effects. |

### Requirement 12: Dose limits

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government or the regulatory body shall establish dose limits for occupational exposure and public exposure, and registrants and licensees shall apply these limits.** | OR, EP | This is the responsibility of the Government/Regulatory body and the Owner/Licensee. |
| 3.26. | The government or the regulatory body shall establish and the regulatory body shall enforce compliance with the dose limits specified in Schedule III for occupational exposures and public exposures in planned exposure situations. | EP | This is the responsibility of the Government/Regulatory body.  Schedule III can be found in document named “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards” which was published by IAEA. |
| 3.27. | The government or the regulatory body shall determine what additional restrictions, if any, are required to be complied with by registrants and licensees to ensure that the dose limits specified in Schedule III are not exceeded owing to possible combinations of doses from exposures due to different authorized practices. | EP | This is the responsibility of the Government/Regulatory body.  Schedule III can be found in document named “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards” which was published by IAEA. |
| 3.28. | Registrants and licensees shall ensure that the exposures of individuals due to the practices for which the registrants and licensees are authorized are restricted, so that neither the effective dose nor the equivalent dose to tissues or organs exceeds any relevant dose limit specified in Schedule III.27 | CWO, OR | This is the responsibility of the Owner/Licensee.  As explained in section 1.4 of this assessment, current AP1000 design is capable of fulfilling this requirement with appropriate radiation programs in place, even though these limits differ from the ones used in 10 CFR 20. Thus conservatively, this is considered as CWO since at some point there could be potentially the need to make additional analyses.  These are 10CFR20.1201 Occupational dose limits for adults.  (a) The licensee shall control the occupational dose to individual adults, except for planned special exposures under § 20.1206, to the following dose limits.  (1) An annual limit, which is the more limiting of:  (i) The total effective dose equivalent being equal to 5 rems (0.05 Sv); or  (ii) The sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems (0.50 Sv).  (2) The annual limits to the lens of the eye, to the skin of the whole body, and to the skin of the extremities, which are:  (i) A lens dose equivalent of 15 rems (0.15 Sv), and  (ii) A shallow-dose equivalent of 50 rem (0.50 Sv) to the skin of the whole body or to the skin of any extremity.  Schedule III can be found in document named “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards” which was published by IAEA. |

### Requirement 13: Safety assessment

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The regulatory body shall establish and enforce requirements for safety assessment, and the person or organization responsible for a facility or activity that gives rise to radiation risks shall conduct an appropriate safety assessment of this facility or activity.** | OR, EP | This is the responsibility of the Regulatory body and the Owner/Licensee. |
| 3.29. | The regulatory body shall establish requirements for persons or organizations responsible for facilities and activities that give rise to radiation risks to conduct an appropriate safety assessment28. Prior to the granting of an authorization, the responsible person or organization shall be required to submit a safety assessment, which shall be reviewed and assessed by the regulatory body. | OR, EP | This is the responsibility of the Regulatory body and the Owner/Licensee. |
| 3.30. | The person or organization, as required under para. 3.9(d), or registrants and licensees, as appropriate, shall conduct a safety assessment that is either generic or specific to the practice or source for which they are responsible.29 | OR, EP | This is the responsibility of the Owner/Licensee or other external party. |
| 3.31. | Safety assessments shall be conducted at different stages, including the stages of siting, design, manufacture, construction, assembly, commissioning, operation, maintenance and decommissioning (or closure) of facilities or parts thereof, as appropriate, so as:  (a) To identify the ways in which exposures could be incurred, account being taken of the effects of external events as well as of events directly involving the sources and associated equipment;  (b) To determine the expected likelihood and magnitudes of exposures in normal operation and, to the extent reasonable and practicable, to make an assessment of potential exposures;  (c) To assess the adequacy of the provisions for protection and safety. | OR, EP | This is the responsibility of the Owner/Licensee or other external party to perform Safety Assessment based on the inputs provided by Westinghouse.  Westinghouse has conducted the AP1000 design development under its recognized QMS and has taken prime responsibility for safety during the design development. The AP1000 design includes measures to reduce risk to people and the environment over the phases of the plant lifecycle. These measures are discussed in the DCD. DCD Chapter 2 discusses siting aspects and DCD chapter 19 includes a risk assessment of the design prior to being finalized to optimize the plant with respect to safety. DCD chapter 12 which discusses radiation safety and protection and DCD chapter 15 which describes accident analyses may help in identifying the ways in which exposures could be incurred. Same chapters may be helpful in assessing magnitudes of potential exposures. |
| 3.32. | The safety assessment shall include, as appropriate, a systematic critical review of:  (a) The operational limits and conditions for the operation of the facility; (b) The ways in which structures, systems and components, including software, and procedures relating to protection and safety might fail, singly or in combination, or might otherwise give rise to exposures, and the consequences of such events;  (c) The ways in which external factors could affect protection and safety;  (d) The ways in which operating procedures relating to protection and safety might be erroneous, and the consequences of such errors;  (e) The implications for protection and safety of any modifications;  (f) The implications for protection and safety of security measures or of any modifications to security measures;  (g) Any uncertainties or assumptions and their implications for protection and safety. | OR | This is the responsibility of the Owner/Licensee.  DCD prepared for the AP1000 plant brings information essential for safety assessment. Items are listed in: a) DCD chapter 16 discusses technical specification including operational limits and conditions, b) DCD chapter 15 discusses risk analysis, taking into consideration systems and components which may fail, resulting in giving rise to exposures.  c) DCD Chapter 3 contains external hazards which may affect protection and safety.  d) DCD Chapter 18 discusses human factors engineering, including operation procedures.  e) In the field of modifications Westinghouse comes with its OR procedure for upgrades in AP1000 design. This procedure establishes the requirements and responsibilities for proposing, evaluating, authorizing, and approving Design Changes for the AP1000 plant program. This procedure also applies when Westinghouse is making changes to the AP1000 plant design when the Owner is responsible for configuration control of the plant. After Design Authority/configuration control has been turned over to the Owner, this procedure applies to both changes initiated internally within Westinghouse or when Westinghouse is requested to make a design change from the Owner based upon the project’s contractual obligation. All Design Changes are being reviewed for the comprehensive effects of the change on other Functional Areas within each unit of the AP1000 plant fleet. The comprehensive effects of changes are being identified by listing (and subsequent tracking) Impacted and Affected Documents associated with a described change. Evaluation, collection, and tracking of Affected Documents are being performed prior to the approval of the Change Paper.  f) Same statement as for point e), g) Same statement as for point b). In the end Westinghouse is taking prime responsibility for safety during the design development. The future operator will be supported by Westinghouse in performing the site-specific safety assessments, starting with the preliminary safety analysis report supporting the application for a construction licensee. |
| 3.33. | The registrant or licensee shall take into account in the safety assessment:  (a) Factors that could give rise to a substantial release of radioactive material, the measures available to prevent or to control such a release, and the maximum activity of radioactive material that, in the event of a major failure of the containment, could be released to the environment;  (b) Factors that could give rise to a smaller but continuing release of radioactive material, and the measures available to detect and to prevent or to control such a release; (c) Factors that could give rise to unintended operation of any radiation generator or a loss of shielding, and the measures available to detect and to prevent or to control such occurrences;  (d) The extent to which the use of redundant and diverse safety features that are independent of each other, so that failure of one does not result in failure of any other, is appropriate to restrict the likelihood and magnitude of potential exposures. | OR | This is the responsibility of the Owner/Licensee. |
| 3.34. | Registrants and licensees shall ensure that the safety assessment is documented and, where appropriate, that it is independently reviewed under the relevant management system. | OR | This is the responsibility of the Owner/Licensee. |
| 3.35. | Registrants and licensees shall perform additional reviews of the safety assessment as necessary to ensure that the technical specifications or conditions of use continue to be met when:  (a) Significant modifications to the facility or to its operating procedures or maintenance procedures are envisaged;  (b) Significant changes occur on the site that could affect the safety of the facility or of activities on the site; (c) Information on operating experience, or information about accidents and other incidents that could result in exposures, indicates that the current assessment might be invalid;  (d) Any significant changes in activities are envisaged; (e) Any relevant changes in guidelines or standards have been made or are envisaged. | OR | This is the responsibility of the Owner/Licensee. |
| 3.36. | If as a result of a safety assessment, or for any other reason, opportunities to improve protection and safety appear to be available and improvement seems desirable, any consequential modifications shall be made cautiously and only after favourable assessment of all the implications for protection and safety. The implementation of all improvements shall be prioritized so as to optimize protection and safety. | OR | This is the responsibility of the Owner/Licensee.  In the field of design changes, Westinghouse should be informed and consulted. Westinghouse may help in the design and implementation of relevant modification on request, if any desirable improvement has been found. At the modifications stage Westinghouse comes with its own procedure for upgrades in AP1000 design. This procedure establishes the requirements and responsibilities for proposing, evaluating, authorizing, and approving Design Changes for the AP1000 plant program. This procedure also applies when Westinghouse is making changes to the AP1000 plant design when the Owner is responsible for configuration control of the plant. After Design Authority/configuration control has been turned over to the Owner, this procedure applies to both changes initiated internally within Westinghouse or when Westinghouse is requested to make a design change from the Owner based upon the project’s contractual obligation. All Design Changes are being reviewed for the comprehensive effects of the change on other Functional Areas within each unit of the AP1000 plant fleet. The comprehensive effects of changes are being identified by listing (and subsequent tracking) Impacted and Affected Documents associated with a described change. Evaluation, collection, and tracking of Affected Documents are being performed prior to the approval of the Change Paper. Westinghouse is responsible for all the modifications/improvements at design level. |

### Requirement 14: Monitoring for verification of compliance

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Registrants and licensees and employers shall conduct monitoring to verify compliance with the requirements for protection and safety.** | OR, EP | This is the responsibility of the Owner/Licensee and/or external party. |
| 3.37. | The regulatory body shall establish requirements that monitoring and measurements be performed to verify compliance with the requirements for protection and safety. The regulatory body shall be responsible for review and approval of the monitoring and measurement programmes of registrants and licensees. | EP | This is the responsibility of the Regulatory body. |
| 3.38. | Registrants and licensees and employers shall ensure that:  (a) Monitoring and measurements of parameters are performed as necessary for verification of compliance with the requirements of these Standards;  (b) Suitable equipment is provided and procedures for verification are implemented;  (c) Equipment is properly maintained, tested and calibrated at appropriate intervals with reference to standards traceable to national or international standards;  (d) Records are maintained of the results of monitoring and verification of compliance, as required by the regulatory body, including records of the tests and calibrations carried out in accordance with these Standards;  (e) The results of monitoring and verification of compliance are shared with the regulatory body as required. | OR, EP | This is the responsibility of the Owner/Licensee and/or external party.  The radiation monitoring system plus the portable equipment is sufficient to monitor the relevant radiological parameters.  The Radiation Monitoring System (RMS) is grouped into four categories:   * Process Monitors (liquid and gaseous), * Effluent Monitors (liquid and gaseous), * Airborne Monitors, * Area Monitors.   Process Monitors monitor systems processes. Ventilation streams and effluent paths are monitored by radiation monitors distributed throughout the plant. The radiation monitors consist of detectors, instruments, process sampling and conditioning skids, Local Radiation Processors, and associated components, as applicable.  Effluent monitors measure the gaseous and liquid discharges.  Airborne Monitors measure the airborne radioactivity and monitor and alert operating personnel to airborne radioactivity concentrations in excess of 10 DAC (Derived air concentration)-hours (as defined in 10 CFR 20). Certain of these monitors also perform process monitor functions, in that they initiate filtration of the ventilation stream.  The area radiation monitors are provided to supplement the personnel and area radiation survey provisions of the health physics program and to comply with the personnel radiation protection guidelines of 10 CFR 20, 10 CFR 50, and 10 CFR 70 (Domestic Licensing of Special Nuclear Material) and Regulatory Guides 1.97 (Criteria for Accident Monitoring Instrumentation for Nuclear Power Plant) and 8.8 (Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable). During fuel handling operations in containment and the fuel handling area, criticality monitoring functions are performed by area radiation monitors in combination with portable monitors, as required by the guidelines of 10 CFR 70.24.  Area monitors provide protection for plant personnel. Detectors are located so that their readouts are representative of the radiation to which the operating personnel would be exposed and local readout/alarm modules are located so that they are easily visible to the operating personnel.  Area monitors have identical alarm, display, and data storage capabilities as described for the process monitors. Area monitors have two distinct audible and visual alarms, initiated when a predetermined setpoint is exceeded on high radiation levels, which are located near the detector or in an area where the local visual alarm can be seen upon entry into the monitored area. Indication and alarms are also provided in the Main Control Room (MCR). |

### Requirement 15: Prevention and mitigation of accidents

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Registrants and licensees shall apply good engineering practice and shall take all practicable measures to prevent accidents and to mitigate the consequences of those accidents that do occur.** | OR | This is the responsibility of the Owner/Licensee. |
| *Good engineering practice* | | | |
| 3.39. | The registrant or licensee, in cooperation with other responsible parties, shall ensure that the siting, location, design, manufacture, construction, assembly, commissioning, operation, maintenance and decommissioning (or closure) of facilities or parts thereof are based on good engineering practice which shall, as appropriate:  (a) Take account of international and national standards; (b) Be supported by managerial and organizational features, with the purpose of ensuring protection and safety throughout the lifetime of the facility; (c) Include adequate safety margins in the design and construction of the facility, and in operations involving the facility, so as to ensure reliable performance in normal operation, and take account of the necessary quality, redundancy and capability for inspection, with emphasis on preventing accidents, mitigating the consequences of those accidents that do occur and restricting any possible future exposures; (d) Take account of relevant developments concerning technical criteria, as well as the results of any relevant research on protection and safety and feedback of information on lessons learned from experience. | COM, OR | 1. The AP1000 plant has been designed to a robust, comprehensive set of design codes and standards. The vast majority of these design codes have originated in the U.S. and are an accepted international best practice. The DCD defines the nuclear codes and standards implemented for the standard AP1000 plant design. The codes identified are primarily internationally accepted nuclear specific standards that have been developed and refined over the decades of advancements of nuclear technology in the U.S. and other countries. These include such standards as Section III of the American Society of Mechanical Engineers (ASME) Code for mechanical components and pressure vessels and American Concrete Institute (ACI 349) for concrete structures and systems, and American Institute of Steel Construction (AISC) N690 for the design of safety‐related concrete and steel structures. For electrical, I&C, and human factors design, the plant design has primarily followed Institute of Electrical and Electronic Engineers (IEEE) or U.S. NRC‐developed guidance. Such standards serve as the basis for Westinghouse nuclear power plant designs delivered throughout the world. An international supply chain is capable of designing and manufacturing equipment and materials in accordance with these standards. The worldwide acceptance of these standards supports the Westinghouse goal to maximize localization to the extent possible. These standards are widely understood and accepted by nuclear regulators.   The following sections of the DCD provide additional information on applicable codes and standards:   * DCD Sections 1.2.1.6 and 3.7.2 – codes and standards for structures, * DCD Section 1.9 – compliance with U.S. NRC Regulatory Criteria, * DCD Section 3.1 – compliance with 10 CFR 50,  Appendix A, * DCD Table 3.2‐3 – principal construction codes for mechanical and fluid system components, * DCD Section 7.1.4 – codes and standards for I&C systems, * DCD Section 8.1.4.3 – codes and standards for electrical systems.   The AP1000 follows applicable codes and standards for siting, design, construction, and assembly.   1. Westinghouse has conducted the AP1000 design development under its recognized QMS and has taken prime responsibility for safety during the design development. The AP1000 plant is designed with administrative programs and procedures to maximize the incorporation of good engineering practices. A primary objective for the AP1000 design is to achieve a very low risk of harm to people and the environment. The AP1000 design includes measures to reduce risk to people and the environment over the phases of the plant lifecycle. These measures are discussed in the DCD. 2. The AP1000 provides sufficient margins to reduce probability of exposure to ionizing radiation. 3. The AP1000 has used relevant operating experience from the existing nuclear power plant fleet to increase safety within the plant and help mitigate potential accidents and exposure.   The Owner/Licensee or/and external parties takes the responsibility to ensure that these requirements remain fulfilled after the commissioning of the AP1000 plant. |
| *Defence in depth* | | | |
| 3.40. | Registrants and licensees shall ensure that a multilevel (defence in depth) system of sequential, independent provisions for protection and safety that is commensurate with the likelihood and magnitude of potential exposures is applied to sources for which the registrants and licensees are authorized. Registrants and licensees shall ensure that if one level of protection were to fail, the subsequent independent level of protection would be available. Such defence in depth shall be applied for the purposes of: (a) Preventing accidents; (b) Mitigating the consequences of any accidents that do occur; (c) Restoring the sources to safe conditions after any such accidents. | OR | This is the responsibility of the Owner/Licensee.  The AP1000 plant design provides systems and procedures to maintain the plant in a controlled state and to prevent abnormal operation and failure. In normal operation, the most fundamental level of defense-in-depth ensures that the plant can be operated stably and reliably. This is achieved by the selection of materials, by using redundancy in key installation elements, by quality assurance during design and construction, by well-trained operators, and by an advanced control system and plant design that provide substantial margins for plant operation before approaching safety limits. The capability for mitigation of anticipated operational occurrences and design basis accidents is demonstrated in the safety analyses in DCD Chapter 15 and the summary of the PRA results presented in DCD Chapter 19. |
| *Accident prevention* | | | |
| 3.41. | Registrants and licensees shall ensure that structures, systems and components, including software, that are related to protection and safety for facilities and activities are designed, constructed, commissioned, operated and maintained so as to prevent accidents as far as reasonably practicable. | OR | This is the responsibility of the Owner/Licensee.  As mentioned previously in this requirement, a primary objective for the AP1000 design is to achieve a very low risk of harm to people and the environment. The AP1000 design includes measures to reduce risk to people and the environment over the phases of the plant lifecycle. These measures are discussed in the DCD. DCD Chapter 2 discusses siting aspects. DCD chapters 3 through 10 discuss design, manufacturing and construction aspects. DCD Chapter 11 discusses radioactive waste management aspects. DCD Chapter 12 discusses radiation protection. DCD Chapter 14 discusses commissioning aspects. DCD Chapter 15 discusses Accident Analyses, DCD Chapter 18 discusses Human Factors Engineering and DCD Chapter 19 discusses Probabilistic Risk Assessment. All these measures are used to prevent accidents as a far as reasonably practicable. |
| 3.42. | The registrant or licensee for any facility or activity shall make suitable arrangements:  (a) To prevent reasonably foreseeable accidents in the facility or the activity;  (b) To mitigate the consequences of those accidents that do occur;  (c) To provide workers with the information, instruction, training and equipment necessary to restrict potential exposures;  (d) To ensure that there are adequate procedures for the control of the facility and for the management of any reasonably foreseeable accidents;  (e) To ensure that safety significant structures, systems and components, including software, and other equipment can be inspected and tested regularly for any degradation that could lead to abnormal conditions or inadequate performance; (f) To ensure that maintenance, inspection and testing appropriate to the preservation of the provisions for protection and safety can be carried out without undue occupational exposure;  (g) To provide, wherever appropriate, automatic systems for safely shutting off or reducing the release of radiation from facilities in the event that operating conditions are outside the stipulated ranges;  (h) To ensure that abnormal operating conditions that could significantly affect protection and safety are detected by systems that respond quickly enough to allow for corrective action to be taken in a timely manner;  (i) To ensure that all relevant safety documentation is available in the appropriate languages understandable to users. | OR | This is the responsibility of the Owner/Licensee. |
| 3.43. | If the safety assessment indicates that there is a reasonable likelihood of an emergency affecting either workers or members of the public, the registrant or licensee shall prepare an emergency plan for the protection of people and the environment. As part of this emergency plan, the registrant or licensee shall include arrangements for the prompt identification of an emergency, and for determining the appropriate level of the emergency response [20]. In relation to the arrangements for the emergency response at the scene by the registrant or licensee, the emergency plan shall include, in particular:  (a) Provision for individual monitoring and area monitoring, and arrangements for medical treatment; (b) Arrangements for assessing and mitigating any consequences of an emergency. | OR | This is the responsibility of the Owner/Licensee.  The AP1000 PRA evaluation risk assessment includes calculations of the AP1000 response to severe accidents. This response includes the release of radionuclides. This analysis supports the technical basis for simplification of offsite emergency planning. The offsite emergency planning is discussed in Chapter 13 of DCD prepared for AP 1000 which may be helpful.  The area radiation monitors are provided to supplement the personnel and area radiation survey provisions of the health physics program and to comply with the personnel radiation protection guidelines of 10 CFR 20, 10 CFR 50, and 10 CFR 70 (Domestic Licensing of Special Nuclear Material) and Regulatory Guides 1.97 (Criteria for Accident Monitoring Instrumentation for Nuclear Power Plant) and 8.8 (Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable). During fuel handling operations in containment and the fuel handling area, criticality monitoring functions are performed by area radiation monitors in combination with portable monitors, as required by the guidelines of 10 CFR 70.24.  IAEA Safety Standards No. GSR Part 3, [1] align with EURATOM 2013/59 [10] and with ICRP-103 2007 Recommendations [9], which evolve from the previous process-based protection approach using practices and interventions by moving to an approach based on the exposure situation.  They recognize planned, emergency, and existing exposure situations, and apply the fundamental principles of justification and optimization of protection to all of these situations. They maintain the Commission’s current individual dose limits for effective dose and equivalent dose from all regulated sources in planned exposure situations. They reinforce the principle of optimization of protection, which should be applicable in a  similar way to all exposure situations, subject to the following restrictions on individual doses and risks; dose and risk constraints for planned exposure situations, and reference levels for emergency and existing exposure situations. |
| 3.44. | Registrants and licensees shall be responsible for the implementation of their emergency plans and shall be prepared to take any necessary action for effective response. To prevent the occurrence of conditions that could lead to a loss of control over a source or to the escalation of such conditions, registrants and licensees shall, as appropriate:  (a) Develop, maintain and implement procedures to provide the means for preventing loss of control over the source and for regaining control over the source as necessary;  (b) Make available equipment, instrumentation and diagnostic aids that may be needed;  (c) Train and periodically retrain personnel in the procedures to be followed and exercise the procedures. | OR | This is the responsibility of the Owner/Licensee. |

