



Regulatory Guide

Near Surface Disposal of Radioactive Waste

FANR-RG-027
Version 0

Federal Authority for Nuclear Regulation (FANR),
P.O. Box 112021, Abu Dhabi, United Arab Emirates

Table of Contents

Basic Principle of Regulatory Guides.....	4
Definitions.....	4
Article (1)	4
Purpose.....	5
Article (2)	5
Concepts.....	6
Article (3)	6
Content of Application	11
Article (4)	11
Safety Case and Safety Assessment.....	11
Article (5)	11
Site Suitability Guidance for a Near Surface Radioactive Waste Disposal Facility	13
Article (6)	13
Site Characterisation for a Near Surface Radioactive Waste Disposal Facility.....	14
Article (7)	14
Construction of a Near Surface Radioactive Waste Disposal Facility	15
Article (8)	15
Operation of a Near Surface Radioactive Waste Disposal Facility	15
Article (9)	15
Closure of a Near Surface Radioactive Waste Disposal Facility	16
Article (10).....	16
Post-Closure Control and Institutional Control Periods.....	17
Article (11).....	17
Radioactive Waste Characteristics.....	18
Article (12).....	18
Radioactive Waste Acceptance in a Near Surface Radioactive Waste Disposal Facility	19
Article (13).....	19
Environmental Monitoring Programmes at a Near Surface Radioactive Waste Disposal Facility	20
Article (14).....	20
Radiation Protection in the Operation of a Near Surface Radioactive Waste Disposal Facility	21

Article (15).....	21
Radiation Protection in the Post-Closure Control Period.....	22
Article (16).....	22
Record-keeping	23
Article (17).....	23
Annex A	26
Content of Licence Applications for Siting, Site Preparation and Construction, Commisioning, and Operation.....	26
Annex B	31
Radioactive Waste Classification.....	31

Basic Principle of Regulatory Guides

Regulatory guides are issued to describe methods and/or criteria acceptable to the Authority for meeting and implementing specific requirements in the Authority's regulations. Regulatory Guides are not substitutes for regulations, and compliance with them is not required. Methods of complying with the requirements in regulations different from the guidance set forth by the regulatory guide can be acceptable if the alternatives provide assurance that the requirements are met.

Definitions

Article (1)

For the purposes of this regulatory guide, the following terms have the meanings set forth below. Other capitalised terms used but not defined herein shall have the meaning ascribed to them in Article 1 of the Federal Law by Decree No. 6 of 2009 Concerning the Peaceful Uses of Nuclear Energy (the Law) and in FANR Regulation for Disposal of Spent Fuel and Radioactive Waste (FANR-REG-27):

Compliance Period	The time from the completion of Disposal Site Closure to one thousand years or longer after Disposal Site Closure based on the Near Surface Radioactive Waste Disposal Facility plan to accept significant quantities of long-lived radionuclides
Chelating Agent	A chelating agent is a chemical compound that reacts with metal ions to form stable, water-soluble metal complexes. The agent rearranges the metal's chemical composition and improves the metal's general stability and likelihood to bond with other substances.
Design Basis	The range of conditions and events taken explicitly into account in the Design of a Facility (according to established Design criteria) such that the Facility can withstand them without exceeding authorised limits by the planned Operation of Safety systems.
Hydrogeologic Unit	Any soil or rock unit or zone, which by virtue of its porosity or permeability or lack thereof has a distinct influence on the Storage or movement of groundwater.
Inadvertent Intruder	A person who might occupy a Radioactive Waste Repository Disposal Site for Radioactive Waste after its Closure and engage in normal activities such as agriculture, dwelling, and construction or other pursuits in which the person might be unknowingly exposed to Ionising Radiation from Radioactive Waste.
Inadvertent Intrusion	Human activities on a Radioactive Waste Repository Disposal Site after its Closure such as agriculture dwelling, and construction or other pursuits during which exposure to Ionising Radiation from Radioactive Waste in the Radioactive Waste Repository Disposal Site may occur.

Worker(s)

Any person who works full-time, part-time or on a temporary basis for a Licensee and who has recognised rights and duties in relation to occupational Radiation Protection.

Purpose**Article (2)**

1. This regulatory guide addresses selected requirements of FANR Regulation 27 for Disposal of Spent Fuel and Radioactive Waste (FANR-REG-27). This regulatory guide relates to the Disposal in Near Surface Radioactive Waste Disposal Facilities of very low level waste (VLLW) and low level waste (LLW). This regulatory guide does not apply to Geological Radioactive Waste Disposal Facilities.
2. The Disposal of Nuclear Material defined by FANR Regulation 10 for the System of Accounting for and Control of Nuclear Material and Application of Additional Protocol (FANR-REG-10) shall be subject to safeguards applied in accordance with the Agreement between the United Arab Emirates and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-proliferation of Nuclear Weapons (hereinafter referred to as the 'Safeguards Agreement'), the Protocol Additional to the Safeguards Agreement and requirements of FANR-REG-10. Disposal of Spent Nuclear Fuel is not applicable for a Near Surface Radioactive Waste Disposal Facility.
3. This regulatory guide addresses the following requirements of FANR-REG-27:
 - a) Article (3) and Article (4) on Concepts and Content of Application respectively correlates to Articles (3), (5) and (8) in FANR-REG-27
 - b) Article (5) Safety Case and the Safety Assessment correlates to Article (6) and (7) in FANR-REG-27
 - c) Article (6) Site Suitability Guidance for a Near Surface Radioactive Waste Disposal Facility correlates to Articles (4) and (5) in FANR-REG-27
 - d) Article (7) Site Characterisation for a Near Surface Radioactive Waste Disposal Facility correlates to Article (5) and (6) in FANR-REG-27
 - e) Article (8) Construction of a Near Surface Radioactive Waste Disposal Facility correlates to Article (6) in FANR-REG-27
 - f) Article (9) Operation of a Near Surface Radioactive Waste Disposal Facility correlates to Articles (4) and (6) in FANR-REG-27
 - g) Article (10) Closure of a Near Surface Radioactive Waste Disposal Facility correlates to Articles (4) and (6) in FANR-REG-27
 - h) Article (11) Post-Closure Control Period and Institutional Control Period correlates to Articles (4), (6), (8), (13) and (14) in FANR-REG-27
 - i) Article (12) Radioactive Waste Characteristics correlates to Article (7) in FANR-REG-27
 - j) Article (13) Radioactive Waste Acceptance in a Near Surface Radioactive Waste Disposal Facility correlates to Article (7) of FANR-REG-27
 - k) Article (14) Environmental Monitoring Programmes at a Near Surface Radioactive Waste Disposal Facility correlates to Article (8) in FANR-REG-27
 - l) Article (15) Radiation Protection in the Operation of a Near Surface Radioactive

- Waste Disposal Facility correlates to Articles (4) and (9) in FANR-REG-27
- m) Article (16) Radiation Protection in the Post-Closure Control Period correlates to Articles (4) and (10) in FANR-REG-27
 - n) Article (17) Record-Keeping correlates to Article (15) in FANR-REG-27.
4. Annex A and Article (4) of this regulatory guide provide specific guidance for the content of the application of:
- a) a Licence for Siting, preparation of a site, Construction, Commissioning of a Near Surface Radioactive Waste Disposal Facility (Near Surface Radioactive Waste Disposal Facility Construction Licence);
 - b) a Licence for Operation of a Near Surface Radioactive Waste Disposal Facility; (Near Surface Radioactive Waste Disposal Facility Operation Licence); and
 - c) an amendment of a Licence for Operation of a Near Surface Radioactive Waste Disposal Facility) with a view to the Closure of the Near Surface Radioactive Waste Disposal Facility.
5. Annex B and Articles, (3)(5) and (12) of this regulatory guide provide specific guidance for Radioactive Waste classification.

Concepts

Article (3)

1. Near Surface Radioactive Waste Disposal Facilities:
- a) FANR-REG-27 stipulates requirements and performance objectives applicable for any method of Disposal in a Radioactive Waste Repository. This regulatory guide contains specific technical guidelines for the near surface Disposal of Radioactive Waste, which involves Disposal in the uppermost section of the earth within a few tens of meters of the earth surface.
 - b) Near surface Disposal includes Disposal in engineered facilities that may be built totally or partially above ground provided that such facilities have protective earthen covers.
 - c) The Near Surface Radioactive Waste Disposal Facility includes all of the land and buildings necessary to carry out the Disposal of Radioactive Waste. The Disposal Site is the section of the Near Surface Radioactive Waste Disposal Facility that is used for the Disposal of Radioactive Waste and consists of Disposal Units and a Buffer Zone. A Disposal Unit is a discrete section of the Disposal Site into which Radioactive Waste is placed for Disposal. A Buffer Zone is a section of the Disposal Site that is controlled by the Licensee and that lies under the Disposal Site and between the boundary of the Disposal Site and any Disposal Unit. It provides controlled space to establish monitoring locations that are intended to provide an early warning of radionuclide movement. The early warning allows the Licensee to carry out any mitigation measures that might be necessary.
 - d) When choosing a near surface Disposal Site, site characteristics taking into account the radiological characteristic of the Radioactive Waste should be evaluated for at least a 300-year period by the applicant for a Licence for the Construction of a Near Surface Radioactive Waste Disposal Facility to provide assurance that the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27 can be met.

