Appendix 3

CONTEXT FOR THE RESPONSES

This appendix gives the national and programmatic context on the basis of which the various participating organisations responded to the questionnaire (see Question 1). Programme status refers, in general, to the situation in the spring of 2005, which was the deadline for responses to the questionnaire, although more recent developments have, in some cases, also been included.

Belgium

Organisations responding to the questionnaire

Responses from Belgian organisations were received from AVN and jointly from ONDRAF/NIRAS and SCK•CEN.

AVN – the Association Vinçotte Nuclear – is an authorised inspection organisation licensed by the Federal Agency for Nuclear Control to carry out the surveillance of the Belgian nuclear installations in the framework of the Belgian laws and regulations. It is through the association of the FANC on one side, and the control organisations such as AVN on the other, that the function of regulator as stipulated in article 20, 1st paragraph, of the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management, is ensured.

ONDRAF/NIRAS – the Belgian Agency for Radioactive Waste and Enriched Fissile Material – is legally in charge of the management of all radioactive waste on Belgian territory. In this framework, ONDRAF/NIRAS is responsible for the R&D programme related to the geological disposal of high-level and long-lived waste.

SCK•CEN – the Nuclear Energy Research Centre – is the main R&D subcontractor of ONDRAF/NIRAS for the deep disposal programme, and assisted ONDRAF/NIRAS in providing responses.

Programme status

With the publication of SAFIR 2 (Safety Assessment and Feasibility Interim Report) in 2002 ONDRAF/NIRAS ended the second methodological R&D phase of the deep disposal programme for high-level and long-lived waste. Since 2004, the programme entered the third methodological R&D phase. The prime aim of these methodological phases is to establish if it is feasible, technically and financially, to design, build, operate and close a safe deep repository for this waste on Belgian territory, without prejudging the actual disposal site. The reference formation and site for methodological research is the Boom Clay at Mol/Dessel, which has been extensively studied from the surface and underground. Belgium has benefited from the HADES URL at Mol-Dessel, which was established at the beginning of the 80s, soon after the inception of the programme.

Repository concepts

Belgian responses to the questionnaire were based on the current concept of disposal of vitrified waste from reprocessing, spent fuel and some intermediate-level waste forms in an approximately 100 m thick Boom Clay layer at a depth of between about 190 m and 290 m. The upper- and underlying-geological formations are sandy water bearing sediments. The engineered barrier design for vitrified high-level waste and spent fuel has been extensively reviewed and modified since the SAFIR 2 report. In the current design, the different components of the engineered barriers (waste, overpack, buffer material and stainless steel envelope) will be assembled at the surface inside supercontainers, before being transported to underground disposal galleries. The galleries for high-level waste and spent fuel have typical diameters of 2 to 2.5 m, and are lined with concrete wedge blocks to stabilise the excavated galleries against clay convergence. Access to the disposal galleries is through a series of shafts and an access gallery. The reference materials for the overpack, the buffer and the container lining are respectively carbon steel, OPC cement based concrete and stainless steel. Galleries are backfilled with a cement-based material.

Canada

Organisations responding to the questionnaire

Responses were received from OPG – Ontario Power Generation – the implementing organisation charged with the disposal of Canadian low- and intermediate-level waste. OPG is also implementing used fuel storage, but it is anticipated that the Canadian Nuclear Waste Management Organization (NWMO) will eventually become the implementing organisation for long-term management of used fuel.

Programme status

A candidate host site has been identified for a repository for low- and intermediate-level waste in the deep sedimentary rock under the Bruce nuclear site. In February 2005, the community indicated its support for the proposal. OPG is currently in the early stages of planning for site characterisation and environmental assessment.

NWMO is evaluating options for long-term management of used fuel in Canada. A recommendation is to be submitted to the federal government in late 2005. Subsequently the federal government will decide on the approach.

Repository concepts

Canadian responses to the questionnaire were based on the proposed low- and intermediate-level waste repository. The wastes include non-processible waste (such as metal scraps), compacted soft wastes, incinerator ashes, resins, activated components and decommissioning wastes. The geological environment at the proposed site is sedimentary rock at a depth of approximately 660 m. The repository will be located in either limestone or shale rock. The waste packages will be placed in vaults excavated in the rock. The vaults will be sealed but not backfilled. The shafts will eventually be filled and sealed.

Czech Republic

Organisations responding to the questionnaire

Responses were received from RAWRA – the Czech Radioactive Waste Repository Authority – the organisation responsible for radioactive waste disposal and research and development activities connected to waste disposal, including geological repository development.