### Requirement 16: Investigations and feedback of information on operating experience

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Registrants and licensees shall conduct formal investigations of abnormal conditions arising in the operation of facilities or the conduct of activities, and shall disseminate information that is significant for protection and safety.** | OR | This is the responsibility of the Owner/Licensee. |
| 3.45. | Registrants and licensees shall ensure that information on both normal operation and abnormal conditions that are significant for protection and safety is disseminated or made available, as appropriate, to the regulatory body and relevant parties, as specified by the regulatory body. This information would include, for example, details of doses associated with given activities, data on maintenance, descriptions of events and information on corrective actions, and information on operating experience from other relevant facilities and activities. | OR | This is the responsibility of the Owner/Licensee. |
| 3.46. | Registrants and licensees shall conduct an investigation as specified by the regulatory body in the event that:  (a) A quantity or operating parameter relating to protection and safety exceeds an investigation level or is outside the stipulated range of operating conditions; or  (b) Any equipment failure, accident, error, mishap or other unusual event or condition occurs that has the potential for causing a quantity to exceed any relevant limit or operating restriction. | OR | This is the responsibility of the Owner/Licensee. |
| 3.47. | The registrant or licensee shall conduct an investigation as soon as possible after an event and shall prepare a written record of its causes, or suspected causes, including a verification or determination of any doses received or committed and recommendations for preventing the recurrence of the event and the occurrence of similar events. | OR | This is the responsibility of the Owner/Licensee. |
| 3.48. | The registrant or licensee shall communicate to the regulatory body and to any other relevant parties, as appropriate, a written report of any formal investigation relating to events as prescribed by the regulatory body, including exposures giving rise to doses exceeding a dose limit. The registrant or licensee shall also immediately report to the regulatory body any event in which a dose limit is exceeded. | OR | This is the responsibility of the Owner/Licensee. |

### Requirement 17: Radiation generators and radioactive sources

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Registrants and licensees shall ensure the safety of radiation generators and radioactive sources.** | NAP | This requirement is not applicable to the technology. |
| 3.49. | Registrants and licensees who are manufacturers or other suppliers of radiation generators and radioactive sources shall ensure that the following responsibilities are discharged, as applicable:  (a) Supplying a well designed, well manufactured and well constructed radiation generator or radioactive source and device in which the radiation generator or radioactive source is used that:  (i) Provides for protection and safety in accordance with the requirements of these Standards;  (ii) Meets engineering, performance and functional specifications;  (iii) Meets quality standards commensurate with the significance for protection and safety of systems and components, including software;  (iv) Provides clear displays, gauges and instructions on operating consoles in the appropriate language understandable to users.  (b) Ensuring that radiation generators and radioactive sources are tested to demonstrate compliance with the relevant specifications.  (c) Making information available, in the appropriate language understandable to users, on the proper installation and use of the radiation generator or radioactive source and on its associated radiation risks, including performance specifications, instructions for operating and maintenance, and instructions for protection and safety.  (d) Ensuring that the protection provided by shielding and by other protective devices is optimized. | NAP | This requirement is not applicable to the technology. |
| 3.50. | Where applicable, registrants and licensees shall make suitable arrangements with suppliers of radiation generators and radioactive sources, the regulatory body and relevant parties for the purposes of:  (a) Obtaining information on conditions of use and operating experience that may be important for protection and safety;  (b) Providing feedback and information that may have implications for protection and safety for other users, or that may have implications for the possibility for improvements in protection and safety for radiation generators and radioactive sources. | NAP | This requirement is not applicable to the technology. |
| 3.51. | When choosing a location to use or to store a radiation generator or radioactive source, registrants and licensees shall take into account:  (a) Factors that could affect the safe management of and control over the radiation generator or radioactive source;  (b) Factors that could affect occupational exposure and public exposure due to the radiation generator or radioactive source;  (c) The feasibility of taking the foregoing factors into account in engineering design. | NAP | This requirement is not applicable to the technology. |
| 3.52. | In selecting a site for a facility that will contain a large amount of radioactive material and that will have the potential for the release of significant amounts of radioactive material, registrants and licensees shall take into account features that might affect protection and safety, features that might affect the integrity or functioning of the facility, and the feasibility of carrying out off-site protective actions if they become necessary. | NAP | This requirement is not applicable to the technology. |
| 3.53. | Registrants and licensees shall maintain an inventory that includes records of:  (a) The location and description of each radiation generator or radioactive source for which they are responsible;  (b) The activity and form of each radioactive source for which they are responsible. | NAP | This requirement is not applicable to the technology. |
| 3.54. | Registrants and licensees shall provide the regulatory body as required with appropriate information from their inventory records of radiation generators and radioactive sources. | NAP | This requirement is not applicable to the technology. |
| 3.55. | Registrants and licensees shall keep radiation generators and radioactive sources under control so as to prevent loss or damage and to prevent any unauthorized person from carrying out any of the activities specified in para. 3.5, by ensuring that:  (a) Control over a radiation generator or radioactive source is relinquished only in compliance with all relevant requirements specified in the registration or licence;  (b) The regulatory body is promptly notified of information regarding a radiation generator or radioactive source that is lost, missing or not under control; (c) A radiation generator or radioactive source is transferred only if the recipient possesses the necessary authorization;  (d) An inventory, as required in para. 3.53, of radiation generators or radioactive sources is checked periodically to confirm that they are in their assigned locations and are under control. | NAP | This requirement is not applicable to the technology. |
| 3.56. | Registrants and licensees shall ensure that sealed sources are categorized in accordance with the categorization scheme set out in Schedule II, and in accordance with the requirements of the regulatory body. | NAP | This requirement is not applicable to the technology. |
| 3.57. | The manufacturer of a radioactive source or a device containing a radioactive source shall ensure that, where practicable, the source itself and its container are marked with the symbol recommended by the International Organization for Standardization [21]30. | NAP | This requirement is not applicable to the technology. |
| 3.58. | Registrants and licensees, in cooperation with manufacturers, shall ensure that, where practicable, sealed sources are identifiable and traceable. | NAP | This requirement is not applicable to the technology. |
| 3.59. | Registrants and licensees shall ensure that when radioactive sources are not in use they are stored in an appropriate manner for protection and safety. | NAP | This requirement is not applicable to the technology. |
| 3.60. | Registrants and licensees shall ensure that arrangements are made promptly for the safe management of and control over radiation generators and radioactive sources, including appropriate financial provision, once it has been decided to take them out of use. | NAP | This requirement is not applicable to the technology. |

### Requirement 18: Human imaging using radiation for purposes other than medical diagnosis, medical treatment or biomedical research

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government shall ensure that the use of ionizing radiation for human imaging for purposes other than medical diagnosis, medical treatment or biomedical research is subject to the system of protection and safety.** | NAP | This requirement is not applicable to the technology. |
| 3.61. | The government, if so decided in accordance with paras 3.18, 3.20 and 3.21, shall ensure that the requirements of para. 3.16 for the justification of practices are applied to any type of human imaging procedure in which radiation is used for purposes other than for medical diagnosis or medical treatment or other than as part of a programme of biomedical research. The justification process shall include the consideration of:  (a) The benefits and detriments of implementing the type of human imaging procedure;  (b) The benefits and detriments of not implementing the type of human imaging procedure;  (c) Any legal or ethical issues associated with the introduction of the type of human imaging procedure; (d) The effectiveness and suitability of the type of human imaging procedure, including the appropriateness of the radiation equipment for the intended use;  (e) The availability of sufficient resources to conduct the human imaging procedure safely throughout the intended period of the practice. | NAP | This requirement is not applicable to the technology. |
| 3.62. | If it has been determined by means of the process specified in para. 3.61 that a particular practice of human imaging using radiation is justified, then such a practice shall be subject to regulatory control. | NAP | This requirement is not applicable to the technology. |
| 3.63. | The regulatory body, in cooperation with other relevant authorities, agencies and professional bodies, as appropriate, shall establish the requirements for regulatory control of the practice and for review of the justification. | NAP | This requirement is not applicable to the technology. |
| 3.64. | For human imaging using radiation, performed by medical personnel using medical radiological equipment, that exposes people to radiation for employment related, legal or health insurance31 purposes without reference to clinical indications:  (a) The government shall ensure, on the basis of consultation between relevant authorities, professional bodies and the regulatory body, that dose constraints are established for such human imaging; (b) The registrant or licensee shall ensure that the appropriate optimization requirements for medical exposure in paras 3.162–3.177 are applied, with dose constraints as required in (a) above used instead of diagnostic reference levels. | NAP | This requirement is not applicable to the technology. |
| 3.65. | Procedures with inspection imaging devices in which radiation is used to expose persons for the purpose of detection of concealed weapons, contraband or other objects on or within the body shall be considered to give rise to public exposure. Registrants and licensees shall apply the requirements for public exposure in planned exposure situations. In particular, registrants and licensees shall ensure that optimization of protection and safety is subject to any dose constraints for public exposure set by the government or the regulatory body. | NAP | This requirement is not applicable to the technology. |
| 3.66. | Registrants and licensees shall ensure that all persons who are to undergo procedures with inspection imaging devices in which ionizing radiation is used are informed of the possibility of requesting the use of an alternative inspection technique that does not use ionizing radiation, where available. | NAP | This requirement is not applicable to the technology. |
| 3.67. | The registrant or licensee shall ensure that any inspection imaging device used for the detection of concealed objects on or within the body, whether it is manufactured in or imported into the State in which it is used, conforms to applicable standards of the International Electrotechnical Commission or the International Organization for Standardization or to equivalent national standards. | NAP | This requirement is not applicable to the technology. |

**OCCUPATIONAL EXPOSURE**

**Scope**

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
| 3.68 | The requirements in respect of occupational exposure in planned exposure situations (paras 3.69–3.116) apply to occupational exposure due to a practice or a source within a practice, as stated in paras 3.1–3.3; and to occupational exposure as required in Section 4 for emergency exposure situations and as required in Section 5 for existing exposure situations. For exposure due to natural sources, these requirements for occupational exposure in planned exposure situations apply, as appropriate, only to the exposure situations specified in para. 3.4(a), (c) and (d). | NR | This is an explanatory statement, not a requirement. |

### Requirement 19: Responsibilities of the regulatory body specific to occupational exposure

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government or the regulatory body shall establish and enforce requirements to ensure that protection and safety is optimized, and the regulatory body shall enforce compliance with dose limits for occupational exposure.** | EP | Responsibility of the Government/Regulatory body.  Westinghouse has conducted the AP1000 design development under its recognized QMS and has taken prime responsibility for safety during the design development. In accordance to ALARA policy which is described in Chapter 12 of the DCD prepared for the AP1000 plant, Westinghouse ensures that radiation protection and safety is optimized. |
| 3.69. | The government or the regulatory body shall establish the responsibilities of employers, registrants and licensees with regard to application of the requirements for occupational exposure in planned exposure situations. | EP | Responsibility of the Government/Regulatory body. |
| 3.70. | The government or the regulatory body shall establish and enforce requirements to ensure that protection and safety is optimized for occupational exposure. | EP | Responsibility of the Government/Regulatory body. |
| 3.71. | The government or the regulatory body shall establish, and the regulatory body shall enforce compliance with, the dose limits specified in Schedule III for occupational exposure. | EP | Responsibility of the Government/Regulatory body.  Schedule III can be found in document named “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards” which was published by IAEA. |
| 3.72. | Before authorization of a new or modified practice, the regulatory body shall require, as appropriate, and review supporting documents from the responsible parties that state:  (a) Design criteria and design features relating to the exposure and potential exposure of workers in all operational states and in accident conditions;  (b) Design criteria and design features of the appropriate systems and programmes for monitoring of workers for occupational exposure in all operational states and in accident conditions. | EP | This is the responsibility of the Regulatory body. |

### Requirement 20: Requirements for monitoring and recording of occupational exposures

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The regulatory body shall establish and enforce requirements for the monitoring and recording of occupational exposures in planned exposure situations.** | EP | This is the responsibility of the Regulatory body. |
| 3.73. | The regulatory body shall be responsible, as appropriate, for:  (a) Establishment and enforcement of requirements for the monitoring, recording and control of occupational exposures in planned exposure situations in accordance with the requirements of these Standards;  (b) Review of monitoring programmes of registrants and licensees, which shall be adequate to ensure that the requirements with regard to occupational exposure in planned exposure situations are fulfilled;  (c) Authorization or approval of service providers for individual monitoring and calibration services;  (d) Review of periodic reports on occupational exposure (including results of monitoring programmes and dose assessments) submitted by employers, registrants and licensees;  (e) Provision for maintaining exposure records and results of the assessment of doses from occupational exposure;  (f) Verification of compliance of an authorized practice with the requirements on the control of occupational exposure. | EP | This is the responsibility of the Regulatory body. |