2. Safety Objectives:

- a) The Disposal of Radioactive Waste in a Near Surface Radioactive Waste Disposal Facility should have the following Safety objectives:
 - protection of the public from releases of radionuclides;
 - protection of an Inadvertent Intruder;
 - protection of individuals during Operation; and
 - stability of the Disposal Site after Closure.
- b) Achieving these objectives depends upon many factors including the Design of the Near Surface Radioactive Waste Disposal Facility, operational procedures, characteristics of the general environment, and the Radioactive Waste acceptable for Disposal.

3. Technical Analyses:

- a) Demonstrating compliance with the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27 requires Assessments of specific factors of the Disposal Site including engineering Design, operational practices, Disposal Site characteristics, and Radioactive Waste acceptable for Disposal. Technical analyses assess the impact of Disposal Site-specific factors on the performance of the Near Surface Radioactive Waste Disposal Facility and the Disposal Site environment both during the operational period i.e. in the analysis for Radiation Protection of individuals during operations and, importantly, for the Disposal of Radioactive Waste over the longer term i.e. in the analyses of the Radiation Protection of the public from releases of radionuclides, the Radiation Protection of Inadvertent Intruders, and the stability of the Disposal Site its Closure.
- b) A performance Assessment should demonstrate Radiation Protection of the public from releases of radionuclides. A performance Assessment should identify the specific characteristics of the Disposal Site (e.g. hydrology, meteorology, geochemistry, biology, and geomorphology), degradation, deterioration, or alteration processes of the engineered Barriers (including the Waste Package), and interactions between the Disposal Site characteristics and engineered Barriers that might affect the performance of the Disposal Site. A performance Assessment should examine the effects of these processes and interaction on the ability of the Disposal Site to limit releases of radionuclides and estimate the annual Dose to a member of the public for comparison with the appropriate performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27.
- c) Inadvertent Intruders might occupy the Disposal Site in the future and engage in normal pursuits without knowing that they might be exposed to Ionising Radiation. Radiation Protection of Inadvertent Intruders can involve two principal controls: Institutional Control to ensure that no such occupation or improper use of the Disposal Site occurs or the designation of Radioactive Waste that could present an unacceptable Dose to an Inadvertent Intruder, and disposing of this Radioactive Waste in a manner that provides some form of intruder barrier that is intended to prevent contact with the Radioactive Waste and limit exposure to Ionizing Radiation from the Radioactive Waste.

- d) The Inadvertent Intruder Assessment should demonstrate Radiation Protection of Inadvertent Intruders through the Assessment of potential exposures to Ionizing Radiation should an Inadvertent Intruder occupy the Disposal Site following a loss of Institutional Control. The Inadvertent Intruder can be exposed to Ionizing Radiation from radionuclides that have been released into the environment as a result of disturbance of the Radioactive Waste or from Ionizing Radiation emitted from Radioactive Waste that is still contained in the Disposal Site. The results of the Inadvertent Intruder Assessment should be compared with the Design criteria set forth in Article (16)(4) of this regulatory guide. An Inadvertent Intruder Assessment can employ a similar methodology to that used for a performance Assessment, but the Inadvertent Intruder Assessment must assume that an Inadvertent Intruder occupies the Disposal Site following a loss of Institutional Control after Closure, and engages in activities that unknowingly expose the Inadvertent Intruder to Ionizing Radiation from the Radioactive Waste.
- e) The Dose calculation methodology used to demonstrate compliance with the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27 should be consistent with the Dose calculation methodology set forth in FANR-REG-04. The Licensee may use the most current scientific models and methodologies (e.g. those accepted by the International Commission on Radiological Protection) appropriate for Disposal Site specific circumstances to calculate the Dose. The weighting factors used in the calculation of the Dose must be consistent with the calculation methodology used to perform the calculation.
- f) Radioactive Waste with significant concentrations and quantities of long-lived radionuclides may require special processing, Design or site conditions for Disposal. Demonstrating Radiation Protection of the public from releases of radionuclides and Inadvertent Intruders from the Disposal of this Radioactive Waste requires an Assessment of the long-term impact. A longer Compliance Period for the performance Assessment should be used to evaluate the suitability of this Radioactive Waste for Disposal on a case-by-case basis considering the Disposal Site specific information.
- g) For a Near Surface Radioactive Waste Disposal Facility that plans to accept significant quantities of long-lived radionuclides e.g. natural occurring Radioactive Material (NORM) residues or waste, a long-term performance Assessment should be carried out based on a Compliance Period of 10,000 years to demonstrate compliance with the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27 and considering the Design criteria set forth in Article (16)(4) of this regulatory guide. The Authority may approve a shorter Compliance Period based on the technical justification presented in the Safety Case of the Compliance Period that needs to be considered in the performance Assessment.

4. Defence-in-Depth:

- a) Defence-in-Depth Safety protections are important together with the technical analyses for ensuring Safety with regard to complex facilities in the face of significant uncertainties. Defence-in-Depth Safety protection combined with technical analyses and scientific judgement form a fundamental part of the Safety Case for licensing a Near Surface Radioactive Waste Disposal Facility. Understanding the capabilities of the Defence-in-Depth Safety protection and the basis for those capabilities ensures that no single layer is exclusively relied upon for Safety, and that the Safety protection is commensurate with the risks associated with the Near Surface Radioactive Waste

Disposal Facility, and increases confidence that the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27 are met.

- b) The Defence-in-Depth Safety protection for a Near Surface Radioactive Waste Disposal Facility may be different during the operational phase while the Licensee is disposing of Radioactive Waste than after the Closure of the Near Surface Radioactive Waste Disposal Facility. While Radioactive Waste is being disposed, and before a Near Surface Radioactive Waste Disposal Facility is closed, the Defence-in-Depth Safety protection with respect to operational activities (e.g. waste handling) will consist of both active Safety protection (e.g. equipment, procedures, and controls) and passive Safety protection (e.g. physical Barriers). The active and passive Safety protection used for operational activities at a Near Surface Radioactive Waste Disposal Facility is comparable to the Defence-in-Depth Safety protection at other operating Nuclear Facilities licensed by the Authority and commensurate with the risk and complexity of the operational Activity. Following Closure of the Near Surface Radioactive Waste Disposal Facility, the Defence-in-Depth Safety protection should be provided through essentially passive Safety protection due to the long periods associated with Disposal of Radioactive Waste. Diversity in the capabilities of the passive Safety protection provided by the Disposal Site (e.g. waste form, container, engineered features, depth of Disposal Unit below the land surface, hydrologic and geochemical characteristics of the Disposal Site) increases the resilience of the Disposal Site to unanticipated failures or external challenges and compensates, in part, for uncertainties in the long-term estimate of performance of the Disposal Site.

5. Waste acceptance:

- a) Demonstrating compliance with the performance objectives also requires an established criteria for the acceptance of Radioactive Waste. The criteria can be determined from the results of the technical analyses that demonstrate compliance with the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27 for a Near Surface Radioactive Waste Disposal Facility.

6. Radioactive Waste classification and near surface Disposal:

- a) Disposal of Radioactive Waste in a Near Surface Radioactive Waste Disposal Facility shall meet the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27. The cornerstone of the Disposal System is the stability of the Radioactive Waste and the Disposal Site to ensure that following the Disposal of Radioactive Waste, the effects of the access of water and the wind erosion to the Disposal Unit and the Radioactive Waste can be minimised.
- b) For long-lived radionuclides and certain radionuclides prone to migration, a maximum Disposal Site Radioactive Waste inventory based on the characteristics of the Disposal System should be established to limit potential Public and Occupational Exposures, and the impact on the environment and to mitigate the uncertainties associated with long-term stability of the Disposal Unit. Some Radioactive Waste, depending on its radiological characteristics, may not be suitable for Disposal if uncertainties cannot be adequately addressed with technical analyses.
- c) The period of post-Closure control and Institutional Control of the Near Surface Radioactive Waste Disposal Facility Disposal Site is to be considered for up to 300 years. This permits the Disposal of very low-level waste and low-level waste without special provisions for protection against Inadvertent Intrusion since these classes of Radioactive Waste, as defined in Annex B to this regulatory guide, contain types and quantities of radioisotopes that will decay during the 300-year period. After the lapse of this period the Radioactive Waste will present an acceptable hazard to an

Inadvertent Intruder. The Licensee or the authority or institution designated under the laws of the State administering the post-Closure control period and Institutional Control period programme has flexibility in controlling access to the Disposal Site, which may include allowing the productive use of the land provided the integrity and long-term performance of the Disposal Site are not affected.