### Requirement 21: Responsibilities of employers, registrants and licensees for the protection of workers

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Employers, registrants and licensees shall be responsible for the protection of workers against occupational exposure. Employers, registrants and licensees shall ensure that protection and safety is optimized and that the dose limits for occupational exposure are not exceeded.** | CWO, OR, EP | This is the responsibility of the Owner/Licensee or/and other external parties.  Westinghouse has conducted the AP1000 design development under its recognized QMS and has taken prime responsibility for safety during the design development. A primary objective for the AP1000 design is to achieve a very low risk of harm to people and the environment. The AP1000 design includes measures to reduce risk to people and the environment over the phases of the plant lifecycle. These measures are discussed in the DCD. ALARA policy confirms that radiation protection and safety from the design point of view is optimized.  As explained in section 1.4 of this assessment, current AP1000 design is capable of fulfilling this requirement with appropriate radiation programs in place, even though these limits differ to the ones used in 10 CFR 20. Thus conservatively, this is considered as CWO since at some point there could be potentially the need to make additional analyses. |
| 3.74. | For workers who are engaged in activities in which they are or could be subject to occupational exposure in planned exposure situations, employers, registrants and licensees shall be responsible for:  (a) Protection of workers against occupational exposure; (b) Compliance with other relevant requirements of these Standards. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.75. | Employers who are also registrants or licensees shall have the responsibilities of both employers and registrants or licensees. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.76. | Employers, registrants and licensees shall ensure, for all workers engaged in activities in which they are or could be subject to occupational exposure, that:  (a) Occupational exposure is controlled so that the relevant dose limits for occupational exposure specified in Schedule III are not exceeded;  (b) Protection and safety is optimized in accordance with the requirements of these Standards; (c) Decisions with regard to measures for protection and safety are recorded and made available to relevant parties, through their representatives where appropriate, as specified by the regulatory body;  (d) Policies, procedures and organizational arrangements for protection and safety are established for implementing the relevant requirements of these Standards, with priority given to design measures and technical measures for controlling occupational exposure;  (e) Suitable and adequate facilities, equipment and services for protection and safety are provided, the type and extent of which are commensurate with the expected likelihood and magnitude of occupational exposure;  (f) Necessary workers’ health surveillance and health services for workers are provided;  (g) Appropriate monitoring equipment and personal protective equipment is provided and arrangements are made for its proper use, calibration, testing and maintenance;  (h) Suitable and adequate human resources and appropriate training in protection and safety are provided, as well as periodic retraining as required to ensure the necessary level of competence;  (i) Adequate records are maintained in accordance with the requirements of these Standards;  (j) Arrangements are made to facilitate consultation of and cooperation with workers, through their representatives where appropriate, with regard to protection and safety on all measures necessary to achieve the effective application of these Standards;  (k) Necessary conditions for promoting safety culture are provided. | OR, EP | This is the responsibility of the Owner/Licensee or other external parties.  As explained in section 1.4 of this assessment, current AP1000 design is capable of fulfilling this requirement with appropriate radiation programs in place, even though these limits differ to the ones used in 10 CFR 20. This potentially might be a need to make additional analyses.  Schedule III can be found in document named “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards” which was published by IAEA. |
| 3.77. | Employers, registrants and licensees:  (a) Shall involve workers, through their representatives where appropriate, in optimization of protection and safety;  (b) Shall establish and use, as appropriate, constraints as part of optimization of protection and safety. | OR, EP | This is the responsibility of the Owner/Licensee or other external parties. |
| 3.78 | Employers, registrants and licensees shall ensure that workers exposed to radiation from sources within a practice that are not required by or directly related to their work have the same level of protection against such exposure as members of the public. | OR, EP | This is the responsibility of the Owner/Licensee or other external parties. |
| 3.79. | Employers, registrants and licensees shall take such administrative actions as are necessary to ensure that workers are informed that ensuring protection and safety is an integral part of a general occupational health and safety programme in which they have specific obligations and responsibilities for their OR protection and the protection of others against radiation exposure and for the safety of sources. | OR, EP | This is the responsibility of the Owner/Licensee or other external parties. |
| 3.80. | Employers, registrants and licensees shall record any report received from a worker that identifies circumstances that could affect compliance with the requirements of these Standards, and shall take appropriate action. | OR, EP | This is the responsibility of the Owner/Licensee or other external parties. |
| 3.81. | Nothing in these Standards shall be construed as relieving employers from complying with applicable national and local laws and regulations governing hazards in the workplace. | NR | This is explanatory statement, not a requirement. |
| 3.82. | Employers, registrants and licensees shall facilitate compliance by workers with the requirements of these Standards. | OR, EP | This is the responsibility of the Owner/Licensee or other external parties. |

### Requirement 22: Compliance by workers

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Workers shall fulfil their obligations and carry out their duties for protection and safety.** | OR | This is the responsibility of the Owner/Licensee to ensure that the employees follow the established rules. |
| 3.83. | Workers:  (a) Shall follow any applicable rules and procedures for protection and safety as specified by the employer, registrant or licensee;  (b) Shall use properly the monitoring equipment and personal protective equipment provided;  (c) Shall cooperate with the employer, registrant or licensee with regard to protection and safety, and programmes for workers’ health surveillance and programmes for dose assessment;  (d) Shall provide to the employer, registrant or licensee such information on their past and present work that is relevant for ensuring effective and comprehensive protection and safety for themselves and others;  (e) Shall abstain from any wilful action that could put themselves or others in situations that would not be in accordance with the requirements of these Standards; (f) Shall accept such information, instruction and training in protection and safety as will enable them to conduct their work in accordance with the requirements of these Standards. | OR | This is the responsibility of the Owner/Licensee to ensure that the employees are well informed about established rules and follow them. |
| 3.84. | A worker who identifies circumstances that could adversely affect protection and safety shall report such circumstances to the employer, registrant or licensee as soon as possible. | OR | This is the responsibility of the Owner/Licensee to ensure that the employees are well informed about established rules and follow them. |

### Requirement 23: Cooperation between employers and registrants and licensees

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Employers and registrants and licensees shall cooperate to the extent necessary for compliance by all responsible parties with the requirements for protection and safety.** | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.85. | If workers are engaged in work that involves or that could involve a source that is not under the control of their employer, the registrant or licensee responsible for the source and the employer shall cooperate to the extent necessary for compliance by both parties with the requirements of these Standards. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.86. | Cooperation between the employer and the registrant or licensee shall include, where appropriate:  (a) The development and use of specific restrictions on exposure and other means of ensuring that the measures for protection and safety for workers who are engaged in work that involves or could involve a source that is not under the control of their employer are at least as good as those for employees of the registrant or licensee;  (b) Specific assessments of the doses received by workers as specified in (a) above;  (c) A clear allocation and documentation of the responsibilities of the employer and those of the registrant or licensee for protection and safety. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.87. | As part of the cooperation between parties, the registrant or licensee responsible for the source or for the exposure as appropriate:  (a) Shall obtain from the employers, including self-employed persons, the previous occupational exposure history of workers as specified in para. 3.103, and any other necessary information;  (b) Shall provide appropriate information to the employer, including any available information relevant for compliance with the requirements of these Standards that the employer requests;  (c) Shall provide both the worker and the employer with the relevant exposure records. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |

### Requirement 24: Arrangements under the radiation protection programme

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Employers, registrants and licensees shall establish and maintain organizational, procedural and technical arrangements for the designation of controlled areas and supervised areas, for local rules and for monitoring of the workplace, in a radiation protection programme for occupational exposure.** | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties.  Westinghouse may assist in establishing procedural and technical arrangements in the area of radiation protection program for occupational exposure, if requested. Chapter 12 of the DCD prepared for the AP1000 plant describes radiation protection and safety what may be helpful in that case. Subsection 12.3 outlines zoning and risk of exposure to radiation within the listed zones. It might be used as a basis for an assessment of the expected annual doses and the probability and magnitude of potential exposure. In the AP1000 plant, the following radiation zones are used:    Previous Zoning should serve to inform this requirement.  Note also the consideration made about the inherent conservativeness embedded in this zoning as explained in subsection 1.4. Further, Westinghouse fully expects that measured dose rates within an operating AP1000 plant will be lower than the illustrated radiation zones in the DCD; and in fact, Westinghouse also expects that, with additional analysis efforts considering realistic source terms, it could be shown that many, if not almost all, of the zone limits indicated in the technical requirements are met. Secondly, although the AP1000 plant was designed in the U.S. where a 50 mSv/a individual dose limit applies, the AP1000 plant design (including radiation zoning) facilitates compliance with annual dose standards of 20 mSv/a for trained workers without any physical design changes or requirements for extraordinary radiation protection initiatives. |
| *Classification of areas: Controlled areas* | | | |
| 3.88. | Registrants and licensees shall designate as a controlled area any area32 in which specific measures for protection and safety are or could be required for:  (a) Controlling exposures or preventing the spread of contamination in normal operation;  (b) Preventing or limiting the likelihood and magnitude of exposures in anticipated operational occurrences and accident conditions. | OR | This is the responsibility of the Owner/Licensee.  AP1000 plant systems are equipped with safety related monitoring instrumentation and appropriate controls to provide quick feedback to any abnormal plant operation. Safety related instrumentation is redundant and on a multiple trained plant monitoring system. Chapter 7 of the DCD prepared for the AP1000 plant includes this topic. |
| 3.89. | In defining the boundaries of any controlled area, registrants and licensees shall take account of the magnitude of the exposures expected in normal operation, the likelihood and magnitude of exposures in anticipated operational occurrences and in accident conditions, and the type and extent of the procedures required for protection and safety. | OR | This is the responsibility of the Owner/Licensee. |
| 3.90. | Registrants and licensees:  (a) Shall delineate controlled areas by physical means or, where this is not reasonably practicable, by some other suitable means.  (b) Shall, where a source is only intermittently brought into operation or energized, or is moved from place to place, delineate an appropriate controlled area by means that are appropriate under the prevailing circumstances and shall specify exposure times.  (c) Shall display the symbol recommended by the International Organization for Standardization [21] and shall display instructions at access points to and at appropriate locations within controlled areas. (d) Shall establish measures for protection and safety, including, as appropriate, physical measures to control the spread of contamination and local rules and procedures for controlled areas.  (e) Shall restrict access to controlled areas by means of administrative procedures such as the use of work permits, and by physical barriers, which could include locks or interlocks, the degree of restriction being commensurate with the likelihood and magnitude of exposures.  (f) Shall provide, as appropriate, at entrances to controlled areas:  (i) Personal protective equipment;  (ii) Equipment for individual monitoring and workplace monitoring;  (iii) Suitable storage for personal clothing.  (g) Shall provide, as appropriate, at exits from controlled areas:  (i) Equipment for monitoring for contamination of skin and clothing;  (ii) Equipment for monitoring for contamination of any objects or material being removed from the area;  (iii) Washing or showering facilities and other personal decontamination facilities;  (iv) Suitable storage for contaminated personal protective equipment.  (h) Shall periodically review conditions to assess whether there is any need to modify the measures for protection and safety or the boundaries of controlled areas;  (i) Shall provide appropriate information, instruction and training for persons working in controlled areas. | OR | This is the responsibility of the Owner/Licensee.  The AP1000 design includes measures to reduce risk to people and the environment over the phases of the plant lifecycle. These measures are discussed in the DCD. The design considered this requirement, as described in DCD subsection 12.3 Radiation Protection Design Features. This subsection outlines the description of the different possible radiation exposure areas along the plant layout and it might be used a assist in the delineation and definition of control area limits. Additional precautions to avoid the spread of contamination out of the radiologically controlled area are described in DCD subsection 12.5. |
| *Classification of areas: Supervised areas* | | | |
| 3.91. | Registrants and licensees shall designate as a supervised area any area not already designated as a controlled area but for which occupational exposure conditions need to be kept under review, even though specific measures for protection and safety are not normally needed. | OR | This is the responsibility of the Owner/Licensee. |
| 3.92. | Registrants and licensees, taking into account the nature, likelihood and magnitude of exposures or contamination in the supervised areas:  (a) Shall delineate the supervised areas by appropriate means;  (b) Shall display approved signs, as appropriate, at access points to supervised areas;  (c) Shall periodically review conditions to assess whether there is any need for further measures for protection and safety or any need for changes to the boundaries of supervised areas. | OR | This is the responsibility of the Owner/Licensee. |
| *Local rules and procedures and personal protective equipment* | | | |
| 3.93 | Employers, registrants and licensees shall minimize the need to rely on administrative controls and personal protective equipment for protection and safety by providing well engineered controls and satisfactory working conditions, in accordance with the following hierarchy of preventive measures: (1) Engineered controls;  (2) Administrative controls;  (3) Personal protective equipment. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.94 | Employers, registrants and licensees, in consultation with workers, or through their representatives where appropriate: (a) Shall establish in writing local rules and procedures that are necessary for protection and safety for workers and other persons;  (b) Shall include in the local rules and procedures any relevant investigation level or authorized level, and the procedures to be followed in the event that any such level is exceeded;  (c) Shall make the local rules and procedures and the measures for protection and safety known to those workers to whom they apply and to other persons who may be affected by them;  (d) Shall ensure that any work in which workers are or could be subject to occupational exposure is adequately supervised and shall take all reasonable steps to ensure that the rules, procedures, and measures for protection and safety are observed;  (e) Shall designate, as appropriate, a radiation protection officer in accordance with criteria established by the regulatory body. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.95. | Employers, registrants and licensees shall ensure that:  (a) Workers are provided with suitable and adequate personal protective equipment that meets relevant standards or specifications, including as appropriate:  (i) Protective clothing;  (ii) Respiratory protective equipment the characteristics of which are made known to the users;  (iii) Protective aprons, protective gloves and organ shields.  (b) Where appropriate, workers receive adequate instruction in the proper use of respiratory protective equipment, including testing for good fit.  (c) Tasks requiring the use of certain personal protective equipment are assigned only to workers who on the basis of medical advice are capable of safely sustaining the extra effort necessary.  (d) All personal protective equipment, including equipment for use in an emergency, is maintained in proper condition and, if appropriate, is tested at regular intervals.  (e) If the use of personal protective equipment is considered for any given task, account is taken of any additional exposure that could result owing to the additional time taken or the inconvenience, and of any non-radiological risks that might be associated with using personal protective equipment while performing the task. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| *Monitoring of the workplace* | | | |
| 3.96. | Registrants and licensees, in cooperation with employers where appropriate, shall establish, maintain and keep under review a programme for workplace monitoring under the supervision of a radiation protection officer or qualified expert. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.97. | The type and frequency of workplace monitoring:  (a) Shall be sufficient to enable:  (i) Evaluation of the radiological conditions in all workplaces; (ii) Assessment of exposures in controlled areas and supervised areas;  (iii) Review of the classification of controlled areas and supervised areas.  (b) Shall be based on dose rate, activity concentration in air and surface contamination, and their expected fluctuations, and on the likelihood and magnitude of exposures in anticipated operational occurrences and accident conditions. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties.  Expected dose rates may be found in Chapter 12 of the DCD prepared for the AP1000 plant. This chapter in general discusses radiation protection and safety. |
| 3.98. | Registrants and licensees, in cooperation with employers where appropriate, shall maintain records of the findings of the workplace monitoring programme. The findings of the workplace monitoring programme shall be made available to workers, through their representatives where appropriate. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |

### Requirement 25: Assessment of occupational exposure and workers’ health surveillance

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Employers, registrants and licensees shall be responsible for making arrangements for assessment and recording of occupational exposures and for workers’ health surveillance.** | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| *Assessment of occupational exposure* | | | |
| 3.99. | Employers, as well as self-employed persons, and registrants and licensees shall be responsible for making arrangements for assessment of the occupational exposure of workers, on the basis of individual monitoring where appropriate, and shall ensure that arrangements are made with authorized or approved dosimetry service providers that operate under a quality management system. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties.  AP1000 RMS provides continuous monitoring of the radiation parameters as described in DCD Section 11.5. It includes monitoring of the radioactivity of the gaseous and liquid process streams, gaseous and liquid effluents, plant airborne and designated areas as shown in DCD Table 11.5-2. Portable (individual) dosimeters and devices for radiation monitoring are within the Owner/Licensee scope. |
| 3.100. | For any worker who usually works in a controlled area, or who occasionally works in a controlled area and may receive a significant dose from occupational exposure, individual monitoring shall be undertaken where appropriate, adequate and feasible. In cases where individual monitoring of the worker is inappropriate, inadequate or not feasible, the occupational exposure shall be assessed on the basis of the results of workplace monitoring and information on the locations and durations of exposure of the worker33. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties.  AP1000 RMS provides continuous monitoring of the radiation parameters as described in DCD Section 11.5. It includes monitoring of the radioactivity of the gaseous and liquid process streams, gaseous and liquid effluents, plant airborne and designated areas as shown in DCD Table 11.5-2. Portable (individual) dosimeters and devices for radiation monitoring are within the Owner/Licensee scope. |
| 3.101. | For any worker who regularly works in a supervised area or who enters a controlled area only occasionally, the occupational exposure shall be assessed on the basis of the results of workplace monitoring or individual monitoring, as appropriate. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties.  AP1000 RMS provides continuous monitoring of the radiation parameters as described in DCD Section 11.5. It includes monitoring of the radioactivity of the gaseous and liquid process streams, gaseous and liquid effluents, plant airborne and designated areas as shown in DCD Table 11.5-2. Portable (individual) dosimeters and devices for radiation monitoring are within the Owner/Licensee scope. |
| 3.102. | Employers shall ensure that workers who could be subject to exposure due to contamination are identified, including workers who use respiratory protective equipment. Employers shall arrange for appropriate monitoring to the extent necessary to demonstrate the effectiveness of the measures for protection and safety and to assess intakes of radionuclides and the committed effective doses. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| *Records of occupational exposure* | | | |
| 3.103. | Employers, registrants and licensees shall maintain records of occupational exposure34 for every worker for whom assessment of occupational exposure is required in paras 3.99–3.102. | OR, EP | This is the responsibility of the Owner/Licensee or other external parties. |
| 3.104. | Records of occupational exposure for each worker shall be maintained during and after the worker’s working life, at least until the former worker attains or would have attained the age of 75 years, and for not less than 30 years after cessation of the work in which the worker was subject to occupational exposure. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.105. | Records of occupational exposure shall include:  (a) Information on the general nature of the work in which the worker was subject to occupational exposure;  (b) Information on dose assessments, exposures and intakes at or above the relevant recording levels specified by the regulatory body and the data upon which the dose assessments were based;  (c) When a worker is or has been exposed while in the employ of more than one employer, information on the dates of employment with each employer and on the doses, exposures and intakes in each such employment;  (d) Records of any assessments made of doses, exposures and intakes due to actions taken in an emergency or due to accidents or other incidents, which shall be distinguished from assessments of doses, exposures and intakes due to normal conditions of work and which shall include references to reports of any relevant investigations. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.106. | Employers, registrants and licensees:  (a) Shall provide workers with access to records of their OR occupational exposure;  (b) Shall provide the supervisor of the programme for workers’ health surveillance, the regulatory body and the relevant employer with access to workers’ records of occupational exposure;  (c) Shall facilitate the provision of copies of workers’ exposure records to new employers when workers change employment;  (d) Shall make arrangements for the retention of exposure records for former workers by the employer, registrant or licensee, as appropriate;  (e) Shall, in complying with (a)–(d) above, give due care and attention to maintaining the confidentiality of records. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.107. | If employers, registrants and licensees cease to conduct activities in which workers are subject to occupational exposure, they shall make arrangements for the retention of workers’ records of occupational exposure by the regulatory body or a State registry, or by a relevant employer, registrant or licensee, as appropriate. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| *Workers’ health surveillance* | | | |
| 3.108. | Programmes for workers’ health surveillance as required in para. 3.76(f):  (a) Shall be based on the general principles of occupational health [22];  (b) Shall be designed to assess the initial fitness and continuing fitness of workers for their intended tasks. | OR, EP | This is the responsibility of the Owner/Licensee or/and other external parties. |
| 3.109. | If one or more workers are to be engaged in work in which they are or could be exposed to radiation from a source that is not under the control of their employer, the registrant or licensee responsible for the source shall, as a precondition for the engagement of such workers, make with the employer any special arrangements for workers’ health surveillance that are needed to comply with the rules established by the regulatory body or other relevant authority. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |

### Requirement 26: Information, instruction and training

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Employers, registrants and licensees shall provide workers with adequate information, instruction and training for protection and safety.** | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties.  In this case the DCD prepared for the AP1000 plant may help. Chapter 18 of DCD covers human factors engineering. All necessary information about radiation protection and safety can be found in chapter 12 of DCD. In the area of procedures, Chapter 13 of the DCD describes conduct of operation. Emergency planning is one of the points of this chapter. Some safety features are localized in chapter 16 of DCD which discusses technical specification. |
| 3.110. | Employers, in cooperation with registrants and licensees: (a) Shall provide all workers with adequate information on health risks due to their occupational exposure in normal operation, anticipated operational occurrences and accident conditions, adequate instruction and training and periodic retraining in protection and safety, and adequate information on the significance of their actions for protection and safety;  (b) Shall provide those workers who could be involved in or affected by the response to an emergency with appropriate information, and adequate instruction and training and periodic retraining, for protection and safety; (c) Shall maintain records of the training provided to individual workers. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties.  As mentioned previously in this requirement, the DCD may help in preparing relevant information significant for radiation protection and safety. |

### Requirement 27: Conditions of service

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Employers, registrants and licensees shall not offer benefits as substitutes for measures for protection and safety.** | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.111. | The conditions of service of workers shall be independent of whether they are or could be subject to occupational exposure. Special compensatory arrangements, or preferential consideration with respect to salary, special insurance coverage, working hours, length of vacation, additional holidays or retirement benefits, shall neither be granted nor be used as substitutes for measures for protection and safety in accordance with the requirements of these Standards. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.112. | Employers shall make all reasonable efforts to provide workers with suitable alternative employment in circumstances for which it has been determined, either by the regulatory body or in the framework of the programme for workers’ health surveillance in accordance with the requirements of these Standards, that workers, for health reasons, may no longer continue in employment in which they are or could be subject to occupational exposure. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |

### Requirement 28: Special arrangements for protection and safety for female workers and for persons under 18 years of age undergoing training

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Employers, registrants and licensees shall make special arrangements for female workers, as necessary, for protection of the embryo or fetus and breastfed infants. Employers, registrants and licensees shall make special arrangements for protection and safety for persons under 18 years of age who are undergoing training.** | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties to establish special arrangements for protection and safety to ensure that the persons described in the requirement does not exceed established limit as long as there is a will to let the described person enter the AP1000 power plant site. |
| 3.113. | Employers, in cooperation with registrants and licensees, shall provide female workers who are liable to enter controlled areas or supervised areas or who may undertake emergency duties with appropriate information on:  (a) The risk to the embryo or fetus due to exposure of a pregnant woman;  (b) The importance for a female worker of notifying her employer as soon as possible if she suspects that she is pregnant35 or if she is breast-feeding;  (c) The risk of health effects for a breastfed infant due to ingestion of radioactive substances. | OR, EP | This is the responsibility of the Owner/Licensee and/or other external parties. |
| 3.114. | Notification of the employer by a female worker if she suspects that she is pregnant or if she is breast-feeding shall not be considered a reason to exclude the female worker from work. The employer of a female worker, who has been notified of her suspected pregnancy or that she is breast-feeding, shall adapt the working conditions in respect of occupational exposure so as to ensure that the embryo or fetus or the breastfed infant is afforded the same broad level of protection as is required for members of the public. | OR, EP | This is the responsibility of the Owner/Licensee or other external parties. |
| 3.115. | Employers, registrants and licensees shall ensure that no person under the age of 16 years is or could be subject to occupational exposure. | OR, EP | This is the responsibility of the Owner/Licensee or other external parties. |
| 3.116. | Employers, registrants and licensees shall ensure that persons under the age of 18 years are allowed access to a controlled area only under supervision and only for the purpose of training for employment in which they are or could be subject to occupational exposure or for the purpose of studies in which sources are used. | OR, EP | This is the responsibility of the Owner/Licensee or other external parties. |

**PUBLIC EXPOSURE**

**Scope**

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
| 3.117. | The requirements in respect of public exposure in planned exposure situations (paras 3.118–3.144) apply to public exposure due to a practice or a source within a practice, as referred to in paras 3.1–3.3. For exposure due to natural sources, such requirements apply only to the types of public exposure specified in para. 3.4(a) and (b). | NR | This is an explanatory statement, not a requirement. |

### Requirement 29: Responsibilities of the government and the regulatory body specific to public exposure

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government or the regulatory body shall establish the responsibilities of relevant parties that are specific to public exposure, shall establish and enforce requirements for optimization, and shall establish, and the regulatory body shall enforce compliance with, dose limits for public exposure.** | EP | This is the responsibility of the Government/Regulatory body. |
| 3.118. | The government or the regulatory body shall establish the responsibilities of registrants and licensees, of suppliers, and of providers of consumer products36 in relation to the application of requirements for public exposure in planned exposure situations. | EP | This is the responsibility of the Government/Regulatory body. |
| 3.119. | The government or the regulatory body shall establish and enforce requirements for the optimization of protection and safety for situations in which individuals are or could be subject to public exposure. | EP | This is the responsibility of the Government/Regulatory body. |
| 3.120. | The government or the regulatory body shall establish or approve constraints on dose and constraints on risk to be used in the optimization of protection and safety for members of the public. When establishing or approving constraints in respect of a source within a practice, the government or the regulatory body shall take into account, as appropriate:  (a) The characteristics of the source and of the practice that are of relevance for public exposure;  (b) Good practice in the operation of similar sources;  (c) Dose contributions from other authorized practices or from possible future authorized practices37, estimated at the design and planning stage, so that the total dose to members of the public is not expected to exceed the dose limit at any time after the start of operation of the source;  (d) The views of interested parties. | EP | This is the responsibility of the Government/Regulatory body. |
| 3.121. | The government or the regulatory body shall establish, and the regulatory body shall enforce compliance with, the dose limits specified in Schedule III for public exposure. | EP | This is the responsibility of the Government/Regulatory body. |
| 3.122. | Before authorization of a new or modified practice, the regulatory body shall require the submission of, and shall review, the safety assessments (paras 3.29–3.36) and other design related documents from the responsible parties that address the optimization of protection and safety, the design criteria and the design features relating to the assessment of exposure and potential exposure of members of the public. | EP | This is the responsibility of the Regulatory body. |
| 3.123. | The regulatory body shall establish or approve operational limits and conditions relating to public exposure, including authorized limits for discharges. These operational limits and conditions:  (a) Shall be used by registrants and licensees as the criteria for demonstration of compliance after the commencement of operation of a source;  (b) Shall correspond to doses below the dose limits with account taken of the results of optimization of protection and safety;  (c) Shall reflect good practice in the operation of similar facilities or activities;  (d) Shall allow for operational flexibility;  (e) Shall take into account the results of the prospective assessment for radiological environmental impacts that is undertaken in accordance with requirements of the regulatory body (see paras 3.9(e) and 3.15(d)). | OR, EP | This is the responsibility of the Regulatory body and the Owner/Licensee. |
| 3.124. | When a source within a practice could cause public exposure outside the territory or other area under the jurisdiction or control of the State in which the source is located, the government or the regulatory body:  (a) Shall ensure that the assessment for radiological impacts includes those impacts outside the territory or other area under the jurisdiction or control of the State;  (b) Shall, to the extent possible, establish requirements for the control of discharges;  (c) Shall arrange with the affected State the means for the exchange of information and consultations, as appropriate. | EP | This is the responsibility of the Government/Regulatory body. |

### Requirement 30: Responsibilities of relevant parties specific to public exposure

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Relevant parties shall apply the system of protection and safety to protect members of the public against exposure.** | COM, OR | This is the responsibility of the Owner/Licensee.  Westinghouse has conducted the AP1000 design development under its recognized QMS and has taken prime responsibility for safety during the design development. A primary objective for the AP1000 design is to achieve a very low risk of harm to people and the environment. The AP1000 design includes measures to reduce risk to people and the environment over the phases of the plant lifecycle. These measures are discussed in the DCD. DCD Chapter 2 discusses siting aspects. DCD chapters 3 through 10 discuss design, manufacturing and construction aspects. DCD Chapter 11 discusses radioactive waste management aspects. DCD Chapter 12 discusses radiation protection. DCD Chapter 14 discusses commissioning aspects. DCD Chapter 15 discusses Accident Analyses, DCD Chapter 18 discusses Human Factors Engineering and DCD Chapter 19 discusses Probabilistic Risk Assessment.  The AP1000 was designed attending the US-NRC regulatory framework. This regulatory framework is mainly collected in the following: Title 10, Part 20, of the Code of Federal Regulations (10 CFR Part 20), "Standards for Protection Against Radiation"; 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities"; and Appendix I to 10 CFR Part 50, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents." |
| *General considerations* | | | |
| 3.125. | Registrants and licensees, in cooperation with suppliers and with providers of consumer products, shall apply the requirements of these Standards and shall verify and demonstrate compliance with them, as specified by the regulatory body, in relation to any public exposure delivered by a source for which they have responsibility. | CWO, OR | This is responsibility of the Owner/Licensee.  As explained in section 1.4 of this assessment, some differences in the standard are exist regarding public exposure; not with the Dose Limit which in both cases is set to 1 mSv effective dose, but in other areas such as the dose limits for the lens of the eye. Nevertheless Westinghouse is confident that the AP1000 plant can meet the dose limits provided in this standard by performing additional calculations based on appropriate assumptions. |
| 3.126. | Registrants and licensees, in cooperation with suppliers, in applying the principle of optimization of protection and safety in the design, planning, operation and decommissioning of a source (or for closure and the post-closure period for waste disposal facilities), shall take into account:  (a) Possible changes in any conditions that could affect exposure of members of the public, such as changes in the characteristics and use of the source, changes in environmental dispersion conditions, changes in exposure pathways or changes in values of parameters used for the determination of the representative person;  (b) Good practice in the operation of similar sources or the conduct of similar practices;  (c) Possible buildup and accumulation in the environment of radioactive substances from discharges during the lifetime of the source;  (d) Uncertainties in the assessment of doses, especially uncertainties in contributions to doses if the source and the representative person are separated in space or in time. | OR | This is the responsibility of the Owner/Licensee. |
| 3.127. | Registrants and licensees, for sources under their responsibility, shall establish, implement and maintain:  (a) Policies, procedures and organizational arrangements for protection and safety in relation to public exposure, in accordance with the requirements of these Standards.  (b) Measures for ensuring:  (i) Optimization of protection and safety;  (ii) Limitation of exposure of members of the public from such sources, in accordance with the authorization.  (c) Measures for ensuring the safety of such sources.  (d) Provision for suitable and adequate resources (including facilities, equipment and services) for the protection and safety of members of the public, commensurate with the likelihood and magnitude of exposures.  (e) Programmes for appropriate training of personnel having functions relevant to protection and safety of members of the public, as well as periodic retraining as required, to ensure the necessary level of competence.  (f) Provision for appropriate monitoring equipment, monitoring programmes and methods for assessing public exposure.  (g) Adequate records of monitoring programmes.  (h) Emergency plans, emergency procedures and emergency arrangements, in accordance with the nature and magnitude of the radiation risks associated with the sources. | OR | This is the responsibility of the Owner/Licensee.  DCD prepared for the AP1000 plant may be helpful in case of listed requirements. DCD Chapter 12 provides information about radiation protection and safety. This chapter contains explanation of ALARA policy which confirms that radiation protection and safety is optimized. DCD Chapter 13 may help with establishing operational and emergency procedures and provides guidance on personnel training. DCD Chapter 18 refers to human factors engineering. DCD Chapter 7 provides information about monitoring systems. AP1000 plant systems are equipped with safety related monitoring instrumentation and appropriate controls to provide quick feedback to any abnormal plant operation. Safety related instrumentation is redundant and on a multiple trained plant monitoring system.  AP1000 RMS provides continuous monitoring of the radiation parameters as described in DCD Section 11.5. It includes monitoring of the radioactivity of the gaseous and liquid process streams, gaseous and liquid effluents, plant airborne and designated areas as shown in DCD Table 11.5-2. |
| *Visitors* | | | |
| 3.128. | Registrants and licensees, in cooperation with employers where appropriate: (a) Shall apply the relevant requirements of these Standards in respect of public exposure for visitors to a controlled area or a supervised area;  (b) Shall ensure that visitors are accompanied in any controlled area by a person who knows the measures for protection and safety for the controlled area;  (c) Shall provide adequate information and instructions to visitors before they enter a controlled area or a supervised area, so as to provide for protection and safety for visitors and for other individuals who could be affected by their actions;  (d) Shall ensure that adequate control is maintained over the entry of visitors to a controlled area or a supervised area, including the use of signs for such areas. | OR | This is the responsibility of the Owner/Licensee. |
| *External exposure and contamination in areas accessible to members of the public* | | | |
| 3.129. | Registrants and licensees shall ensure that if a source can give rise to external exposure of members of the public:  (a) The floor plans and arrangements of equipment for all new installations utilizing such sources, as well as all significant modifications to existing installations, are subject, as appropriate, to review and approval by the regulatory body prior to commissioning;  (b) Shielding and other measures for protection and safety, including access control, are provided as appropriate for restricting public exposure, in particular at open sites such as for some applications of industrial radiography. | COM, OR | 1. Before a construction permit is issued, the technology is thoroughly evaluated by the national regulator. Any changes to the approved design impacting safety requires reevaluation. This also applies to the existing installations. The AP1000 plant design goes through the licensing process for every country and requires approval from the domestic regulator prior to construction and commissioning of the plant. 2. The design has considered this requirement. Areas in the AP1000 plant are classified as non-radiation areas and restricted radiologically controlled areas for radiation protection purposes. Restricted areas are further categorized as radiation areas, high radiation areas, airborne radioactivity areas, contamination areas, and radioactive materials areas, to comply with 10 CFR 20 and plant procedures and instructions.   Entrance to the RCA is normally through the access control area at the health physics area entry/exit location in the annex building, described at subsection 12.5.2 of DCD. High and very high radiation areas are segregated and identified in accordance with 10 CFR 20. The entrances to high and very high radiation areas are locked or barricaded and equipped with audible and/or visible alarms, as required. Radiation protection features have been described in Chapter 12 of DCD.  This is the responsibility of the Owner/Licensee to control the access to the plant after the commissioning process, including entry of members of the public under special permission. |
| 3.130. | Registrants and licensees shall ensure, as appropriate, that:  (a) Specific provisions for confinement are established for the design and operation of a source that could cause the spread of contamination in areas that are accessible to members of the public;  (b) Measures for protection and safety are implemented for restricting public exposure due to contamination in areas within a facility that are accessible to members of the public. | COM, OR | The design has considered this requirement. Areas in the AP1000 plant are classified as non-radiation areas and restricted radiologically controlled areas for radiation protection purposes. Restricted areas are further categorized as radiation areas, high radiation areas, airborne radioactivity areas, contamination areas, and radioactive materials areas, to comply with 10 CFR 20 and plant procedures and instructions.  Entrance to the RCA is normally through the access control area at the health physics area entry/exit location in the annex building, described at subsection 12.5.2 of DCD. High and very high radiation areas are segregated and identified in accordance with 10 CFR 20. The entrances to high and very high radiation areas are locked or barricaded and equipped with audible and/or visible alarms, as required. AP1000 RMS provides continuous monitoring of the radiation parameters as described in DCD Section 11.5. As such, access to the areas that contain radioactive sources is restricted, strictly controlled and these precautions prevent the spread of contamination, as well as ensure that the radiation hazard is continuously monitored. Westinghouse ensures that all economically justified measures and precautions have been established at the level of design to minimize the risk of public exposure.  It is the responsibility of the Owner/Licensee to control the access to the plant after the commissioning process, including entry of members of the public under special permission. |