- d) Radioactive Waste that will not decay to levels that present an acceptable hazard to an Inadvertent Intruder within 300 years should be disposed of at a greater depth (within the depth limits of near surface Disposal) than the other classes of Radioactive Waste so that subsequent surface activities by an Inadvertent Intruder will not disturb the Radioactive Waste. Where Disposal Site conditions prevent deeper Disposal, intruder Barriers such as concrete covers may be used. The intruder Barriers should be designed for an effective life sufficient to allow decay to levels that present an acceptable hazard to an Inadvertent Intruder.
- e) Regardless of the Radioactive Waste classification, some Radioactive Waste may require enhanced controls or restrictions at a particular Near Surface Radioactive Waste Disposal Facility. A performance Assessment and an Inadvertent Intruder Assessment shall be used to identify these enhanced controls and restrictions, which are Disposal Site and Radioactive Waste specific. Enhanced controls or restrictions could include additional limits on the Radioactive Waste radioactivity concentration or the total radioactivity at the Disposal Site, more robust intruder Barriers, deeper burial depth, and Radioactive Waste-specific stability requirements. These enhanced controls or restrictions could mitigate the uncertainty associated with the evolutionary effects of the natural environment and the Disposal Site performance over the Compliance Period.

7. The licensing process:

- a) Prior to the Construction phase, the applicant for a Licence for Construction of a Near Surface Radioactive Waste Disposal Facility goes through a licensing process determined by the Authority to provide a Safety Case, which includes the basis for the site selection, the Design of the Near Surface Radioactive Waste Disposal Facility considering the types of Radioactive Waste and Waste Forms, the Operation of the Near Surface Radioactive Waste Disposal Facility, and Closure and post-Closure control period activities to ensure that the requirements of FANR-REG-27 are met.
- b) During the operational phase of the Near Surface Radioactive Waste Disposal Facility, the Licensee shall carry out Disposal activities in accordance with the requirements of FANR-REG-27 and the conditions of the Near Surface Radioactive Waste Disposal Facility Licence for Operation. At the time of completion of Disposal operations, the Licensee shall apply to the Authority to amend the Near Surface Radioactive Waste Disposal Facility Licence for Operation with a view to the Closure of the Near Surface Radioactive Waste Disposal Facility. After final review of the Licensee's Near Surface Radioactive Waste Disposal Facility Closure plan, the Authority may approve the final activities necessary to prepare the Disposal Site so that ongoing active Maintenance of the Disposal Site is not required during the period of Institutional Control.
- c) During the period when the Disposal Site Closure activities are being carried out, the Licensee is in a Disposal Site Closure phase. Following that, for a post-Closure control period of five years, the Licensee should remain at the Disposal Site for a period of post-Closure observation and Maintenance to ensure that the Disposal Site is stable and ready for Institutional Control. The period of post Closure observation and Maintenance is used to ensure that the Disposal Site Closure activities have not resulted in unintended instability at the Disposal Site. The Authority may approve shorter or require longer periods if conditions warrant. At the end of this period, the Licensee shall apply for an amendment of the Licence for authorisation of transfer of

responsibility for Institutional Control of the Disposal Site to the authority or institution designated under the laws of the State in accordance with the requirements set forth in Article (13) of FANR-REG-27.

Content of Application

Article (4)

1. Applications for a Licence for Construction of a Near Surface Radioactive Waste Disposal Facility and for a Licence for Operation of a Near Surface Radioactive Waste Disposal Facility should consist of general information, specific technical information, and institutional information. An environmental impact assessment report should accompany the application. Guidance on the content of the applications can be found in Annex A to this regulatory guide.
2. An application to amend the Licence for Operation of a Near Surface Radioactive Waste Disposal Facility with a view to the Closure of the Near Surface Radioactive Waste Disposal Facility should include a final revision and specific details of the Near Surface Radioactive Waste Disposal Facility Closure plan included as part of the applications for the Licence for Construction of the Near Surface Radioactive Waste Disposal Facility and for the Licence for Operation of the Near Surface Radioactive Waste Disposal Facility submitted under Article (3) of FANR-REG-27. The aforementioned application should include each of the following:
 - a) Any additional geological, hydrological or other Disposal Site data pertinent to the long-term containment of disposed Radioactive Wastes obtained during the operational period of the Near Surface Radioactive Waste Disposal Facility.
 - b) The results of tests, experiments or any other analyses relating to backfill of excavated areas, Closure and sealing, Radioactive Waste migration and interaction with emplacement media or any other tests, experiments or analysis pertinent to the long-term containment of the disposed Radioactive Waste within the Disposal Site of the Near Surface Radioactive Waste Disposal Facility including revised analyses in accordance with technical analyses requirements set forth in Annex A of this regulatory guide and updates of the Defence-in-Depth Safety protection using details of the submitted Closure plan and Radioactive Waste inventory.
 - c) Any proposed revision of plans for:
 - i. Decontamination and/ or dismantlement of surface facilities;
 - ii. Backfilling of excavated areas; or
 - iii. Stabilisation of the Disposal Site for post-Closure control period care.
3. Upon review and consideration of an application to amend the Licence for Operation of the Near Surface Radioactive Waste Disposal Facility with a view to the Closure of the Near Surface Radioactive Waste Disposal Facility submitted in accordance with Article (4)2 of this regulatory guide, the Authority will issue an amendment authorising the Closure if there is reasonable assurance that there is long-term containment of emplaced Radioactive Waste within the Disposal Site.

Safety Case and Safety Assessment

Article (5)

1. The Safety Case for a Near Surface Radioactive Waste Disposal Facility should address Safety both in the Operation and after Closure of a Near Surface Radioactive Waste Disposal Facility. All aspects of Operation relevant to Safety should be considered in the

Safety Case including site selection, excavation and Construction, Radioactive Waste disposal and back-filling, sealing and closing operations. Consideration should be given to both Occupational Exposure and Public Exposure resulting from conditions of normal Operation and anticipated operational occurrences over the operating lifetime of the Near Surface Radioactive Waste Disposal Facility. The Safety Case should also address Safety in transport for which requirements are established in FANR Regulation 13 for the Safe Transport of Radioactive Materials (FANR-REG-13).

2. As a Near Surface Radioactive Waste Disposal Facility will operate for long periods before its final Closure, a programme to manage ageing (e.g. a programme of preventive Maintenance) should be put in place for both active and passive systems. Active components should be the focus of the Maintenance programme. An ageing management programme should also be put in place for passive structures (e.g. engineered features) that are required to maintain integrity in the operational phase as well as during the post-Closure control period and the Institutional Control period. Ageing management programmes should be designed to detect problems in construction and operation that might not otherwise be discovered until after Closure.
3. Accidents at a Near Surface Radioactive Waste Disposal Facility that may occur infrequently but with significant radiological consequences i.e. possible Accidents that could give rise to Doses over the short term in excess of annual Dose limits specified in FANR Regulation 04 for Radiation Dose Limits and Optimisation of Radiation Protection for Nuclear Facilities (FANR-REG-04) should be considered with regard to both their likelihood of occurrence and the magnitude of possible Doses. The adequacy of the Design and of the operational features of the Near Surface Radioactive Waste Disposal Facility should also be evaluated.
4. With regard to Safety after Closure of a Near Surface Radioactive Waste Disposal Facility, the expected range of possible developments affecting the Disposal system and events that might affect its performance including those of low probability should be considered by a Licence applicant in the Safety Case and supporting Safety Assessment by the following means:
 - a) By presenting evidence that the Disposal system, and any possible developments and events that might affect it are sufficiently well understood;
 - b) By demonstrating the feasibility of implementing the Design of a Near Surface Radioactive Waste Disposal Facility;
 - c) By providing convincing estimates of the performance of the Disposal system and a reasonable level of assurance that all the relevant Safety requirements will be complied with and that Radiation Protection has been optimised; and
 - d) By identifying and presenting an analysis of the associated uncertainties.
5. The Safety Case may include the presentation of multiple lines of reasoning based on, for example, studies of natural analogues, suitable characteristics of the site, engineering considerations, operational procedures and institutional assurances of a Near Surface Radioactive Waste Disposal Facility.
6. The performance of the Disposal System under expected and less likely developments and events, which can be outside the Design performance range of the Near Surface Radioactive Waste Disposal Facility should be analysed in the Safety Case. Sensitivity analyses and uncertainty analyses should be undertaken to gain an understanding of the performance of the Disposal system and its components under a range of developments and events.
7. The consequences of unexpected events and processes should be explored to test the robustness of the Disposal System. The resilience of the Disposal System, in particular,

should be assessed. Quantitative analyses should be carried out at least over the period for which regulatory requirements apply.

8. The Integrated Management System established for these Design features and operational features should be addressed in the Safety Case.