### Requirement 31: Radioactive waste and discharges

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Relevant parties shall ensure that radioactive waste and discharges of radioactive material to the environment are managed in accordance with the authorization.** | OR, EP | This is the responsibility of the Owner/Licensee and/or external party.  In the DCD prepared for the AP1000 plant, Chapter 11 describes process of radioactive waste management which may be helpful in this case. |
| *Radioactive waste* | | | |
| 3.131. | Registrants and licensees, in cooperation with suppliers, as appropriate:  (a) Shall ensure that any radioactive waste generated is kept to the minimum practicable in terms of both activity and volume;  (b) Shall ensure that radioactive waste is managed in accordance with the requirements of these Standards and the requirements of other applicable IAEA standards, and in accordance with the relevant authorization;  (c) Shall ensure that there is separate processing of radioactive waste of different types, where warranted by differences in factors such as radionuclide content, half-life, activity concentration, volume, and physical and chemical properties, taking into account the available options for storage and disposal of radioactive waste, without precluding the mixing of radioactive waste for purposes of protection and safety;  (d) Shall ensure that activities for the predisposal management of and for the disposal of radioactive waste are conducted in accordance with the requirements of applicable IAEA standards38, and in accordance with the authorization;  (e) Shall maintain an inventory of all radioactive waste that is generated, stored, transferred or disposed of;  (f) Shall develop and implement a strategy for radioactive waste management and shall include appropriate evidence that protection and safety is optimized. | COM, OR, EP | This is the responsibility of the Owner/Licensee.  DCD Chapter 11 describes the standard AP1000 plant waste management systems.  (a) The AP1000 plant design conforms with the principles of waste management as far as practicable and fulfils these requirements. The minimization of radwaste is typically strongly dependent on the operational programs implemented within any given plant (specifically in the area of dry wastes). From a reactor design standpoint, appropriate measures have been taken to minimize the production of radwaste. These include proven radwaste treatment techniques and minimization of plant source term through appropriate materials selection. Material specifications related to source term reduction are described under “Materials” in subsection 12.3.1.1.1 and in Table 12.3-1 of the DCD.  The AP1000 standard plant design does not include provisions for packaging or volume reduction of solid radwaste. The final selection of the packaging and treatment solutions will be performed as part of site-specific project development,  (b) Radwaste Management is a responsibility of the Owner,  (c) As discussed throughout DCD Chapter 11, the AP1000 standard plant design provides appropriate design provisions for the management of liquid and gaseous radwaste for the entire lifecycle (generation, segregation, collection, treatment, and controlled discharge),  (d) (EP) Allowable activities for waste packages are determined by each countries taking into account the disposal options available (in line with IAEA guidance),  (e) Inventory Records will need to be incorporated by the Owner as part of the Owner-scope operational programs applicable to radiation protection, radioactive waste and spent fuel management,  (f) Radioactive waste management is to be included by the Owner in the operational programs applicable to radiation protection, radioactive waste and spent fuel management. |
| *Discharges* | | | |
| 3.132. | Registrants and licensees, in cooperation with suppliers, in applying for an authorization for discharges, as appropriate: (a) Shall determine the characteristics and activity of the material to be discharged, and the possible points and methods of discharge;  (b) Shall determine by an appropriate pre-operational study all significant exposure pathways by which discharged radionuclides could give rise to exposure of members of the public;  (c) Shall assess the doses to the representative person due to the planned discharges;  (d) Shall consider the radiological environmental impacts in an integrated manner with features of the system of protection and safety, as required by the regulatory body;  (e) Shall submit to the regulatory body the findings of (a)–(d) above as an input to the establishment by the regulatory body, in accordance with para. 3.123, of authorized limits on discharges and conditions for their implementation. | COM, OR | This is the responsibility of the Owner/Licensee.  (a) In the AP1000 design, monitoring features are provided within the plant to ensure that planned discharges to the environment are performed appropriately and that discharge lines are isolated in the event that discharges exceed expectation. Refer to DCD Chapter 11 for a description of controlled gaseous and liquid discharges, as well as information on the plant radiation monitoring system. Sampling provisions are included in the radioactive waste systems.  (b)(c)(d)(e) This is an Owner Requirement and will be subject to a Project Specific Study, which will take into account the Site Specific Information, the regulatory requirements (Limits, dose constraints), and the information on discharges, see (a). |
| 3.133. | Registrants and licensees shall ensure that operational limits and conditions relating to public exposure are met in accordance with paras 3.123 and 3.124. | OR | This is the responsibility of the Owner/Licensee. |
| 3.134. | Registrants and licensees shall review and modify their discharge control measures, as appropriate and in agreement with the regulatory body, taking into account:  (a) Operating experience;  (b) Any changes in exposure pathways or in the characteristics of the representative person that could affect the assessment of doses due to the discharges. | OR | This is the responsibility of the Owner/Licensee.  The design has considered this requirement. AP1000 plant is designed in a way that all liquid and gaseous release points are monitored using continuous radiation monitoring system RMS. AP1000 Effluent monitoring shall most likely conform with Recommendation 2004/2/Euratom which provides guidance to EU countries on the reporting of discharges of radioactive nuclides. |

### Requirement 32: Monitoring and reporting

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The regulatory body and relevant parties shall ensure that programmes for source monitoring and environmental monitoring are in place and that the results from the monitoring are recorded and are made available.** | OR, EP | This is the responsibility of the regulatory body and the Owner/Licensee or other External Institutions.  AP1000 RMS provides continuous monitoring of the radiation parameters as described in DCD Section 11.5. It includes monitoring of the radioactivity of the gaseous and liquid process streams, gaseous and liquid effluents, plant airborne and designated areas as shown in DCD Table 11.5-2. |
| 3.135. | The regulatory body shall be responsible, as appropriate, for:  (a) Review and approval of monitoring programmes of registrants and licensees, which shall be sufficient for:  (i) Verifying compliance with the requirements of these Standards in respect of public exposure in planned exposure situations;  (ii) Assessing doses from public exposure.  (b) Review of periodic reports on public exposure (including results of monitoring programmes and dose assessments) submitted by registrants and licensees.  (c) Making provision for an independent monitoring programme.  (d) Assessment of the total public exposure due to authorized sources and practices in the State on the basis of monitoring data provided by registrants and licensees and with the use of data from independent monitoring and assessments.  (e) Making provision for maintaining records of discharges, results of monitoring programmes and results of assessments of public exposure.  (f) Verification of compliance of an authorized practice with the requirements of these Standards for the control of public exposure. | EP | This is the responsibility of the Regulatory body. |
| 3.136. | The regulatory body shall publish or shall make available on request, as appropriate, results from source monitoring and environmental monitoring programmes and assessments of doses from public exposure. | EP | This is the responsibility of the Regulatory body. |
| 3.137. | Registrants and licensees shall, as appropriate:  (a) Establish and implement monitoring programmes to ensure that public exposure due to sources under their responsibility is adequately assessed and that the assessment is sufficient to verify and demonstrate compliance with the authorization. These programmes shall include monitoring of the following, as appropriate:  (i) External exposure due to such sources;  (ii) Discharges;  (iii) Radioactivity in the environment;  (iv) Other parameters important for the assessment of public exposure.  (b) Maintain appropriate records of the results of the monitoring programmes and estimated doses to members of the public.  (c) Report or make available to the regulatory body the results of the monitoring programme at approved intervals, including, as applicable, the levels and composition of discharges, dose rates at the site boundary and in premises open to members of the public, results of environmental monitoring and retrospective assessments of doses to the representative person.  (d) Report promptly to the regulatory body any levels exceeding the operational limits and conditions relating to public exposure, including authorized limits on discharges, in accordance with reporting criteria established by the regulatory body.  (e) Report promptly to the regulatory body any significant increase in dose rate or concentrations of radionuclides in the environment that could be attributed to the authorized practice, in accordance with reporting criteria established by the regulatory body.  (f) Establish and maintain a capability to conduct monitoring in an emergency in the event of unexpected increases in radiation levels or in concentrations of radionuclides in the environment due to an accident or other unusual event attributed to the authorized source or facility.  (g) Verify the adequacy of the assumptions made for the assessment of public exposure and the assessment for radiological environmental impacts.  (h) Publish or make available on request, as appropriate, results from source monitoring and environmental monitoring programmes and assessments of doses from public exposure. | OR | This is the responsibility of the Owner/Licensee.  AP1000 plant systems are equipped with safety related monitoring instrumentation and appropriate controls to provide quick feedback to any abnormal plant operation. Safety related instrumentation is redundant and on a multiple trained plant monitoring system. Monitors are localized at strategic points to indicate any undesirable releases. These monitors are used to ensure that personnel, members of public, and environment are safe from radioactivity. Chapter 7 of the DCD prepared for the AP1000 plant includes this topic. |

### Requirement 33: Consumer products

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Providers of consumer products shall ensure that consumer products are not made available to the public unless their use by members of the public has been justified, and either their use has been exempted or their provision to the public has been authorized.** | NAP | The requirement is not applicable to the technology. |
| 3.138. | Providers of consumer products shall ensure that consumer products are not made available to the public unless the justification of their use by members of the public has been approved by the government or the regulatory body, and either their use has been exempted on the basis of the criteria specified in Schedule I or their provision to the public has been authorized. | NAP | The requirement is not applicable to the technology. |
| 3.139. | Upon receipt of a request for authorization to provide consumer products to the public, the regulatory body:  (a) Shall require the provider of the consumer product to provide documents to demonstrate compliance with the requirements in paras 3.138–3.144;  (b) Shall verify the assessments and the selection of parameters presented in the request for authorization;  (c) Shall determine whether the end use of the consumer product can be exempted;  (d) Shall authorize the provision to the public of the consumer product, where appropriate, subject to specific conditions of authorization. | NAP | The requirement is not applicable to the technology. |
| 3.140. | Providers of consumer products:  (a) Shall comply with the conditions of the authorization to provide consumer products to the public;  (b) Shall ensure that consumer products comply with the requirements of these Standards;  (c) Shall plan for appropriate arrangements for the servicing, maintenance, recycling or disposal of consumer products. | NAP | The requirement is not applicable to the technology. |
| 3.141. | The design and manufacture of consumer products, with regard to features that could affect exposure during normal handling, transport and use, as well as in the event of mishandling, misuse, accident or disposal, shall be subject to the optimization of protection and safety. In this regard, designers, manufacturers and other providers of consumer products shall take into account the following:  (a) The various radionuclides that could be used in consumer products and their radiation types, energies, activities and half-lives;  (b) The chemical and physical forms of the radionuclides that could be used in consumer products and their significance for protection and safety in normal conditions and abnormal conditions;  (c) The containment and shielding of radioactive substances in consumer products and access to these radioactive substances in normal conditions and abnormal conditions;  (d) The need for servicing or repair of consumer products and ways in which this could be done;  (e) Relevant experience with similar consumer products. | NAP | The requirement is not applicable to the technology. |
| 3.142. | Providers of consumer products shall ensure that:  (a) Where practicable, a legible label is firmly affixed to a visible surface of each consumer product that:  (i) States that the consumer product contains radioactive substances and identifies the radionuclides and their activities;  (ii) States that the provision of the consumer product to the public has been authorized by the regulatory body;  (iii) Provides information on required or recommended options for recycling or disposal.  (b) The information specified in (a) above is also printed legibly on the retail packaging of the consumer product. | NAP | The requirement is not applicable to the technology. |
| 3.143. | Providers of consumer products shall provide clear and appropriate information and instructions with each consumer product on: (a) Correct installation, use and maintenance of the consumer product;  (b) Servicing and repair;  (c) The radionuclides and their activities at a specified date;  (d) Dose rates in normal operation and during servicing and repair;  (e) Required or recommended options for recycling or disposal. | NAP | The requirement is not applicable to the technology. |
| 3.144. | Providers of consumer products shall provide the consumer product retailers with appropriate information on safety and instructions on their transport and storage. | NAP | The requirement is not applicable to the technology. |

**PUBLIC EXPOSURE**

**Scope**

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
| 3.145. | The requirements in respect of medical exposure in planned exposure situations (paras 3.146–3.185) apply to all medical exposures39, including intended, unintended and accidental exposures. | NR | This is an explanatory statement, not a requirement. |
| 3.146. | Dose limits do not apply to medical exposures. | NR | This is an explanatory statement, not a requirement. |

### Requirement 34: Responsibilities of the government specific to medical exposure

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government shall ensure that relevant parties are authorized to assume their roles and responsibilities, and that diagnostic reference levels, dose constraints, and criteria and guidelines for the release of patients are established.** | NAP | The requirement is not applicable to the technology. |
| 3.147. | The government, in accordance with paras 2.13–2.28, shall ensure with regard to medical exposures that, as a result of consultation between the health authority, relevant professional bodies and the regulatory body, the relevant parties identified in paras 2.40 and 2.41 are authorized to assume their roles and responsibilities, and shall ensure that they are notified of their duties in relation to protection and safety for individuals undergoing medical exposures. | NAP | The requirement is not applicable to the technology. |
| 3.148. | The government shall ensure, as part of the responsibilities specified in para. 2.15, that as a result of consultation between the health authority, relevant professional bodies and the regulatory body, a set of diagnostic reference levels is established for medical exposures incurred in medical imaging, including image guided interventional procedures. In setting such diagnostic reference levels, account shall be taken of the need for adequate image quality, to enable the requirements of para. 3.169 to be fulfilled. Such diagnostic reference levels shall be based, as far as possible, on wide scale surveys or on published values that are appropriate for the local circumstances. | NAP | The requirement is not applicable to the technology. |
| 3.149. | The government shall ensure that, as a result of consultation between the health authority, relevant professional bodies and the regulatory body, the following are established:  (a) Dose constraints, to enable the requirements of paras 3.173 and 3.174, respectively, to be fulfilled for:  (i) Exposures of carers and comforters40;  (ii) Exposures due to diagnostic investigations of volunteers participating in a programme of biomedical research.  (b) Criteria and guidelines for the release of patients who have undergone therapeutic radiological procedures using unsealed sources or patients who still retain implanted sealed sources. | NAP | The requirement is not applicable to the technology. |

### Requirement 35: Responsibilities of the regulatory body specific to medical exposure

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The regulatory body shall require that health professionals with responsibilities for medical exposure are specialized in the appropriate area and that they fulfil the requirements for education, training and competence in the relevant specialty.** | NAP | The requirement is not applicable to the technology. |
| 3.150. | The regulatory body shall ensure that the authorization for medical exposures to be performed at a particular medical radiation facility allows personnel (radiological medical practitioners, medical physicists, medical radiation technologists and any other health professionals with specific duties in relation to the radiation protection of patients) to assume the responsibilities specified in these Standards only if they: (a) Are specialized41 in the appropriate area42;  (b) Meet the respective requirements for education, training and competence in radiation protection, in accordance with para. 2.32;  (c) Are named in a list maintained up to date by the registrant or licensee. | NAP | The requirement is not applicable to the technology. |

### Requirement 36: Responsibilities of registrants and licensees specific to medical exposure

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Registrants and licensees shall ensure that no person incurs a medical exposure unless there has been an appropriate referral, responsibility has been assumed for ensuring protection and safety, and the person subject to exposure has been informed as appropriate of the expected benefits and risks.** | NAP | The requirement is not applicable to the technology. |
| 3.151. | Registrants and licensees shall ensure that no patient, whether symptomatic or asymptomatic, undergoes a medical exposure unless:  (a) It is a radiological procedure that has been requested by a referring medical practitioner and information on the clinical context has been provided, or it is part of an approved health screening programme;  (b) The medical exposure has been justified by means of consultation between the radiological medical practitioner and the referring medical practitioner, as appropriate, or it is part of an approved health screening programme;  (c) A radiological medical practitioner has assumed responsibility for protection and safety in the planning and delivery of the medical exposure as specified in para. 3.154(a);  (d) The patient or the patient’s legal authorized representative has been informed as appropriate of the expected diagnostic or therapeutic benefits of the radiological procedure as well as the radiation risks. | NAP | The requirement is not applicable to the technology. |
| 3.152. | Registrants and licensees shall ensure that no individual incurs a medical exposure as part of a programme of biomedical research unless the exposure has been approved by an ethics committee (or other institutional body that has been assigned functions similar to those of an ethics committee by the relevant authority) as required in para. 3.161 and a radiological medical practitioner has assumed responsibility as specified in para. 3.154(a). Registrants and licensees shall ensure that the requirements specified in para. 3.174 are fulfilled for the optimization of protection and safety for persons subject to exposure as part of a programme of biomedical research. | NAP | The requirement is not applicable to the technology. |
| 3.153. | Registrants and licensees shall ensure that no individual incurs a medical exposure as a carer or comforter unless he or she has received, and has indicated an understanding of, relevant information on radiation protection and information on the radiation risks prior to providing care and comfort to an individual undergoing a radiological procedure. Registrants and licensees shall ensure that the requirements specified in para. 3.173 are fulfilled for the optimization of protection and safety for any radiological procedure in which an individual acts as a carer or comforter. | NAP | The requirement is not applicable to the technology. |
| 3.154. | Registrants and licensees shall ensure that:  (a) The radiological medical practitioner performing or overseeing the radiological procedure has assumed responsibility for ensuring overall protection and safety for patients in the planning and delivery of the medical exposure, including the justification of the radiological procedure as required in paras 3.155–3.161 and the optimization of protection and safety, in cooperation with the medical physicist and the medical radiation technologist as required in paras 3.162–3.177;  (b) Radiological medical practitioners, medical physicists, medical radiation technologists and other health professionals with specific duties in relation to protection and safety for patients in a given radiological procedure are specialized in the appropriate area;  (c) Sufficient medical personnel and paramedical personnel are available as specified by the health authority;  (d) For therapeutic radiological procedures, the requirements of these Standards for calibration, dosimetry and quality assurance, including the acceptance and commissioning of medical radiological equipment, as specified in paras 3.167, 3.168(c), 3.170 and 3.171, are fulfilled by or under the supervision of a medical physicist;  (e) For diagnostic radiological procedures and image guided interventional procedures, the requirements of these Standards for medical imaging, calibration, dosimetry and quality assurance, including the acceptance and commissioning of medical radiological equipment, as specified in paras 3.167, 3.168(a) and (b), 3.169, 3.170 and 3.171, are fulfilled by or under the oversight of or with the documented advice of a medical physicist, whose degree of involvement is determined by the complexity of the radiological procedures and the associated radiation risks;  (f) Any delegation of responsibilities by a principal party is documented. | NAP | The requirement is not applicable to the technology. |

### Requirement 37: Justification of medical exposures

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Relevant parties shall ensure that medical exposures are justified.** | NAP | The requirement is not applicable to the technology. |
| 3.155. | Medical exposures shall be justified by weighing the diagnostic or therapeutic benefits43 that they are expected to yield against the radiation detriment that they might cause, with account taken of the benefits and the risks of available alternative techniques that do not involve medical exposure. | NAP | The requirement is not applicable to the technology. |
| 3.156. | Generic justification of a radiological procedure shall be carried out by the health authority in conjunction with appropriate professional bodies, and shall be reviewed from time to time, with account taken of advances in knowledge and technological developments. | NAP | The requirement is not applicable to the technology. |
| 3.157. | The justification of medical exposure for an individual patient shall be carried out by means of consultation between the radiological medical practitioner and the referring medical practitioner, as appropriate, with account taken, in particular for patients who are pregnant or breast-feeding or are paediatric, of:  (a) The appropriateness of the request;  (b) The urgency of the radiological procedure;  (c) The characteristics of the medical exposure;  (d) The characteristics of the individual patient;  (e) Relevant information from the patient’s previous radiological procedures. | NAP | The requirement is not applicable to the technology. |
| 3.158. | Relevant national or international referral guidelines shall be taken into account for the justification of the medical exposure of an individual patient in a radiological procedure. | NAP | The requirement is not applicable to the technology. |
| 3.159. | Justification for radiological procedures to be performed as part of a health screening programme for asymptomatic populations shall be carried out by the health authority in conjunction with appropriate professional bodies. | NAP | The requirement is not applicable to the technology. |
| 3.160 | Any radiological procedure on an asymptomatic individual that is intended to be performed for the early detection of disease, but not as part of an approved health screening programme, shall require specific justification for that individual by the radiological medical practitioner and the referring medical practitioner, in accordance with the guidelines of relevant professional bodies or the health authority. As part of this process, the individual shall be informed in advance of the expected benefits, risks and limitations of the radiological procedure. | NAP | The requirement is not applicable to the technology. |
| 3.161. | The medical exposure of volunteers as part of a programme of biomedical research is deemed to be not justified unless:  (a) It is in accordance with the provisions of the Helsinki Declaration [23] and takes into account the guidelines published by the Council for International Organizations of Medical Sciences [24], together with the recommendations of the ICRP [25];  (b) It is subject to approval by an ethics committee (or other institutional body that has been assigned functions similar to those of an ethics committee by the relevant authority), subject to any dose constraints that may be specified (as required in paras 3.149(a)(ii) and 3.174), and subject to applicable national regulations and local regulations. | NAP | The requirement is not applicable to the technology. |

### Requirement 38: Optimization of protection and safety

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Registrants and licensees and radiological medical practitioners shall ensure that protection and safety is optimized for each medical exposure.** | NAP | The requirement is not applicable to the technology. |
| *Design considerations* | | | |
| 3.162. | In addition to ensuring that the responsibilities stated in para. 3.49 are discharged, as applicable, registrants and licensees, in cooperation with suppliers, shall ensure that medical radiological equipment and software that could influence the delivery of medical exposure are used only if they conform to the applicable standards of the International Electrotechnical Commission and the International Organization for Standardization or to national standards adopted by the regulatory body. | NAP | The requirement is not applicable to the technology. |
| *Operational considerations* | | | |
| 3.163. | For diagnostic radiological procedures and image guided interventional procedures, the radiological medical practitioner, in cooperation with the medical radiation technologist and the medical physicist, and if appropriate with the radiopharmacist or radiochemist, shall ensure that the following are used:  (a) Appropriate medical radiological equipment and software, and, for nuclear medicine, appropriate radiopharmaceuticals;  (b) Appropriate techniques and parameters to deliver a medical exposure of the patient that is the minimum necessary to fulfil the clinical purpose of the radiological procedure, with account taken of relevant norms of acceptable image quality established by relevant professional bodies and of relevant diagnostic reference levels established in accordance with paras 3.148 and 3.169. | NAP | The requirement is not applicable to the technology. |
| 3.164. | For therapeutic radiological procedures, the radiological medical practitioner, in cooperation with the medical physicist and the medical radiation technologist, shall ensure that for each patient the exposure of volumes other than the planning target volume is kept as low as reasonably achievable consistent with delivery of the prescribed dose to the planning target volume within the required tolerances. | NAP | The requirement is not applicable to the technology. |
| 3.165. | For therapeutic radiological procedures in which radiopharmaceuticals are administered, the radiological medical practitioner, in cooperation with the medical physicist and the medical radiation technologist, and if appropriate with the radiopharmacist or radiochemist, shall ensure that for each patient the appropriate radiopharmaceutical with the appropriate activity is selected and administered, so that the radioactivity is primarily localized in the organ(s) of interest, while the radioactivity in the rest of the body is kept as low as reasonably achievable. | NAP | The requirement is not applicable to the technology. |
| 3.166. | Registrants and licensees shall ensure that the particular aspects of medical exposures are considered in the optimization process for:  (a) Paediatric patients subject to medical exposure;  (b) Individuals subject to medical exposure as part of an approved health screening programme;  (c) Volunteers subject to medical exposure as part of a programme of biomedical research; (d) Relatively high doses44 to the patient;  (e) Exposure of the embryo or fetus, in particular for radiological procedures in which the abdomen or pelvis of the pregnant female patient is exposed to the useful radiation beam or could otherwise receive a significant dose;  (f) Exposure of a breastfed infant as a result of a female patient having undergone a radiological procedure with radiopharmaceuticals. | NAP | The requirement is not applicable to the technology. |
| *Calibration* | | | |
| 3.167. | In accordance with para. 3.154(d) and (e), the medical physicist shall ensure that:  (a) All sources giving rise to medical exposure are calibrated in terms of appropriate quantities using internationally accepted or nationally accepted protocols;  (b) Calibrations are carried out at the time of commissioning a unit prior to clinical use, after any maintenance procedure that could affect the dosimetry and at intervals approved by the regulatory body;  (c) Calibrations of radiation therapy units are subject to independent verification45 prior to clinical use;  (d) Calibration of all dosimeters used for dosimetry of patients and for the calibration of sources is traceable to a standards dosimetry laboratory. | NAP | The requirement is not applicable to the technology. |
| *Dosimetry of patients* | | | |
| 3.168. | Registrants and licensees shall ensure that dosimetry of patients is performed and documented by or under the supervision of a medical physicist, using calibrated dosimeters and following internationally accepted or nationally accepted protocols, including dosimetry to determine the following: (a) For diagnostic radiological procedures, typical doses to patients for common procedures;  (b) For image guided interventional procedures, typical doses to patients;  (c) For therapeutic radiological procedures, absorbed doses to the planning target volume for each patient treated with external beam therapy and/or brachytherapy and absorbed doses to relevant tissues or organs as determined by the radiological medical practitioner;  (d) For therapeutic radiological procedures with unsealed sources, typical absorbed doses to patients. | NAP | The requirement is not applicable to the technology. |
| *Diagnostic reference levels* | | | |
| 3.169. | Registrants and licensees shall ensure that:  (a) Local assessments, on the basis of the measurements required in para. 3.168, are made at approved intervals for those radiological procedures for which diagnostic reference levels have been established (para. 3.148).  (b) A review is conducted to determine whether the optimization of protection and safety for patients is adequate, or whether corrective action is required if, for a given radiological procedure:  (i) Typical doses or activities exceed the relevant diagnostic reference level; or  (ii) Typical doses or activities fall substantially below the relevant diagnostic reference level and the exposures do not provide useful diagnostic information or do not yield the expected medical benefit to the patient. | NAP | The requirement is not applicable to the technology. |
| *Quality assurance for medical exposures* | | | |
| 3.170. | Registrants and licensees, in applying the requirements of these Standards in respect of management systems, shall establish a comprehensive programme of quality assurance for medical exposures with the active participation of medical physicists, radiological medical practitioners, medical radiation technologists and, for complex nuclear medicine facilities, radiopharmacists and radiochemists, and in conjunction with other health professionals as appropriate. Principles established by the World Health Organization, the Pan American Health Organization and relevant professional bodies shall be taken into account. | NAP | The requirement is not applicable to the technology. |
| 3.171. | Registrants and licensees shall ensure that programmes of quality assurance for medical exposure include, as appropriate to the medical radiation facility: (a) Measurements of the physical parameters of medical radiological equipment made by, or under the supervision of, a medical physicist:  (i) At the time of acceptance and commissioning of the equipment prior to its clinical use on patients;  (ii) Periodically thereafter;  (iii) After any major maintenance procedure that could affect protection and safety of patients;  (iv) After any installation of new software or modification of existing software that could affect protection and safety of patients.  (b) Implementation of corrective actions if measured values of the physical parameters mentioned in (a) above are outside established tolerance limits.  (c) Verification of the appropriate physical and clinical factors used in radiological procedures.  (d) Maintaining records of relevant procedures and results.  (e) Periodic checks of the calibration and conditions of operation of dosimetry equipment and monitoring equipment. | NAP | The requirement is not applicable to the technology. |
| 3.172. | Registrants and licensees shall ensure that regular and independent audits are made of the programme of quality assurance for medical exposures, and that their frequency is in accordance with the complexity of the radiological procedures being performed and the associated risks. | NAP | The requirement is not applicable to the technology. |
| *Dose constraints* | | | |
| 3.173. | Registrants and licensees shall ensure that relevant dose constraints (para. 3.149(a)(i)) are used in the optimization of protection and safety in any radiological procedure in which an individual acts as a carer or comforter. | NAP | The requirement is not applicable to the technology. |
| 3.174. | Registrants and licensees shall ensure that dose constraints specified or approved by the ethics committee (or other institutional body that has been assigned functions similar to those of an ethics committee by the relevant authority) on a case by case basis as part of a proposal for biomedical research (para. 3.161) are used in the optimization of protection and safety for persons subject to exposure as part of a programme of biomedical research. | NAP | The requirement is not applicable to the technology. |

### Requirement 39: Pregnant or breast-feeding female patients

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Registrants and licensees shall ensure that there are arrangements in place for appropriate radiation protection in cases where a female patient is or might be pregnant or is breast-feeding.** | NAP | The requirement is not applicable to the technology. |
| 3.175. | Registrants and licensees shall ensure that signs in appropriate languages are placed in public places, waiting rooms for patients, cubicles and other appropriate places, and that other means of communication are also used as appropriate46, to request female patients who are to undergo a radiological procedure to notify the radiological medical practitioner, medical radiation technologist or other personnel in the event that:  (a) She is or might be pregnant;  (b) She is breast-feeding and the scheduled radiological procedure includes the administration of a radiopharmaceutical. | NAP | The requirement is not applicable to the technology. |
| 3.176. | Registrants and licensees shall ensure that there are procedures in place for ascertaining the pregnancy status of a female patient of reproductive capacity before the performance of any radiological procedure that could result in a significant dose to the embryo or fetus, so that this information can be considered in the justification for the radiological procedure (paras 3.155 and 3.156) and in the optimization of protection and safety (para. 3.166). | NAP | The requirement is not applicable to the technology. |
| 3.177. | Registrants and licensees shall ensure that there are arrangements in place for establishing that a female patient is not currently breast-feeding before the performance of any radiological procedure involving the administration of a radiopharmaceutical that could result in a significant dose to a breastfed infant, so that this information can be considered in the justification for the radiological procedure (paras 3.155 and 3.157) and in the optimization of protection and safety (para. 3.166). | NAP | The requirement is not applicable to the technology. |

### Requirement 40: Release of patients after radionuclide therapy

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Registrants and licensees shall ensure that there are arrangements in place to ensure appropriate radiation protection for members of the public and for family members before a patient is released following radionuclide therapy.** | NAP | The requirement is not applicable to the technology. |
| 3.178. | The radiological medical practitioner shall ensure that no patient who has undergone a therapeutic radiological procedure with a sealed source or an unsealed source is discharged from a medical radiation facility until it has been established by either a medical physicist or the facility’s radiation protection officer that: (a) The activity of radionuclides in the patient is such that doses that could be received by members of the public and family members would be in compliance with the requirements set by the relevant authorities (para. 3.149(b)); and  (b) The patient or the legal guardian of the patient is provided with:  (i) Written instructions for keeping doses to persons in contact with or in the vicinity of the patient as low as reasonably achievable and for avoiding the spread of contamination;  (ii) Information on the radiation risks. | NAP | The requirement is not applicable to the technology. |

### Requirement 41: Unintended and accidental medical exposures

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Registrants and licensees shall ensure that all practicable measures are taken to minimize the likelihood of unintended or accidental medical exposures. Registrants and licensees shall promptly investigate unintended or accidental medical exposures and, if appropriate, shall implement corrective actions.** | NAP | The requirement is not applicable to the technology. |
| 3.179. | Registrants and licensees, in accordance with the relevant requirements of paras 2.51, 3.41–3.42 and 3.49–3.50, shall ensure that all practicable measures are taken to minimize the likelihood of unintended or accidental medical exposures arising from flaws in design and operational failures of medical radiological equipment, from failures of and errors in software, or as a result of human error. | NAP | The requirement is not applicable to the technology. |
| *Investigation of unintended and accidental medical exposures* | | | |
| 3.180. | Registrants and licensees shall promptly investigate any of the following unintended or accidental medical exposures:  (a) Any medical treatment delivered to the wrong individual or to the wrong tissue or organ of the patient, or using the wrong radiopharmaceutical, or with an activity, a dose or dose fractionation differing substantially from (over or under) the values prescribed by the radiological medical practitioner, or that could lead to unduly severe secondary effects;  (b) Any diagnostic radiological procedure or image guided interventional procedure in which the wrong individual or the wrong tissue or organ of the patient is subject to exposure;  (c) Any exposure for diagnostic purposes that is substantially greater than was intended;  (d) Any exposure arising from an image guided interventional procedure that is substantially greater than was intended; (e) Any inadvertent exposure of the embryo or fetus in the course of performing a radiological procedure;  (f) Any failure of medical radiological equipment, failure of software or system failure, or accident, error, mishap or other unusual occurrence with the potential for subjecting the patient to a medical exposure that is substantially different from what was intended. | NAP | The requirement is not applicable to the technology. |
| 3.181. | Registrants and licensees shall, with regard to any unintended or accidental medical exposures investigated as required in para. 3.180:  (a) Calculate or estimate the doses received and the dose distribution within the patient;  (b) Indicate the corrective actions required to prevent the recurrence of such an unintended or accidental medical exposure;  (c) Implement all the corrective actions that are under their OR responsibility;  (d) Produce and keep, as soon as possible after the investigation or as otherwise required by the regulatory body, a written record that states the cause of the unintended or accidental medical exposure and includes the information specified in (a)–(c) above, as relevant, and any other information as required by the regulatory body; and for significant unintended or accidental medical exposures or as otherwise required by the regulatory body, submit this written record, as soon as possible, to the regulatory body, and to the relevant health authority if appropriate;  (e) Ensure that the appropriate radiological medical practitioner informs the referring medical practitioner and the patient or the patient’s legal authorized representative of the unintended or accidental medical exposure. | NAP | The requirement is not applicable to the technology. |