Site Suitability Guidance for a Near Surface Radioactive Waste Disposal Facility

Article (6)

1. The primary emphasis in Disposal Site suitability is given to isolation of Radioactive Waste; a matter having long-term implications, and to Disposal Site features that ensure that the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27 are met.
2. The Disposal Site should be characterised, modelled and analysed by the applicant for a Licence for Construction of a Near Surface Radioactive Waste Disposal Facility, and later monitored by the Near Surface Radioactive Waste Disposal Facility Construction Licensee and Near Surface Radioactive Waste Disposal Facility Operation Licensee.
3. The Near Surface Radioactive Waste Disposal Facility Disposal Site should be selected in a location where the projected population growth and future developments are not likely to affect the capability of the Near Surface Radioactive Waste Disposal Facility to meet the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27.
4. The selection of areas with known natural resources that, if exploited, would result in failure to meet the performance objectives set forth in Article (4)1 to 6 of FANR-REG-27 should be avoided.
5. The Disposal Site should be generally well drained and free of areas of flooding or frequent ponding. Upstream drainage areas should be minimised to decrease the amount of runoff, which could erode or inundate Disposal Units.
6. The Disposal Site should provide sufficient depth to the water table so that ground water intrusion into the Radioactive Waste will be avoided or delayed until the radioactivity has decayed to sufficiently low levels according to the Safety Case. The Authority will consider an exception to this requirement to allow Disposal below the water table if it can be conclusively shown that Disposal Site characteristics will result in molecular diffusion being the predominant means of radionuclide movement and the rate of movement will result in the performance objectives set forth in Articles (4)(1) - (4)(6) of FANR-REG-27 being met. In no case will Radioactive Waste Disposal be permitted in the zone of fluctuation of the water table.
7. The Hydrogeological Unit used for disposal should not discharge ground water to the surface.
8. Areas should be avoided where tectonic processes such as faulting, folding, seismic activity or volcanism may occur with such frequency and extent to significantly affect the ability of the Disposal Site to meet the performance objectives set forth in Articles (4)(1) - (4)(6) of FANR-REG-27 or may preclude defensible modelling and prediction of long-term implications.
9. Areas should be avoided where surface geological processes such as mass wasting, erosion, slumping, land sliding or weathering occur with such frequency and extent to significantly affect the ability of the Disposal Site to meet the performance objectives set forth in Articles (4)(1) - (4)(6) of FANR-REG-27, or may preclude defensible modelling and prediction of long-term implications.
10. The Disposal Site should not be located where nearby facilities or activities could adversely impact the ability of the site for a Near Surface Radioactive Waste Disposal

Facility to meet the performance objectives set forth in Articles (4)(1)-(4)(6) of FANR-REG-27 or significantly mask the environmental monitoring programme.

Site Characterisation for a Near Surface Radioactive Waste Disposal Facility

Article (7)

1. The overall objective of a Near Surface Radioactive Waste Disposal Facility Disposal Site characterisation is to develop the technical information needed for:
 - a) Demonstration that the performance objectives and the minimum technical requirements on site suitability will be met;
 - b) Evaluation of the ability of the site characteristics to contribute to isolation of the Radioactive Waste;
 - c) Design of the Near Surface Radioactive Waste Disposal Facility;
 - d) Identification of interaction between the site characteristics and the Radioactive Waste and waste containers;
 - e) Establishment of data collection points and a baseline of data for some sections of the site monitoring programme; and
 - f) Identification of the potential environmental impact resulting from Construction, Operation, and Closure of the Near Surface Radioactive Waste Disposal Facility.
2. There should be an understanding of the site for a Near Surface Radioactive Waste Disposal Facility in order to present a comprehensive scientific description of the Disposal System on which descriptions that are used in the Safety Assessment can be based. The focus should be on features, events and processes (otherwise known as FEPs) relating to the site that could have an impact on Safety, and that are addressed in the Safety Case and supporting Safety Assessment. In particular, this should demonstrate that there is adequate geological, geomorphological or topographical stability (as appropriate to the type of Near Surface Radioactive Waste Disposal Facility), and features and processes that contribute to Safety. It also should demonstrate that other features, events and processes do not undermine the Safety Case.
3. Characterisation of the geological aspects should include activities such as the investigation of long-term stability, seismicity, geotechnical parameters relevant to the Design, groundwater flow regimes, geochemical conditions, and mineralogy. The extent of characterisation necessary will depend on the Design of the Near Surface Radioactive Waste Disposal Facility and the site in question.
4. A graded approach should be adopted depending on the hazard potential of the Radioactive Waste and the complexity of the site and the Near Surface Radioactive Waste Disposal Facility Design. Site characterisation undertaken in an iterative manner should provide input into the Safety Case and has to be guided by the Safety Case. Similarly, an investigation of natural background radiation and the radionuclide content in soil, groundwater and other media, for example, may contribute to a better understanding of the characteristics of the Near Surface Radioactive Waste Disposal Facility site. It may also assist in the evaluation of the radiological impact on the environment by providing a reference for future comparisons.
5. The characterisation of the surface environmental features should include natural aspects such as hydrological and meteorological aspects, and flora and fauna. It also should cover human activities in the vicinity of the Near Surface Radioactive Waste Disposal Facility site relating to normal residential settlement patterns, and industrial and agricultural activities. Due regard should be given to the probable natural evolution of the Near Surface

Radioactive Waste Disposal Facility site including the effects of erosion and climate change.

Construction of a Near Surface Radioactive Waste Disposal Facility

Article (8)

1. The Design of a Near Surface Radioactive Waste Disposal Facility may differ widely depending on the types of Radioactive Waste to be disposed of and the host geological formation and/ or surface environment. In general, optimal use should be made of the Safety features offered by the host environment. This should be done by designing a Near Surface Radioactive Waste Disposal Facility that does not cause unacceptable long-term disturbance of the Disposal Site, is itself protected by the site of the Near Surface Radioactive Waste Disposal Facility, and carries out Safety functions that complement the natural Barriers.
2. The Design features for the Near Surface Radioactive Waste Disposal Facility should be directed towards Defence-in-Depth, long-term isolation and avoidance of the need to continue active Maintenance after the Closure of the Disposal Site. Surface features should direct surface water drainage away from Disposal Units at velocities and gradients, which will not result in erosion that will require ongoing active Maintenance in the future. The Near Surface Radioactive Waste Disposal Facility should be designed to minimise to the extent practicable the contact of water with the Radioactive Waste during Storage, the contact of standing water with Radioactive Waste during Disposal, and the contact of percolating or standing water with Radioactive Waste after Disposal. Covers of the Disposal Units should be designed to minimise to the extent practicable water infiltration, to direct percolating or surface water away from the disposed Radioactive Waste, and to resist degradation by surface geologic processes and biotic activity.
3. The configuration of the Disposal Unit should be designed so that Radioactive Waste is placed in the most suitable locations. Materials used in the Near Surface Radioactive Waste Disposal Facility should be resistant to degradation under the conditions prevailing in the Near Surface Radioactive Waste Disposal Facility (e.g. conditions of chemistry and temperature) and selected to limit any undesirable impact on the Safety functions of any element of the Disposal System.
4. The demonstration of the feasibility of manufacturing Radioactive Waste containers and of constructing engineered Barriers with the necessary features is important for the purpose of Safety Assessment and for assurance that an adequate level of performance can be achieved.
5. The construction of Disposal Units could continue after the commencement of Operation of part of the Near Surface Radioactive Waste Disposal Facility and after the disposal of Waste Packages. Such overlapping of Construction and Operation activities should be planned and carried out so as to ensure Safety both in Operation and after Closure of the Near Surface Radioactive Waste Disposal Facility. The management and performance of all activities should reflect a combination of best practices in Radiation Protection, industrial safety and civil engineering.

Operation of a Near Surface Radioactive Waste Disposal Facility

Article (9)

1. All operations and activities important to the Safety of a Near Surface Radioactive Waste Disposal Facility should be subject to restrictions and controls. Emergency plans should be put in place. The various procedures and plans should be documented and the documentation should be subject to appropriate control procedures. The Safety Case

should address and justify both the Design and the operational management arrangements that are used to ensure that the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27 are met. Additionally, Near Surface Radioactive Waste Disposal Facility specific criteria may be established by the Authority or by the Licensee.

2. The Safety Case also should demonstrate that hazards and other Ionizing Radiation risks to Workers and to members of the public under conditions of normal Operation and anticipated operational occurrences of the Near Surface Radioactive Waste Disposal Facility have been reduced as low as reasonably achievable to meet the performance objectives set forth in Articles (4)(1) - (4)(6) in FANR-REG-27. Active control of Safety should be maintained by the Licensee of a Near Surface Radioactive Waste Disposal Facility Licence for Operation until the Closure of the Near Surface Radioactive Waste Disposal Facility.

Closure of a Near Surface Radioactive Waste Disposal Facility

Article (10)

1. Closure of a Near Surface Radioactive Waste Disposal Facility should include the Decommissioning of operational systems and components, and the placement of the Near Surface Radioactive Waste Disposal Facility in a state that has been demonstrated to provide the Safety functions necessary for long term Safety.
2. The process of Closure of a Near Surface Radioactive Waste Disposal Facility should be documented in an initial plan for Near Surface Radioactive Waste Disposal Facility Closure included in the application for a Near Surface Radioactive Waste Disposal Facility Licence for Construction. An updated plan for Near Surface Radioactive Waste Disposal Facility Closure should be included in the application for a Near Surface Radioactive Waste Disposal Facility Licence for Operation, which forms part of the Safety Case for the post-Closure control period. Before the Construction activities commence, there should be sufficient evidence that the Closure activities planned during the Design phase will function as intended to meet the Design requirements.
3. The Closure plan should take into account factors such as the type of Radioactive Waste that will be disposed of at the Near Surface Radioactive Waste Disposal Facility, the timing of Disposal actions, annual estimates of Radioactive Waste volumes, the location of Radioactive Waste within the Disposal Site, and the phased interim Closure of individual Disposal Units (vaults, cells or trenches).
4. The Closure plan should describe the installation of final engineered Barriers and site markers (if applicable) and how the Near Surface Radioactive Waste Disposal Facility will be transferred into the period of Institutional Control.
5. The Closure plan should be updated during the Operation of the Near Surface Radioactive Waste Disposal Facility and should provide order and structure to planned Disposal activities with regard to final Closure.
6. Parts or segments of the Disposal Site may be closed as Radioactive Waste is emplaced and Disposal Units become full. Elsewhere at the Disposal Site Disposal activities may be ongoing until Radioactive Waste capacities are reached and final Disposal Site Closure activities are completed. The impact of the Closure of individual Disposal Units on the Safety Case for the entire Near Surface Radioactive Waste Disposal Facility should be well understood and adequately documented.
7. The Closure plan should describe any controls intended for the post-Closure control period. Such controls may include the radiation monitoring plan and the surveillance programme to meet the performance objectives set forth in Article (4)(1) – (4)(6) and Article (10) in FANR-REG-27. A description of the record-keeping system and provisions for any

control on the use of the site should also be included together with the means for enforcing any restrictions on access to, or use of, the site.

8. The final revision of the Closure plan should be submitted with the application to amend the Near Surface Radioactive Waste Disposal Facility Licence for Operation with a view to the Closure in accordance with Article (4)2 of this regulatory guide.

Post-Closure Control and Institutional Control Periods

Article (11)

1. The long-term Safety of a Disposal Site for Radioactive Waste should not be dependent on post-Closure control period activities. Even the violation of passive Safety features should not give rise to the criteria for intervention being exceeded. Institutional Control cannot be the sole or main component of Safety for a Disposal Site. The ability of Institutional Control to provide the contributions to Safety set forth in the Safety Case should be demonstrated and justified in the Safety Case.
2. Inadvertent Intrusion into a Disposal Site for Radioactive Waste may be reduced over a longer timescale than that foreseen by the use of controls such as the preservation of information by means of markers and archives including international archives.
3. Post-Closure control and Institutional Control over a Disposal Site for Radioactive Waste should provide additional assurance of the Safety and Nuclear Security of the Disposal Site. Examples include provisions for preventing access to the Disposal Site of Inadvertent Intruders and post-Closure control period monitoring capable of providing early warning of the migration of radionuclides from the Disposal Site before they reach the Disposal Site boundary.
4. For Disposal Sites, the Radioactive Waste acceptance criteria will limit consequences of Inadvertent Intrusion into Disposal Sites within the requirements set forth in FANR-REG-27 even if control over the Disposal Site is lost. The Dose Constraint set forth in Article (4)(2) of FANR-REG-27 with regard to the estimated Dose or risk to the Representative Person, who might be exposed to Ionizing Radiation in the future as a result of possible natural processes affecting the Radioactive Waste Repository applies to the anticipated normal evolution of the site following the period of Institutional Control.
5. A Near Surface Radioactive Waste Disposal Facility may not be closed for several dozens of years or longer after its operations have commenced. Plans for possible future post-Closure control period and Institutional Control period over which they would be applied may initially be flexible and conceptual in nature, but plans should be developed and refined as the Near Surface Radioactive Waste Disposal Facility approaches its Closure. Consideration should be given to:
 - a) local land use controls;
 - b) site restrictions or surveillance and monitoring;
 - c) local, national and international records; and
 - d) the use of durable surface and/ or sub-surface markers.
6. Arrangements should be made to enable the transfer of information about the Disposal Site and its contents to the future generations to enable any future decisions on the Disposal Site and its Safety.

Radioactive Waste Characteristics

Article (12)

1. The following are the minimum guidelines for Radioactive Waste characteristics and are intended to facilitate Radioactive Waste handling at the Near Surface Radioactive Waste Disposal Facility and provide protection of health and Safety of the personnel at the Near Surface Radioactive Waste Disposal Facility:
 - a) Liquid Radioactive Waste such as contaminated oil should be solidified or packaged in sufficient absorbent material to absorb twice the volume of the liquid.
 - b) Solid Radioactive Waste containing liquid should contain as little free standing and non-corrosive liquid as is reasonably achievable, but in no case should the liquid exceed 1% of the volume.
 - c) Radioactive Waste should not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures that can be reached in a Near Surface Radioactive Waste Disposal Facility, or of explosive reaction with water.
 - d) Radioactive Waste should not contain or be capable of generating quantities of gases, vapours or fumes harmful to persons transporting, handling or disposing of the Radioactive Waste. This does not apply to gaseous Radioactive Waste packaged in accordance with Article (12)(1)(f) of this regulatory guide.
 - e) Radioactive Waste should not be pyrophoric. Pyrophoric materials contained in Radioactive Waste should be treated, prepared and packaged to be non-flammable.
 - f) Radioactive Waste in a gaseous form should be packaged at a pressure that does not exceed 1.5 atmospheres at 20 °C. Total radioactivity should not exceed 3.7E12 Becquerel per container.
 - g) Radioactive Waste containing hazardous, biological pathogenic or infectious material should be treated to reduce to the maximum extent practicable the potential hazard from the non-radiological materials.
2. The guidance in this Article is intended to provide stability of the Waste Form. Stability is intended to ensure that the Radioactive Waste does not structurally degrade and affect the overall stability of the Disposal Site through slumping, collapse or other failure of the Disposal Unit and thereby lead to water infiltration. Stability is also a factor in limiting exposure of an Inadvertent Intruder since it provides guidance for a recognisable and non-dispersible Waste Form.
 - a) The Waste Form should have structural stability. A structurally stable Waste Form will generally maintain its physical dimensions and its form under the expected Disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, microbial activity and internal factors such as Ionizing Radiation effects and chemical changes. Structural stability can be provided by the Waste Form itself, by processing the Radioactive Waste to a stable form, or by placing the Radioactive Waste in a Disposal container or structure that provides for stability after Disposal. Radioactive Waste should not be packaged for Disposal in cardboard or fiberboard boxes.
 - b) Notwithstanding the provisions in Article (12)(1)(a) and (12)(1)(b) above, liquid Radioactive Waste or Radioactive Waste containing liquid should be converted into a Waste Form that contains as little free standing and non-corrosive liquid as is reasonably achievable, but in no case should the liquid exceed 1% of the volume of the Radioactive Waste when the Radioactive Waste is in a disposal container designed to ensure stability or 0.5% of the volume of the Radioactive Waste for

Radioactive Waste processed to a stable Waste Form.

- c) Void spaces within the Waste Form and between the Waste Form and its Waste Package should be reduced to the extent practicable.

Radioactive Waste Acceptance in a Near Surface Radioactive Waste Disposal Facility

Article (13)

1. Radioactive Waste acceptance criteria for a given Near Surface Radioactive Waste Disposal Facility should ensure the safe handling of Waste Packages and unpackaged Radioactive Waste in conditions of normal Operation and anticipated operational occurrences at the Near Surface Radioactive Waste Disposal Facility. Radioactive Waste acceptance criteria should also ensure the fulfilment of the Safety functions for the Waste Form and Waste Packages with regard to Safety in the long term. Examples of possible parameters for Radioactive Waste acceptance criteria include the characteristics and performance requirements of the Waste Packages and the unpackaged Radioactive Waste to be disposed of such as the radionuclide content or radioactivity limits and the properties of the Waste Form and Waste Packages.
2. Modelling and/ or testing of the behaviour of Waste Forms should be undertaken during the pre-disposal management of Radioactive Waste to ensure the physical and chemical stability of the different Waste Packages and unpackaged Radioactive Waste under the conditions expected in the Near Surface Radioactive Waste Disposal Facility and to ensure adequate performance of Waste Forms in the event of anticipated operational occurrences or Accidents at the Near Surface Radioactive Waste Disposal Facility.
3. Radioactive Waste should be characterised to provide sufficient information to ensure compliance with Radioactive Waste acceptance criteria prior to transport to the Near Surface Radioactive Waste Disposal Facility. Arrangements should be put in place to verify that the Radioactive Waste and Waste Packages received for Disposal comply with these requirements and criteria and, if not, to confirm that corrective measures are taken during pre-disposal management of Radioactive Waste. Quality control of Waste Packages should be carried out during the pre-disposal management of Radioactive Waste and is achieved mainly on the basis of records, pre-conditioning testing (e.g. of containers) and control of the conditioning process. Post-conditioning testing and the need for corrective measures should be limited as far as practicable.
4. The Radioactive Waste acceptance criteria should include the Radioactive Waste characteristics important for Safety in the operational and post-Closure control period of the Near Surface Radioactive Waste Disposal Facility, and should specify the following:
 - a) Permitted levels of radioactivity in each Waste Package and permitted levels of long lived radionuclides in each Waste Package;
 - b) Permitted surface Dose rate and surface contamination;
 - c) The permissible range of chemical and physical properties of the Radioactive Waste and the Waste Form;
 - d) Substances or properties that are not permissible in Radioactive Waste for Disposal;
 - e) The permissible dimensions, mass and other manufacturing specifications of each Waste Package;
 - f) Limits on permitted uncertainties in respect of Radioactive Waste characterisation; and
 - g) Requirements for accompanying documentation.