### Requirement 42: Reviews and records

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **Registrants and licensees shall ensure that radiological reviews are performed periodically at medical radiation facilities and that records are maintained.** | NAP | The requirement is not applicable to the technology. |
| *Radiological reviews* | | | |
| 3.182. | Registrants and licensees shall ensure that radiological reviews are performed periodically by the radiological medical practitioners at the medical radiation facility, in cooperation with the medical radiation technologists and the medical physicists. The radiological review shall include an investigation and critical review of the current practical application of the radiation protection principles of justification and optimization for the radiological procedures that are performed in the medical radiation facility. | NAP | The requirement is not applicable to the technology. |
| *Records* | | | |
| 3.183. | Registrants and licensees shall maintain for a period as specified by the regulatory body and shall make available, as required, the following personnel records:  (a) Records of any delegation of responsibilities by a principal party (as required in para. 3.154(f));  (b) Records of training of personnel in radiation protection (as required in para. 3.150(b)). | NAP | The requirement is not applicable to the technology. |
| 3.184. | Registrants and licensees shall maintain for a period as specified by the regulatory body and shall make available, as required, the following records of calibration, dosimetry and quality assurance:  (a) Records of the results of the calibrations and periodic checks of the relevant physical and clinical parameters selected during treatment of patients;  (b) Records of dosimetry of patients, as required in para. 3.168;  (c) Records of local assessments and reviews made with regard to diagnostic reference levels, as required in para. 3.169;  (d) Records associated with the quality assurance programme, as required in para. 3.171(d). | NAP | The requirement is not applicable to the technology. |
| 3.185. | Registrants and licensees shall maintain for a period as specified by the regulatory body and shall make available, as required, the following records for medical exposure:  (a) For diagnostic radiology, information necessary for retrospective assessment of doses, including the number of exposures and the duration of fluoroscopic radiological procedures;  (b) For image guided interventional procedures, information necessary for retrospective assessment of doses, including the duration of the fluoroscopic component and the number of images acquired;  (c) For nuclear medicine, the types of radiopharmaceutical administered and their activity;  (d) For external beam radiation therapy or brachytherapy, a description of the planning target volume, the absorbed dose to the centre of the planning target volume, and the maximum and minimum absorbed doses delivered to the planning target volume, or equivalent alternative information on absorbed doses to the planning target volume, and the absorbed doses to relevant tissues or organs as determined by the radiological medical practitioner; and in addition, for external beam radiation therapy, the dose fractionation and the overall treatment time;  (e) Exposure records for volunteers subject to medical exposure as part of a programme of biomedical research;  (f) Reports on investigations of unintended and accidental medical exposures (as required in para. 3.181(d)). | NAP | The requirement is not applicable to the technology. |

## Emergency exposure situations

**Scope**

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
| 4.1. | The requirements for emergency exposure situations established in Section 4 apply to activities undertaken in preparedness for and in response to a nuclear or radiological emergency. | NR | This an explanatory statement, not a requirement. |

**GENERIC REQUIREMENTS**

### Requirement 43: Emergency management system

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government shall ensure that an integrated and coordinated emergency management system is established and maintained.** | EP | This is the responsibility of the Government.  Westinghouse DCD prepared for the AP1000 plant may be helpful in developing emergency management system. Conduct of operation described in chapter 13 of the DCD includes emergency planning. Also, chapter 19 of the DCD is Probabilistic Risk Assessment, and it contains hazards assessment that may be helpful with preparing for different types of emergency events. |
| 4.2. | The government shall ensure that an emergency management system is established and maintained on the territories and within the jurisdiction of the State for the purposes of emergency response to protect human life, health and the environment in the event of a nuclear or radiological emergency. | EP | This is the responsibility of the Government. |
| 4.3. | The emergency management system shall be designed to be commensurate with the results of a hazard assessment [20] and to enable an effective emergency response to reasonably foreseeable events (including very low probability events) in connection with facilities or activities. | OR | This is the responsibility of the Owner/Licensee. |
| 4.4. | The emergency management system shall be integrated, to the extent practicable, into an all-hazards emergency management system. | OR | This is the responsibility of the Owner/Licensee. |
| 4.5. | The emergency management system shall provide for essential elements at the scene, and at the local, national and international level, as appropriate, including the following [20]:  (a) Hazard assessment;  (b) Development and exercising of emergency plans and emergency procedures;  (c) Clear allocation of responsibilities to persons and organizations having roles in the arrangements for emergency preparedness and response;  (d) Arrangements for efficient and effective cooperation and coordination among organizations;  (e) Reliable communication, including public information;  (f) Optimized protection strategies for the implementation and the termination of measures for the protection of members of the public who could be subject to exposure in an emergency, including relevant considerations for protection of the environment;  (g) Arrangements for the protection of emergency workers;  (h) Education and training, including training in radiation protection, of all persons involved in emergency response and exercising of emergency plans and emergency procedures;  (i) Preparations for the transition from emergency exposure situation to existing exposure situation;  (j) Arrangements for the medical response and the public health response in an emergency;  (k) Provision for individual monitoring and environmental monitoring and for dose assessment;  (l) Involvement of relevant parties and interested parties. | OR | This is the responsibility of the Owner/Licensee.  Westinghouse DCD prepared for the AP1000 plant may be helpful in developing emergency management system. Conduct of operation described at chapter 13 of the DCD includes emergency planning. Also, chapter 19 of the DCD is Probabilistic Risk Assessment, and it contains hazards assessment that may be helpful with preparing for different types of emergency events. |
| 4.6. | The government shall ensure the coordination of its emergency arrangements and capabilities with the relevant international emergency arrangements. | EP | This is the responsibility of the Government. |

**PUBLIC EXPOSURE**

### Requirement 44: Preparedness and response for an emergency

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government shall ensure that protection strategies are developed, justified and optimized at the planning stage, and that emergency response is undertaken by their timely implementation.** | EP | This is the responsibility of the Government. |
| 4.7. | The government shall ensure that protection strategies are developed, justified and optimized at the planning stage, by using scenarios based on the hazard assessment, for avoiding deterministic effects and reducing the likelihood of stochastic effects due to public exposure. | EP | This is the responsibility of the Government.  Chapter 19 of the DCD prepared for the AP1000 plant is Probabilistic Risk Assessment and it contains hazards assessment that may be helpful in meeting this requirement. |
| 4.8. | Development of a protection strategy shall include, but shall not be limited to, the following three successive steps: (1) A reference level expressed in terms of residual dose shall be set, typically an effective dose in the range of 20–100 mSv, that includes dose contributions via all exposure pathways. The protection strategy shall include planning for residual doses to be as low as reasonably achievable below the reference level, and the strategy shall be optimized.  (2) On the basis of the outcome of the optimization of the protection strategy, using the reference level, generic criteria for particular protective actions and other response actions, expressed in terms of projected dose or of dose that has been received, shall be developed. If the numerical values of the generic criteria47 are exceeded, those protective actions and other response actions, either individually or in combination, shall be implemented.  (3) Once the protection strategy has been optimized and a set of generic criteria has been developed, pre-established operational criteria for initiating the different parts of an emergency plan, primarily for the initial phase, shall be derived from the generic criteria. Operational criteria, such as on-scene conditions, operational intervention levels and emergency action levels, shall be expressed in terms of parameters or observable conditions. Arrangements shall be established in advance to revise these operational criteria, as appropriate, in an emergency, with account taken of the prevailing conditions as they evolve. | CWO, EP, OR | This is the responsibility of the Owner/Licensee and/or external parties.  The provided effective doses are in Agreement with EURATOM 2013/59 [10] Annex I. Reference levels for public exposure are referred to in Articles 7 (Reference levels, in which there is a request to establish them for emergency and existing exposure situations), 101 (Establishment of strategies) and the recommendation in ICRP-103 [11] for planning of emergency Exposure Situations, see Table 8.  This will be based on Westinghouse provided information. In this respect:  Two sets of radiological consequence analyses have been performed for the AP1000 plant design. In the US, radiological consequences have historically been calculated using very conservative methodologies (where consideration of severe accidents is included as part of the design basis dose analyses), and likewise compared with specific acceptance criteria consistent with those conservative assumptions. The dose analyses presented in DCD [3] Chapter 15 were performed in this context, meeting U.S requirements. For the United Kingdom (UK) Generic Design Assessment (GDA) licensing process, dose calculations were performed using more realistic assumptions, consistent with common regulatory practice outside of the US.  The analyses applicable to the Reference Plant are those presented in DCD Chapter 15. Total effective dose equivalent (TEDE) doses calculated for US licensing include contributions from inhalation and immersion. Doses calculated at the main control room, at the site boundary or exclusion area boundary (EAB) for the limiting 2‐hour interval, and at the low population zone (LPZ) outer boundary for the duration of the accident releases. Only the adult age group is considered. In the US, the acceptance criteria for radiological releases calculated and presented in the DCD are established by 10 CFR 50.34, which requires that:   * An individual at the boundary of the exclusion area for any 2‐hour period would not receive a radiation dose in excess of 25 rem (250 mSv) TEDE, * An individual at the outer boundary of the low population zone would not receive a radiation dose in excess of 25 rem (250 mSv) TEDE All events analyzed as described in DCD Chapter 15 meet the US acceptance criteria.   Note that although the NRC requirements seem to be less strict, this is not necessarily true due to the conservatisms that are included in the U.S NRC approach (mainly the requirement that the source term is based on a deterministic core melt accident, a significantly more conservative source term). The U.S NRC requires the dose assessment for LOCAs to postulate a source term consistent with full core melt, despite the safety analysis prediction of limited fuel rod failures and the maintenance of coolable geometry. The US analysis requirements, which are thus significantly more conservative, have correspondingly higher limits than in other countries in some cases; this is the reason that the DCD results would not comply with the limits prescribed in other countries, but the reason, as explained above, is simply due to the different licensing methodology and terminology used in dose analyses in the US-specific analyses.  A second set of analyses have been performed in support of licensing or pre-licensing efforts in other geographies, for example in Czech Republic or in the United Kingdom, especially during the licensing process in the United Kingdom, the UK regulator requested that Westinghouse calculate the radiological consequences of design basis faults using methods and assumptions consistent with relevant UK practice, which tend to be more realistic than U.S. methods. Dose calculations include contributions from inhalation and immersion and also from the activity deposited on the ground. Doses are calculated not only at the EAB, LPZ and in the MCR, but also to any individual onsite. Doses at all locations are calculated for the duration of releases and are reported for the adult age groups. The contribution to the doses from the activity deposited on the ground is based on a full year of exposure to the contaminated ground. These assessment calculations provide confidence that analysis might suffice to accommodate to these reference levels.  However specific calculations for accident analyses will need to be developed to fulfill IAEA Safety Standards No. GSR Part 3, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards expectations. |
| 4.9. | Each protective action shall be justified in the context of the protection strategy. | OR | This is the responsibility of the Owner/Licensee. |
| 4.10. | The government shall ensure that in making arrangements for emergency preparedness and response it is taken into consideration that emergencies are dynamic, that decisions taken early in the emergency response may influence subsequent actions, and that different geographical areas may have different prevailing conditions and there may be different requirements for the response. | EP | This is the responsibility of the Government. |
| 4.11. | The government shall ensure that the response in an emergency exposure situation is undertaken by the timely implementation of arrangements for emergency response, including but not limited to:  (a) Promptly taking protective actions and other response actions to avoid severe deterministic effects on the basis of observed conditions and, if possible, before any exposure occurs. Dose levels required to be used as generic criteria for preventing severe deterministic effects are given in Table IV.1 of Schedule IV (p. 372);  (b) Assessing the effectiveness of the protective actions and other response actions taken and modifying them as appropriate;  (c) Comparing residual doses with the applicable reference level, giving priority to those groups for whom residual doses exceed the reference level;  (d) Implementing further protection strategies as necessary, on the basis of prevailing conditions and available information. | EP | This is the responsibility of the Government.  Schedule IV can be found in document named “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards” which was published by IAEA. |

**EXPOSURE OF EMERGENCY WORKERS**

### Requirement 45: Arrangements for controlling the exposure of emergency workers

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government shall establish a programme for managing, controlling and recording the doses received in an emergency by emergency workers.** | EP | This is the responsibility of the Government. |
| 4.12. | The government shall establish a programme for managing, controlling and recording the doses received in an emergency by emergency workers, which shall be implemented by response organizations and employers. | EP | This is the responsibility of the Government. |
| 4.13. | The response organization and employers responsible for ensuring compliance with the requirements in paras 4.14–4.19 shall be specified in the emergency plan. | EP | This is the responsibility of the Government. |
| 4.14. | In an emergency exposure situation, the relevant requirements for occupational exposure in planned exposure situations (paras 3.69–3.116) shall be applied for emergency workers, in accordance with a graded approach, except as required in para. 4.15. | OR, EP | This is the responsibility of the Owner/Licensee and/or external parties. |
| 4.15. | Response organizations and employers shall ensure that no emergency worker is subject to an exposure in an emergency in excess of 50 mSv other than: (a) For the purposes of saving life or preventing serious injury;  (b) When undertaking actions to prevent severe deterministic effects and actions to prevent the development of catastrophic conditions that could significantly affect people and the environment; or  (c) When undertaking actions to avert a large collective dose. | OR, EP | This is the responsibility of the Owner/Licensee and/or external parties. |
| 4.16. | In the exceptional circumstances specified in para. 4.15, response organizations and employers shall make all reasonable efforts to keep doses to emergency workers below the values set out in Table IV.2 of Schedule IV (p. 373). In addition, emergency workers undertaking actions as a result of which their doses could approach or exceed the values set out in Table IV.2 of Schedule IV shall do so only when the expected benefits to others would clearly outweigh the risks to the emergency workers. | OR, EP | This is the responsibility of the Owner/Licensee and/or external parties.  Schedule IV can be found in document named “Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards” which was published by IAEA. |
| 4.17. | Response organizations and employers shall ensure that emergency workers who undertake actions in which the doses received might exceed 50 mSv do so voluntarily48; that they have been clearly and comprehensively informed in advance of the associated health risks, as well as of available measures for protection and safety; and that they are, to the extent possible, trained in the actions that they may be required to take. | OR, EP | This is the responsibility of the Owner/Licensee and/or external parties. |
| 4.18. | Response organizations and employers shall take all reasonable steps to assess and record the doses received in an emergency by emergency workers. Information on the doses received and information concerning the associated health risks shall be communicated to the workers involved. | OR, EP | This is the responsibility of the Owner/Licensee and/or external parties. |
| 4.19. | Workers who receive doses in an emergency exposure situation shall not normally be precluded from incurring further occupational exposure. However, qualified medical advice shall be obtained before any further occupational exposure if such a worker has received a dose exceeding 200 mSv or at the request of the worker. | OR | This is the responsibility of the Owner/Licensee. |

**TRANSITION FROM AN EMERGENCY EXPOSURE SITUATION TO AN EXISTING EXPOSURE SITUATION**

### Requirement 46: Arrangements for the transition from an emergency exposure situation to an existing exposure situation

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government shall ensure that arrangements are in place and are implemented as appropriate for the transition from an emergency exposure situation to an existing exposure situation.** | EP | This is the responsibility of the Government. |
| 4.20. | The government shall ensure that, as part of its overall emergency preparedness, arrangements are in place for the transition from an emergency exposure situation to an existing exposure situation. The arrangements shall take into account that different geographical areas may undergo the transition at different times. The responsible authority shall take the decision to make the transition to an existing exposure situation. The transition shall be made in a coordinated and orderly manner, by making any necessary transfer of responsibilities between organizations, with the involvement of relevant authorities and interested parties. | EP | This is the responsibility of the Government and/or the Owner/Licensee. |
| 4.21. | Workers undertaking work such as repairs to plant and buildings or activities for radioactive waste management, or undertaking remedial actions for the decontamination of the site and surrounding areas, shall be subject to the relevant requirements for occupational exposure in planned exposure situations stated in Section 3. | OR, EP | This is the responsibility of the Owner/Licensee and/or external parties. |

## Existing exposure situations

**Scope**

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
| 5.1. | The requirements for existing exposure situations in Section 5 apply to:  (a) Exposure due to contamination of areas by residual radioactive material deriving from:  (i) Past activities that were never subject to regulatory control or that were subject to regulatory control but not in accordance with the requirements of these Standards; (ii) A nuclear or radiological emergency, after an emergency has been declared to be ended (as required in para. 4.20).  (b) Exposure due to commodities, including food, feed, drinking water and construction materials, that incorporate radionuclides deriving from residual radioactive material as stated in para. 5.1(a).  (c) Exposure due to natural sources, including:  (i) 222Rn and its progeny and 220Rn and its progeny, in workplaces other than those workplaces for which exposure due to other radionuclides in the uranium decay chain or the thorium decay chain is controlled as a planned exposure situation, in dwellings and in other buildings with high occupancy factors for members of the public;  (ii) Radionuclides of natural origin, regardless of activity concentration, in commodities, including food, feed, drinking water, agricultural fertilizer and soil amendments, and construction materials, and residual radioactive material in the environment;  (iii) Materials, other than those stated in (c)(ii) above, in which the activity concentration of no radionuclide in either the uranium decay chain or the thorium decay chain exceeds 1 Bq/g and the activity concentration of 40K does not exceed 10 Bq/g;  (iv) Exposure of aircrew and space crew to cosmic radiation. | NR | This is an explanatory statement, not a requirement.  It shows the alignment with EURATOM 2013/59 [10[10]] and with ICRP-103 2007 Recommendations [9] which evolve from the previous process-based protection approach using practices and interventions by moving to an approach based on the exposure situation. They recognize planned, emergency, and existing exposure situations, and apply the fundamental principles of justification and optimization of protection to all of these situations. They maintain the Commission’s current individual dose limits for effective dose and equivalent dose from all regulated sources in planned exposure situations. They reinforce the principle of optimization of protection, which should be applicable in a similar way to all exposure situations, subject to the following restrictions on individual doses and risks; dose and risk constraints for planned exposure situations, and reference levels for emergency and existing exposure situations. |