Environmental Monitoring Programmes at a Near Surface Radioactive Waste Disposal Facility

Article (14)

1. Monitoring should be carried out at each step in the Siting, Design, Construction, Commissioning, Operation, Closure and in the post-Closure control period of a Near Surface Radioactive Waste Disposal Facility. The objectives of the monitoring programme include:
 - a) Obtaining information for subsequent assessments;
 - b) Assurance of operational Safety of a Near Surface Radioactive Waste Disposal Facility;
 - c) Assurance that conditions at the Near Surface Radioactive Waste Disposal Facility for Operation are consistent with the Safety Assessment;
 - d) Confirmation that conditions are consistent with the Safety Case after the Closure of the Near Surface Radioactive Waste Disposal Facility Disposal Site.
2. Monitoring programmes should be designed by an applicant for a relevant Licence and implemented by the respective Licensee so as not to reduce the overall level of Safety of the Near Surface Radioactive Waste Disposal Facility Disposal Site after its Closure.
3. Monitoring during the Operation of a Near Surface Radioactive Waste Disposal Facility should include measurements of external Dose rates in the environment and radionuclide activity concentrations in the air, water, soil, bottom sediments, vegetation, the bodies of animals and food.
4. The design of an monitoring programme during the Operation of a Near Surface Radioactive Waste Disposal Facility should be consistent with the objectives of monitoring. The need for and the scale of a monitoring programme will be determined primarily by the significance of the expected Doses to a Representative Person. Measurements should be made and sampling carried out at appropriate locations accessible to the public outside the operations boundary of the Near Surface Radioactive Waste Disposal Facility. The measurements should include measurements of external radiation levels and of radionuclide concentrations in all relevant environmental samples, food products and drinking water. The locations for measurements and sampling should be determined on a site specific basis with the aim of determining the highest radiation Doses to the public and identifying the areas most contaminated with radionuclides.
5. Post-Closure control period monitoring programmes aimed at confirming the Safety of a Near Surface Radioactive Waste Disposal Facility Disposal Site should include measurements of environmental radiation levels and of radionuclide concentrations in environmental samples collected for this purpose. The monitoring programme should be based on the assumptions, modelling and findings of the Safety Assessment. Due account should be also taken of site specific factors (e.g. climate, site location, geological and geomorphological conditions, the Design of the Near Surface Radioactive Waste Disposal Facility Disposal Site and its Barriers, the off-site environment and the population distribution).
6. In the long term, changes in climatic and environmental conditions such as hydrological flows or groundwater chemistry of a Hydrogeologic Unit as well as societal changes such as changes in land use or food production technologies may occur and may result in substantial changes in pathways and levels of Public Exposure to Ionizing Radiation from Radioactive Waste in a Near Surface Radioactive Waste Disposal Facility. The surveillance monitoring programmes in the surroundings of a closed Near Surface Radioactive Waste Disposal Facility should be reviewed by an authority or institution designated under the laws of the State to take responsibility for Institutional Control, to

take into account any changes in the conditions of Public Exposure to Ionizing Radiation from Radioactive Waste in a Near Surface Radioactive Waste Disposal Facility.

Radiation Protection in the Operation of a Near Surface Radioactive Waste Disposal Facility

Article (15)

1. A Radiation Protection programme should relate to all phases of a lifetime of a Near Surface Radioactive Waste Disposal Facility i.e. from its Design and Operation to its Closure. The general objective of a Radiation Protection programme is to reflect the application of the management responsibility for Radiation Protection and Safety through the adoption of management structures, policies, procedures and organisational arrangements that are commensurate with the nature and extent of the risks.
2. A Radiation Protection programme should be developed, documented, implemented and updated on a regular basis, and be consistent with Articles (3) to (13) and Articles (25) and (26) of FANR Regulation 11 for Radiation Protection and Predisposal Radioactive Waste Management for Nuclear Facilities (FANR-REG-11).
3. The Radiation Protection programme should be overseen by one or more persons appointed by the Licensee of the Near Surface Radioactive Waste Disposal Facility Licence for Operation, and given the powers and authority to act as a Radiation Protection Officer. The individual designated as a Radiation Protection Officer should have training and experience in the field of work. Appointment of a person as the Radiation Protection Officer does not relieve the Licensee of the Near Surface Radioactive Waste Disposal Facility Licence for Operation from its ultimate responsibility for Safety.
4. The basic structure of the Radiation Protection Officer should document with an appropriate level of detail:
 - a) The assignment of responsibilities for occupational Radiation Protection and Safety to different management levels including corresponding organisational arrangements and, if applicable (for example in the case of itinerant Workers), the allocation of the respective responsibilities between employers and the Licensee;
 - b) The designation of Controlled or Supervised Areas;
 - c) The local rules for Workers to follow and the supervision of work;
 - d) The arrangements for radiation monitoring of Workers and the workplace including the acquisition and Maintenance of Radiation Protection instruments for normal operations and Emergencies;
 - e) The system for recording and reporting all the relevant information related to the control of exposures, the decisions regarding measures for occupational Radiation Protection and Safety, and the radiation monitoring of individuals;
 - f) The education and training programme on the nature of the hazards, protection and Safety;
 - g) The methods for periodically reviewing and auditing the performance of the Radiation Protection Programme;

- h) The plans to be implemented from a Radiation Protection prospective in the event of an Emergency; and
 - i) The health surveillance programme.
5. Licensees should ensure that there are arrangements in place for appropriate Radiation Protection in cases where a female is (or might be) pregnant or is breast-feeding.
 6. Notification of the Licensee by a female Worker if she suspects that she is pregnant or if she is breast-feeding should 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 should adapt the working conditions in respect of Occupational Exposure so as to ensure that the embryo or foetus or the breastfed infant is afforded the same broad level of protection as is required for members of the public.
 7. Female Workers and employers both have responsibilities regarding the protection of the embryo or foetus. The Worker herself should, on becoming aware that she is pregnant, notify the employer so that her working conditions may be modified, if necessary.
 8. Licensees should maintain records of the Radiation Protection programme until the Licence is terminated by the Authority including:
 - a) The provisions of the programme;
 - b) Audits and other review of the programme content and implementation.

Radiation Protection in the Post-Closure Control Period

Article (16)

1. The performance objectives set forth in Article (4)(1) to (4)(6) of FANR-REG-27 are to site, Design, construct, operate and close a Near Surface Radioactive Waste Disposal Facility so that Radiation Protection after its Closure is Optimised, social and economic factors being taken into account. A reasonable assurance should be provided that Doses and risks to members of the public in the long term will not exceed the Dose Constraints or Risk Constraints as applied to the Design Basis for the Near Surface Radioactive Waste Disposal Facility Disposal Site.
2. The Dose Constraint or the Risk Constraint set forth in Article (4)(2) of FANR-REG-27 is to be considered as a planned potential exposure as part of the Design Basis of the Disposal Site, and applies to an Inadvertent Intruder that does not disrupt the Design functions of the Facility. It also applies to credible natural events that may reasonably affect the Facility.
3. The Dose Constraint or the Risk Constraint set forth in Article (4)(2) of FANR-REG-27 does not apply to severe natural events or severe Inadvertent Intrusion resulting in disruption of the engineering Barriers or coming into contact with the Radioactive Waste. It does not apply to conditions that exceed the Design Basis for planned potential exposure of the Near Surface Radioactive Waste Disposal Facility Disposal Site.
4. The severe natural events or severe Inadvertent Intrusion event resulting in disruption of the engineering Barriers where people might coming into contact with the Radioactive Waste are considered an exposure condition associated with an Accident and should be evaluated based on the principle of optimisation using the following Design criteria:

- a) In the case of an expected annual Dose of less than 1 mSv to those living on or around the Near Surface Radioactive Waste Disposal Facility Disposal Site, efforts to reduce the probability of Inadvertent Intrusion or to limit its consequences are not necessary.
- b) In the case of an expected annual Dose of greater than 20 mSv to those living on or around the Near Surface Radioactive Waste Disposal Facility Disposal Site, alternative options for Radioactive Waste Disposal are to be considered such as Disposal of the Radioactive Waste below the surface or separation of the radionuclide content giving rise to the higher Dose.
- c) In the case of an expected annual Dose in the range 1–20 mSv to those living on or around the Near Surface Radioactive Waste Disposal Facility Disposal Site, reasonable efforts are warranted at the stage of development of the Near Surface Radioactive Waste Disposal Facility Disposal Site to reduce the probability of Inadvertent Intrusion or to limit its consequences by means of Optimisation of the Design of the Near Surface Radioactive Waste Disposal Facility Disposal Site.
- d) Similar considerations should apply where the relevant thresholds for deterministic effects of Ionizing Radiation on human body organs may be exceeded.

Record-keeping

Article (17)

1. The Licensee(s) under this regulatory guide should establish a procedure for maintaining adequate documentation and records in accordance with the Integrated Management System required in Article (15)(8) of FANR-REG-27. The scope and level of details of the records will depend on the hazard and/ or the complexity of the proposed Operation of a Near Surface Radioactive Waste Disposal Facility.
2. Records will have varying periods of relevance. The requirements are for the records that relate to a Near Surface Radioactive Waste Disposal Facility, the Radioactive Waste itself and compliance with the acceptance criteria for Radioactive Waste Disposal to be retained for a period agreed with the Authority. These records should include (but not be limited to) the following:
 - a) The data needed for a national inventory of Radioactive Waste;
 - b) The data needed for Radioactive Waste characterisation;
 - c) The records from the control processes for treatment, packaging and conditioning;
 - d) Radioactive Waste acceptance records including waste acceptance criteria, characterisation methods and audits, and other reviews of programme content and implementation;
 - e) The documents on the procurement of containers required to provide confinement for a certain period;
 - f) The specifications for Waste Packages and audit records for individual containers and Waste Packages;
 - g) Trends in operating performance of the Near Surface Radioactive Waste Disposal Facility;
 - h) Non-compliances with the specifications for Waste Packages and the actions taken

- to rectify the non-compliances;
- i) Monitoring records;
 - j) Results of Safety Assessments;
 - k) Written Operation procedures; and
 - l) Any additional data as required by the Authority.
3. A Radioactive Waste characterisation record should contain the following information relating to the Radioactive Waste:
- a) Type of Radiation Source;
 - b) Origin of Radioactive Waste;
 - c) Physical and chemical characteristics of Waste Form;
 - d) Amount (volume and/ or mass) of Radioactive Waste;
 - e) Radiological characteristics (the radioactivity concentration, the total radioactivity, the radionuclides present and their relative proportions);
 - f) Classification of Radioactive Waste in accordance with the Radioactive Waste classification as specified in Article (12) and in Annex B of this regulatory guide; and
 - g) Chemical, pathogen or other hazard associated with the Radioactive Waste and the concentrations of hazardous material.
4. Following the receipt and acceptance of a shipment of Radioactive Waste for Disposal, the Near Surface Radioactive Waste Disposal Facility Operation Licensee should record:
- a) The date of receipt of the shipment of the Radioactive Waste at the Near Surface Radioactive Waste Disposal Facility;
 - b) The date of Disposal of the Radioactive Waste.
 - c) A traceable shipment manifest number;
 - d) A description of how the Waste Package fulfills the Radioactive Waste acceptance criteria for the Near Surface Radioactive Waste Disposal Facility;
 - e) A description of any engineered barrier or structural overpack provided for Disposal of the Radioactive Waste;
 - f) The location of the disposed Waste Packages at the Disposal Site;
 - g) The containment integrity of the Radioactive Waste Disposal containers as received;
 - h) Any discrepancies between Radioactive Waste listed on the manifest and those received;
 - i) The volume of any pallets, bracing or other shipping or Radioactive Waste generated on the Near Surface Radioactive Waste Disposal Facility site that are contaminated, and are disposed of as contaminated or suspect materials;
 - j) Any evidence of leaking or damaged Disposal containers or Ionizing Radiation or contamination levels in excess of limits specified in Authority regulations;

- k) Any re-packaging operations of any of the Disposal containers included in the shipment; and
- l) Any other information required by the Authority as per Licence conditions.

The Licensee should retain these records until given to the entity responsible for Institutional Control.

5. The annual reports to be submitted by the Licensee(s) to the Authority in accordance with this regulatory guide should include (but not be limited to) the following:
 - a) The quantity of each of the principal radionuclides released to unrestricted areas at the site of the Near Surface Radioactive Waste Disposal Facility in liquid and in airborne effluents during the preceding year;
 - b) The results of the environmental monitoring programme;
 - c) A summary of the Licensee's Disposal Unit survey and Maintenance activities;
 - d) A summary, by Radioactive Waste class, of activities and quantities of radionuclides disposed of;
 - e) Any instances in which observed site characteristics at the Disposal Site were significantly different from those described in the application for the Licence held by the Licensee; and
 - f) Any other information the Authority may require.
6. If the quantities of Radioactive Material released during the reporting period, monitoring results, or Maintenance performed are significantly different from those expected in the application documents previously reviewed as part of the review of a Licence application, the report should cover this specifically.
7. Occupational Radiation exposure data should be provided to the Authority in a format and frequency agreed upon with the Authority using a method defined by the Authority for import into the UAE National Dose Registry.

Annex A

Content of Licence Applications for Siting, Site Preparation and Construction, Commissioning, and Operation

A. General Information

The general information should include each of the following:

1. Identity of the Licence applicant including:
 - a) The full name, address, telephone number and description of the business or occupation of the applicant;
 - b) If the applicant is a partnership, the name and address of each partner and the principal location where the partnership does business;
 - c) If the applicant is a corporation or an unincorporated association, (i) the state where it is incorporated or organised and the principal location where it does business, and (ii) the names and addresses of its directors and principal officers; and
 - d) If the applicant is acting as an agent or representative of another person in filing the application, all information in this paragraph should be supplied with respect to the other person.
2. Qualifications of the Licence applicant:
 - a) The organisational structure of the applicant, both offsite and onsite, including a description of lines of authority and assignments of responsibilities whether in the form of administrative directives, contract provisions, or otherwise;
 - b) The technical qualifications including training and experience of the applicant and members of the applicant's staff to engage in the proposed activities. Minimum training and experience requirements for personnel filling key positions described in paragraph (2)(a) of this section should be provided;
 - c) A description of the applicant's personnel training programme; and
 - d) The plan to maintain an adequate complement of trained personnel to carry out Radioactive Waste receipt, handling and Disposal operations in a safe manner.
3. A description of:
 - a) The location of the proposed Near Surface Radioactive Waste Disposal Facility site;
 - b) The general character of the proposed activities;
 - c) The types and quantities of Radioactive Waste to be received, possessed, and disposed of;
 - d) Plans for use of the Near Surface Radioactive Waste Disposal Facility for purposes other than Disposal of Radioactive Waste;
 - e) The proposed facilities and equipment;
 - f) Proposed schedules for Construction of a Near Surface Radioactive Waste Disposal Facility, receipt of Radioactive Waste, and initial placement of Radioactive Waste at the Disposal Site.

B. Specific Technical Information

The specific technical information which supports the Safety Case based on the objective of the application for a Licence should include the following applicable information needed to demonstrate that the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27 will be met:

1. A description of the natural and relevant demographic Disposal site characteristics as determined by Disposal site selection and characterisation activities. The description should include geological, geotechnical, geochemical, geomorphological, radiological, hydrological, meteorological, climatological, and biotic features of the Disposal Site and its vicinity.
2. An environmental impact assessment (EIA) of the proposed sites should include an evaluation of the effects of the proposed Disposal Facility on public health and Safety and on the environment.
3. A description of the Design features of the Near Surface Radioactive Waste Disposal Facility, the Disposal Site and the Disposal Units. The description should include those Design features related to infiltration of water; integrity of covers for Disposal Units; structural stability of backfill, Radioactive Waste and covers; contact of Radioactive Waste with standing water; Disposal Site drainage; Disposal Site Closure and stabilisation; elimination to the extent practicable of long-term Disposal Site Maintenance; Inadvertent Intrusion; Occupational Exposure; Disposal Site monitoring; and adequacy of the size of the Buffer Zone for monitoring and potential mitigative measures.
4. A description of the principal Design criteria and their relationship to the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27.
5. A description of the Design Basis natural events or phenomena and their relationship to the principal Design criteria.
6. A description of codes and standards, which the Licence applicant has applied to the Design and which will apply to Construction of the Near Surface Radioactive Waste Disposal Facility.
7. A description of the Construction, Commissioning and Operation of the Near Surface Radioactive Waste Disposal Facility. The description should include as a minimum the methods of Construction of Disposal Units; Radioactive Waste placement; the procedures for and areas of Radioactive Waste segregation; types of Inadvertent Intruder Barriers; onsite traffic and drainage systems; survey control programme; methods and areas of Radioactive Waste Storage; and methods to control surface water and groundwater access to the Radioactive Waste. The description should also include a description of the methods to be employed in the handling and Disposal of Radioactive Waste containing Chelating Agents or other non-radiological substances that might affect meeting the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27.
8. A description of the Disposal Site Closure plan including those Design features that are intended to facilitate Disposal Site Closure and eliminate the need for ongoing active Maintenance.
9. An identification of the known natural resources at the Disposal Site, the exploitation of which could result in an Inadvertent Intrusion into the Radioactive Waste after the post-Closure control period.
10. A description of the type, amount, classification and specification of the Radioactive Waste proposed for receipt, possession and disposed at the Near Surface Radioactive Waste Disposal Facility including the criteria for acceptance of Radioactive Waste for Disposal.