**GENERIC REQUIREMENTS**

### Requirement 47: Responsibilities of the government specific to existing exposure situations

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government shall ensure that existing exposure situations that have been identified are evaluated to determine which occupational exposures and public exposures are of concern from the point of view of radiation protection.** | EP | This is the responsibility of the Government. |
| 5.2. | The government shall ensure that, when an existing exposure situation is identified, responsibilities for protection and safety are assigned and appropriate reference levels are established. | EP | This is the responsibility of the Government. |
| 5.3. | The government shall include in the legal and regulatory framework for protection and safety (see Section 2) provision for the management of existing exposure situations. The government, in the legal and regulatory framework, as appropriate: (a) Shall specify the exposure situations that are included in the scope of existing exposure situations;49  (b) Shall specify the general principles underlying the protection strategies developed to reduce exposure when remedial actions and protective actions have been determined to be justified;50  (c) Shall assign responsibilities for the establishment and implementation of protection strategies to the regulatory body and to other relevant authorities51 and, as appropriate, to registrants, licensees and other parties involved in the implementation of remedial actions and protective actions;  (d) Shall provide for the involvement of interested parties in decisions regarding the development and implementation of protection strategies, as appropriate. | EP | This is the responsibility of the Government. |
| 5.4. | The regulatory body or other relevant authority assigned to establish a protection strategy for an existing exposure situation shall ensure that it specifies:  (a) The objectives to be achieved by means of the protection strategy;  (b) Appropriate reference levels. | EP | This is the responsibility of Regulatory body or external party. |
| 5.5. | The regulatory body or other relevant authority shall implement the protection strategy, including:  (a) Arranging for evaluation of the available remedial actions and protective actions for achieving the objectives, and for evaluation of the efficiency of the actions planned and implemented;  (b) Ensuring that information is available to individuals subject to exposure on potential health risks and on the means available for reducing their exposures and the associated risks. | EP | This is the responsibility of Regulatory body or external party. |

**PUBLIC EXPOSURE**

**Scope**

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
| 5.6. | The requirements in respect of public exposure in existing exposure situations (paras 5.7–5.23) apply to any public exposure arising from the situations specified in para. 5.1. | NR | This is an explanatory statement, not a requirement. |

### Requirement 48: Justification for protective actions and optimization of protection and safety

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government and the regulatory body or other relevant authority shall ensure that remedial actions and protective actions are justified and that protection and safety is optimized.** | EP | This is the responsibility of the Government and Regulatory body or other external party. |
| 5.7. | The government and the regulatory body or other relevant authority shall ensure that the protection strategy for the management of existing exposure situations, established in accordance with paras 5.2 and 5.4, is commensurate with the radiation risks associated with the existing exposure situation; and that remedial actions or protective actions are expected to yield sufficient benefits to outweigh the detriments associated with taking them, including detriments in the form of radiation risks.52 | EP | This is the responsibility of the Government/Regulatory body or other external party. |
| 5.8. | The regulatory body or other relevant authority and other parties responsible for remedial actions or protective actions shall ensure that the form, scale and duration of such actions are optimized. While this optimization process is intended to provide optimized protection for all individuals subject to exposure, priority shall be given to those groups for whom the dose exceeds the reference level. All reasonable steps shall be taken to prevent doses from remaining above the reference levels. Reference levels shall typically be expressed as an annual effective dose to the representative person in the range of 1–20 mSv or other corresponding quantity, the actual value depending on the feasibility of controlling the situation and on experience in managing similar situations in the past. | EP | This is the responsibility of the Regulatory body or other external party. |
| 5.9. | The regulatory body or other relevant authority shall periodically review the reference levels to ensure that they remain appropriate in the light of the prevailing circumstances. | EP | This is the responsibility of the Regulatory body or other external party. |

### Requirement 49: Responsibilities for remediation of areas with residual radioactive material

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government shall ensure that provision is made for identifying those persons or organizations responsible for areas with residual radioactive material; for establishing and implementing remediation programmes and post-remediation control measures, if appropriate; and for putting in place an appropriate strategy for radioactive waste management.** | EP | This is the responsibility of the Government. |
| 5.10. | For the remediation of areas with residual radioactive material deriving from past activities or from a nuclear or radiological emergency (para. 5.1(a)), the government shall ensure that provision is made in the framework for protection and safety for:  (a) The identification of those persons or organizations responsible for the contamination of areas and those responsible for financing the remediation programme, and the determination of appropriate arrangements for alternative sources of funding if such persons or organizations are no longer present or are unable to meet their liabilities;  (b) The designation of persons or organizations responsible for planning, implementing and verifying the results of remedial actions;  (c) The establishment of any restrictions on the use of or access to the areas concerned before, during and, if necessary, after remediation;  (d) An appropriate system for maintaining, retrieval and amendment of records that cover the nature and the extent of contamination; the decisions made before, during and after remediation; and information on verification of the results of remedial actions, including the results of all monitoring programmes after completion of the remedial actions. | EP | This is the responsibility of the Government. |
| 5.11. | The government shall ensure that a strategy for radioactive waste management is put in place to deal with any waste arising from the remedial actions and that provision for such a strategy is made in the framework for protection and safety. | EP | This is the responsibility of the Government. |
| 5.12. | The persons or organizations responsible for the planning, implementation and verification of remedial actions shall, as appropriate, ensure that: (a) A remedial action plan, supported by a safety assessment, is prepared and is submitted to the regulatory body or other relevant authority for approval.  (b) The remedial action plan is aimed at the timely and progressive reduction of the radiation risks and eventually, if possible, at the removal of restrictions on the use of or access to the area.  (c) Any additional doses received by members of the public as a result of the remedial actions are justified on the basis of the resulting net benefit, including consideration of the consequent reduction of the annual dose.  (d) In the choice of the optimized remediation option:  (i) Radiological impacts on people and the environment are considered together with non-radiological impacts on people and the environment, and with technical, societal and economic factors;  (ii) The costs of the transport and management of radioactive waste, the radiation exposure of and health risks to the workers managing the radioactive waste, and any subsequent public exposure associated with its disposal are all taken into account.  (e) A mechanism for public information is in place and interested parties are involved in the planning, implementation and verification of the remedial actions, including any monitoring following remediation.  (f) A monitoring programme is established and implemented.  (g) A system for maintaining adequate records relating to the existing exposure situation and to actions taken for protection and safety is in place.  (h) Procedures are in place for reporting to the regulatory body or other relevant authority on any abnormal conditions relevant to protection and safety. | OR, EP | This is the responsibility of the Owner/Licensee or the external party. |
| 5.13. | The regulatory body, in accordance with para. 2.29, or other relevant authority shall take responsibility, in particular for:  (a) Review of the safety assessment submitted by the responsible person or organization, approval of the remedial action plan and of any subsequent changes to the remedial action plan, and granting of any necessary authorization;  (b) Establishment of criteria and methods for assessing safety;  (c) Review of work procedures, monitoring programmes and records;  (d) Review and approval of significant changes to procedures or equipment that may have radiological environmental impacts or that may alter the exposure conditions for workers taking remedial actions or for members of the public;  (e) Where necessary, establishment of regulatory requirements for control measures following remediation. | EP | This is the responsibility of the Regulatory body or other external party. |
| 5.14. | The person or organization responsible for carrying out the remedial actions:  (a) Shall ensure that the work, including management of the radioactive waste arising, is conducted in accordance with the remedial action plan;  (b) Shall take responsibility for all aspects of protection and safety, including the conduct of a safety assessment;  (c) Shall monitor the area regularly during the remediation so as to verify levels of contamination, to verify compliance with the requirements for radioactive waste management, and to enable any unexpected levels of radiation to be detected and the remedial action plan to be modified accordingly, subject to approval by the regulatory body or other relevant authority;  (d) Shall perform a radiological survey after completion of remedial actions to demonstrate that the end point conditions, as established in the remedial action plan, have been met;  (e) Shall prepare and retain a final remediation report and shall submit a copy to the regulatory body or other relevant authority. | OR, EP | This is the responsibility of the Owner/Licensee or the external party. |
| 5.15. | After the remedial actions have been completed, the regulatory body or other relevant authority:  (a) Shall review, amend as necessary and formalize the type, extent and duration of any post-remediation control measures already identified in the remedial action plan, with due consideration of the residual radiation risks.  (b) Shall identify the person or organization responsible for any post-remediation control measures.  (c) Shall, where necessary, impose specific restrictions for the remediated area to control:  (i) Access by unauthorized persons; (ii) Removal of radioactive material or use of such material, including its use in commodities;  (iii) Future use of the area, including the use of water resources and its use for the production of food or feed, and the consumption of food from the area.  (d) Shall periodically review conditions in the remediated area and, if appropriate, shall amend or remove any restrictions. | EP | This is the responsibility of the Regulatory body or other external party. |
| 5.16. | The person or organization responsible for post-remediation control measures shall establish and maintain, for as long as required by the regulatory body or other relevant authority, an appropriate programme, including any necessary provision for monitoring, to verify the long term effectiveness of the completed remedial actions for areas in which controls are required after remediation. | OR, EP | This is the responsibility of the Owner/Licensee or the external party. |
| 5.17. | For those areas with long lasting residual radioactive material, in which the government has decided to allow habitation and the resumption of social and economic activities, the government, in consultation with interested parties, shall ensure that arrangements are in place, as necessary, for the continuing control of exposure with the aim of establishing conditions for sustainable living, including:  (a) Establishment of reference levels for protection and safety that are consistent with day to day life;  (b) Establishment of an infrastructure to support continuing ‘self-help protective actions’ in the affected areas, such as by the provision of information and advice, and by monitoring. | EP | This is the responsibility of the Government. |
| 5.18. | The conditions prevailing after the completion of remedial actions, if the regulatory body or other relevant authority has imposed no restrictions or controls, shall be considered to constitute the background conditions for any new facilities and activities or for habitation on the land. | NR | This is an explanatory statement, not a requirement. |

### Requirement 50: Public exposure due to radon indoors

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The government shall provide information on levels of radon indoors and the associated health risks and, if appropriate, shall establish and implement an action plan for controlling public exposure due to radon indoors.** | NAP | The requirement is not applicable to the technology. |
| 5.19. | As part of its responsibilities, as required in para. 5.3, the government shall ensure that:  (a) Information is gathered on activity concentrations of radon in dwellings and other buildings with high occupancy factors for members of the public53 through appropriate means, such as representative radon surveys;  (b) Relevant information on exposure due to radon and the associated health risks, including the increased risks relating to smoking, is provided to the public and other interested parties. | NAP | The requirement is not applicable to the technology. |
| 5.20. | Where activity concentrations of radon that are of concern for public health are identified on the basis of the information gathered as required in para. 5.19(a), the government shall ensure that an action plan is established comprising coordinated actions to reduce activity concentrations of radon in existing buildings and in future buildings, which includes54:  (a) Establishing an appropriate reference level for 222Rn for dwellings and other buildings with high occupancy factors for members of the public, with account taken of the prevailing social and economic circumstances, that in general will not exceed an annual average activity concentration due to 222Rn of 300 Bq/m3 55;  (b) Reducing activity concentrations of 222Rn and consequent exposures to levels at which protection is optimized;  (c) Giving priority to actions to reduce activity concentrations of 222Rn in those situations for which such action is likely to be most effective56;  (d) Including in building codes appropriate preventive measures and corrective actions to prevent the ingress of 222Rn and to facilitate further actions wherever necessary. | NAP | The requirement is not applicable to the technology. |
| 5.21. | The government shall assign responsibility for:  (a) Establishing and implementing the action plan for controlling public exposure due to 222Rn indoors;  (b) Determining the circumstances under which actions are to be mandatory or are to be voluntary, with account taken of legal requirements and of the prevailing social and economic circumstances. | NAP | The requirement is not applicable to the technology. |

### Requirement 51: Exposure due to radionuclides in commodities

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The regulatory body or other relevant authority shall establish reference levels for exposure due to radionuclides in commodities.** | NAP | The requirement is not applicable to the technology. |
| 5.22. | The regulatory body or other relevant authority shall establish specific reference levels for exposure due to radionuclides in commodities such as construction materials, food and feed, and in drinking water, each of which shall typically be expressed as, or be based on, an annual effective dose to the representative person that generally does not exceed a value of about 1 mSv. | NAP | The requirement is not applicable to the technology. |
| 5.23. | The regulatory body or other relevant authority shall consider the guideline levels for radionuclides in food traded internationally that could contain radioactive substances as a result of a nuclear or radiological emergency, which have been published by the Joint Food and Agriculture Organization of the United Nations/World Health Organization Codex Alimentarius Commission [26]. The regulatory body or other relevant authority shall consider the guideline levels for radionuclides contained in drinking water that have been published by the World Health Organization [27]. | NAP | The requirement is not applicable to the technology. |

**OCCUPATIONAL EXPOSURE**

**Scope**

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
| 5.24. | The requirements in respect of occupational exposure in existing exposure situations (paras 5.25–5.33) apply to any occupational exposure arising from the situations specified in para. 5.1. | NR | This is an explanatory statemen, not a requirement. |

### Requirement 52: Exposure in workplaces

|  | **Description** | **Compliance** | **Justification** |
| --- | --- | --- | --- |
|  | **The regulatory body shall establish and enforce requirements for the protection of workers in existing exposure situations.** | EP | This is the responsibility of the Regulatory body. |
| 5.25. | The requirements in respect of public exposure stated in paras 5.7–5.9 shall be applied for protection and safety for workers in existing exposure situations, other than in those specific situations identified in paras 5.26–5.33. | OR | This is the responsibility of the Owner/Licensee. |
| **Remediation of areas with residual radioactive material** | | | |
| 5.26. | Employers shall ensure that the exposure of workers undertaking remedial actions is controlled in accordance with the relevant requirements on occupational exposure in planned exposure situations as established in Section 3. | OR | This is the responsibility of the Owner/Licensee. |
| **Exposure due to radon in workplaces** | | | |
| 5.27. | The regulatory body or other relevant authority shall establish a strategy for protection against exposure due to 222Rn in workplaces, including the establishment of an appropriate reference level for 222Rn. The reference level for 222Rn shall be set at a value that does not exceed an annual average activity concentration of 222Rn of  1000 Bq/m3, with account taken of the prevailing social and economic circumstances.57 | NAP | The requirement is not applicable to the technology. |
| 5.28. | Employers shall ensure that activity concentrations of 222Rn in workplaces are as low as reasonably achievable below the reference level established in accordance with para. 5.27, and shall ensure that protection is optimized. | NAP | The requirement is not applicable to the technology. |
| 5.29. | If, despite all reasonable efforts by the employer to reduce activity concentrations of radon, the activity concentration of 222Rn in workplaces remains above the reference level established in accordance with para. 5.27, the relevant requirements for occupational exposure in planned exposure situations as stated in Section 3 shall apply. | NAP | The requirement is not applicable to the technology. |
| **Exposure of aircrew and space crew due to cosmic radiation** | | | |
| 5.30. | The regulatory body or other relevant authority shall determine whether assessment of the exposure of aircrew due to cosmic radiation is warranted. | NAP | The requirement is not applicable to the technology. |
| 5.31. | Where such assessment is deemed to be warranted, the regulatory body or other relevant authority shall establish a framework which shall include a reference level of dose and a methodology for the assessment and recording of doses received by aircrew from occupational exposure to cosmic radiation. | NAP | The requirement is not applicable to the technology. |
| 5.32. | In accordance with para. 5.31:  (a) Where the doses of aircrew are likely to exceed the reference level, employers of aircrew:  (i) Shall assess and keep records of doses;  (ii) Shall make records of doses available to aircrew.  (b) Employers:  (i) Shall inform female aircrew of the risk to the embryo or fetus due to exposure to cosmic radiation and of the need for early notification of pregnancy;  (ii) Shall apply the requirements of para. 3.114 in respect of notification of pregnancy. | NAP | The requirement is not applicable to the technology. |
| 5.33. | The regulatory body or other relevant authority shall establish, where appropriate, a framework for radiation protection that applies to individuals in space based activities that is appropriate for the exceptional conditions of space. While the requirements of these Standards in respect of dose limits do not apply to individuals in space based activities, all reasonable efforts shall be made to optimize protection for individuals in space based activities by restricting the doses received by such individuals while not unduly limiting the extent of such activities. | NAP | The requirement is not applicable to the technology. |

# References

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3. APP-GW-GL-067, Revision 0, Assessment of AP1000 Compliance with IAEA Safety Standard No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for Safety of Radiation Sources, 1996,
4. APP-GW-GL-068, Revision B, Assessment of AP1000 Compliance with IAEA Safety Standard, General Safety Requirements Part 5, Predisposal Management of Radioactive Waste,
5. APP-GW-GL-069, Revision 0, AP1000 Comparison to IAEA Safety Standard No. GS-R-2, Preparedness and Response for a Nuclear or Radiological Emergency,
6. APP-GW-GL-704, Revision 1, AP1000 Plant Comparison to IAEA Safety Standard No. GSR Part 4 – Safety Assessment for Facilities and Activities,
7. APP-GW-GL-700, Revision 19, AP1000 Plant Design Control Document,
8. APP-GW-GL-022, Revision 8, Probabilistic Risk Assessment,
9. ICRP Publication 103. Annals of the ICRP Publication 103. "The 2007 Recommendations of the International Commission on Radiological Protection". March 2007
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