11. A description of the Integrated Management System tailored to Radioactive Waste Disposal, developed and applied by the Licence applicant during the Siting, Design, Construction, Operation, and Closure of the Near Surface Radioactive Waste Disposal Facility and the receipt, handling and Disposal of Radioactive Waste.
12. A description of the Radiation Protection Programme for control and monitoring of radioactive effluents to ensure compliance with the performance objectives set forth in Article (4)(1) - (4)(6) of FANR-REG-27 and a description of Occupational Exposure to ensure compliance with the requirements of FANR-REG-04 and to control contamination of personnel, vehicles, equipment, buildings and the Near Surface Radioactive Waste Disposal Facility. Both routine operations and Accidents should be addressed by the Licence applicant. The programme description should include procedures, instrumentation, facilities and equipment.
13. A description of the environmental monitoring programme to provide data to evaluate Disposal Site performance including the potential health and environmental impact, and the plan for taking corrective measures commensurate with any detected radionuclide migration.
14. Identification of the Defence-in-Depth Safety protection including a description of the capability of each Defence-in-Depth Safety protection relied upon to maintain Safety and a basis for the capability of each Defence-in-Depth Safety protection.
15. A description of the administrative procedures that the Licence applicant will apply to control activities at the Near Surface Radioactive Waste Disposal Facility.
16. A description of the Facility's electronic record-keeping system as required in Article (15)(7) of FANR-REG-27.

C. Technical Analyses

The specific technical information should also include the following analyses needed to demonstrate that the performance objectives set forth in Article (4)1 to 6 of FANR-REG-27 will be met:

1. A performance Assessment that demonstrates that there is reasonable assurance that the exposure to humans from the release of radionuclides shall meet the performance objective set forth in Article (4)1 to 6 of FANR-REG-27. The performance Assessment should:
 - a) Consider features, events and processes that might affect demonstrating compliance with performance objectives set forth in Article (4)1 to 6 of FANR-REG-27. The features, events and processes considered must represent a range of phenomena with both beneficial and adverse effects on performance, and must consider the specific technical information required in this regulatory guide in Annex A item B(1) to B(16). A technical basis for either inclusion or exclusion of specific features, events, and processes should be provided.
 - b) Consider the likelihood of disruptive or other unlikely features, events, or processes for comparison with the Dose Constraint set forth in Article (4)(2) of FANR-REG-27
 - c) Provide a technical basis for models used in the performance Assessment (e.g. comparisons made with output of detailed process-level models or empirical observations such as laboratory testing, field investigations, or natural analogs).
 - d) Evaluate contaminant transport pathways and processes in environmental media (e.g. air, soil, groundwater, surface water) including but not limited to advection, diffusion, plant uptake, and exhumation by burrowing animals.

- e) Account for uncertainties and variability in the projected behavior of the Disposal Site and general environment and in the demographics and behaviour of human receptors.
 - f) Identify and differentiate between the roles performed by the natural Disposal Site characteristics and Design features of the Near Surface Radioactive Waste Disposal Facility in limiting releases of radionuclides to the public.
 - g) Include technical justification of the Compliance Period that needs to be considered in the performance Assessment.
2. An Inadvertent Intruder Assessment that demonstrates there is reasonable assurance that any Inadvertent Intruder will not be exposed to doses that exceed the limits set forth in Article (16)(4) of this regulatory guide. The Inadvertent Intruder Assessment should:
- a) Assume that an Inadvertent Intruder occupies the Disposal Site and engages in normal activities (e.g., dwelling construction, agriculture, and drilling for water) and other reasonably foreseeable pursuits that are consistent with the activities and pursuits occurring in and around the Disposal Site at the time of development of the Inadvertent Intruder Assessment. Licensees shall update the Inadvertent Intruder Assessment prior to Closure, in accordance with this regulatory guide, Article (4)(2), to reflect any significant changes to the activities and pursuits occurring in and around the Disposal Site.
 - b) Identify Barriers to Inadvertent Intrusion that inhibit contact with the Radioactive Waste or limit exposure to Ionizing Radiation from the Radioactive Waste, and provide a basis for the time period over which Barriers are effective.
 - c) Account for uncertainties and variability in the projected behavior of the Disposal Site and general environment.
 - d) Include technical justification of the Compliance Period that need to be considered in the Inadvertent Intruder Assessment.
3. Analyses of the protection of individuals during operations should include Assessments of expected Public and Occupational Exposures due to routine operations and likely Accidents during handling, Storage and Disposal of Radioactive Waste. The analyses should provide reasonable assurance that Public and Occupational exposures will be controlled to meet the requirements of FANR-REG-04.
4. Analyses of the long-term stability of the Disposal Site and the need for ongoing active Maintenance after Closure should be based upon analyses of active natural processes such as erosion, mass wasting, slope failure, settlement of Radioactive Waste and backfill, infiltration through covers over Disposal areas and adjacent soils, and surface drainage of the Disposal Site. The analyses should provide reasonable assurance that long-term stability of the disposal site can be ensured for the Compliance Period and that there will not be a need for ongoing active Maintenance of the Disposal Site following Site Closure.

D. Institutional Information

The institutional information should include a certification by the authority or institution designated under the laws of the State that it will assume responsibility for the care for the post-Closure control period observation and Maintenance of the Disposal Site.

E. Other Information

Depending upon the nature of the Radioactive Waste to be disposed of, and the Design and proposed Operation of the Near Surface Radioactive Waste Disposal Facility, additional information may be requested by the Authority that may include, but is not limited to, Physical Protection measures and Safety information concerning special fissionable material, which are not part of this regulatory guide.

Annex B

Radioactive Waste Classification

For the purposes of consideration of Radioactive Waste Disposal options and to aid communication about Radioactive Waste management, Licensees should classify their Radioactive Waste holdings taking into account the scheme established in IAEA Safety Standard GSG-1: Classification of Radioactive Waste. The Radioactive Waste classes established by this international classification scheme, as adopted by the Authority, are as follows:

- a) Exempt waste (EW): Radioactive Waste that meets the criteria for clearance or Exemption from Regulatory Control for Radiation Protection purposes as described in FANR Regulation 11 for Radiation Protection and Predisposal Radioactive Waste Management in Nuclear Facilities (FANR-REG-11) or FANR Regulation 24 for Basic Safety Standards for Facilities and Activities involving Ionising Radiation other than in Nuclear Facilities (FANR-REG-24), as applicable.
- b) Very short-lived waste (VSLW): Radioactive Waste that can be stored for decay over a limited period of up to a few years and subsequently approved for clearance by the Authority for uncontrolled Disposal, use or discharge. This class includes Radioactive Waste containing primarily radionuclides with very short half-lives often used for research and medical purposes.
- c) Very low level waste (VLLW): Radioactive Waste that does not necessarily meet the criteria of exempt waste but that does not need a high level of containment and isolation and is, therefore, suitable for Disposal in near surface landfill type facilities with limited Regulatory Control. Such landfill type facilities may also contain other hazardous waste. Typical Radioactive Waste in this class includes soil and rubble with low levels of radioactivity concentration. Concentrations of longer lived radionuclides in very low level waste are generally very limited.
- d) Low level waste (LLW): Radioactive Waste that is above clearance levels established in FANR-REG-11 or FANR-REG-24, as applicable, but with limited amounts of long-lived radionuclides. Such Radioactive Waste requires robust isolation and containment for periods of up to a few hundred years and is suitable for Disposal in engineered in a Near Surface Radioactive Waste Disposal Facility. This class covers a very broad range of Radioactive Waste. Low level waste may include short lived radionuclides at higher levels of activity concentration, and also long lived radionuclides, but only at relatively low levels of activity concentration.
- e) Intermediate level waste (ILW): Radioactive Waste that (because of its content particularly of long lived radionuclides) requires a greater degree of containment and isolation than that

provided by near surface Disposal. However, intermediate level waste needs no provision, or only limited provision, for heat dissipation during its Storage and Disposal. Intermediate level waste may contain long-lived radionuclides, in particular, alpha-emitting radionuclides that will not decay to a level of activity concentration acceptable for near surface Disposal during the time for which Institutional Control can be relied upon. Therefore, Radioactive Waste in this class requires Disposal at greater depths, of the order of tens of metres to a few hundred metres.

f) High level waste (HLW):

Radioactive Waste with levels of activity concentration high enough to generate significant quantities of heat by the radioactive decay process or Radioactive Waste with large amounts of long lived radionuclides that need to be considered in the Design of a Disposal Facility for such Radioactive Waste. Disposal in deep, stable geological formations usually several hundred metres or more below the surface is the generally recognised option for disposal of high level waste.

Note:

Further details about this Radioactive Waste classification are available in IAEA Safety Standard GSG-1: Classification of Radioactive Waste.

Licensees may also classify Radioactive Waste for operational purposes, but it should be possible to broadly relate the operational classifications to the classes in this Annex B.