Programme status

The Czech national programme is in the process of selecting a site for detailed characterisation. Currently there are six candidate sites, chosen on the basis of air-born geophysical measurements, remote sensing, field checking, and pre-feasibility studies.

Repository concepts

Czech responses to the questionnaire were based on disposal of spent fuel and other long-lived wastes in long-lived containers (probably including steel canisters) surrounded by a (probably clay-based) buffer in disposal areas mined in a granite formation.

Finland

Organisations responding to the questionnaire

Responses were received from STUK, the Radiation and Nuclear Safety Authority of Finland. STUK is the Finnish regulatory body.

Programme status

In the Finnish programme, the first (political) authorisation step, the decision in principle for a repository for spent fuel disposal, was taken in 2001, allowing the selection of the disposal site (Olkiluoto). An underground rock characterisation facility is currently being excavated. In 2012, it is foreseen that the application for a construction licence will be submitted. If the application is accepted, the operation of the facility is currently foreseen as beginning in 2020.

Repository concepts

Finnish responses to the questionnaire were based on disposal according to the KBS-3 concept (see Sweden, below).

France

Organisations responding to the questionnaire

Responses from French organisations were received from Andra and IRSN.

Andra is the French National Agency for the management of radioactive waste. Andra designs and implements disposal solutions suited to each category of waste. It manages, operates and monitors surface-disposal for low-level radioactive waste, and is in charge of implementing management solutions for other wastes.

IRSN provides technical support to the French Safety Authority in charge of underground repository safety assessment for high level wastes.

All responses to the questionnaire from these French organisations refer (except when noted) to the geological disposal project for the management of intermediate level waste (such as bituminous waste, cementeous waste, and metallic waste), vitrified waste and spent fuel. The potential of clay host rock is currently under consideration.

Programme status

Studies related to the geological disposal in France are at the feasibility stage. They rely, in the case of studies on clay formations, on data from a site-specific underground rock laboratory (the Bure URL) located at the Meuse/Haute-Marne site in the Eastern part of the Paris Basin and are documented in "Dossier 2005 Argile". Studies on granite are based on generic data and are documented in "Dossier 2005 Granite".

Repository concepts

French responses to the questionnaire were mostly based on the concept studied at the Bure URL. In this concept, the repository is constructed at 500 m depth in the 150 million year old Callovo Oxfordian indurated clay (argillite), which has surrounding clay and limestone formations. Specific repository modules are dedicated to each waste type. Intermediate-level waste is placed in concrete-overpacks in concrete-backfilled cavities. Vitrified high-level waste is placed in horizontal tunnels inside steel overpacks designed to isolate the waste from water until the temperature has sufficiently decreased. In the case of spent fuel, which is placed in horizontal tunnels inside steel overpacks with a surrounding bentonite buffer, the design lifetime of the overpacks is around ten thousand years, with up to four fuel rods in each overpack. The repository is designed so to facilitate reversibility.

Germany

Organisations responding to the questionnaire

Responses from German organisations were received from BfS, GRS-B and GRS-K.

BfS is the Federal Office for Radiation Protection. The German Atomic Energy Act gives the responsibility for the disposal of radioactive waste to the federal government, with BfS as the responsible authority (implementer).

GRS is an independent and non-profit scientific-technical expert and research organisation in the field of nuclear reactor safety and the entire nuclear fuel cycle. The main task of the Final Repository Safety Research Division of GRS/Brunswick (GRS-B) is the development of safety assessment methodologies for repositories for radioactive waste. On behalf of BfS, GRS-B has performed the safety analyses for the post-closure phase of the Morsleben repository. The Waste Management Division of GRS/Cologne (GRS-K) provides technical expertise to the German regulator BMU (the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety) and to licensing authorities (state governments).

Programme status

In Germany, it is intended to dispose of all types of radioactive waste in deep geological formations. Prior to 1980 the former iron ore mine Konrad was selected as a site for disposal of short-lived and long-lived radioactive waste with negligible heat generation and the salt dome at Gorleben as a site for the disposal of all types of solid and solidified radioactive waste, including heat generating radioactive waste originating from reprocessing and spent fuel elements. Both sites are in the Federal State of Lower Saxony. In the former German Democratic Republic, short-lived low- and intermediate-level radioactive waste was disposed of in the Morsleben (ERAM) repository, a former rock salt and potash mine.

The Lower Saxony administrative court decided on 8 March 2006 that the permission given for the Konrad repository was justified. At Gorleben, a moratorium on underground exploration became effective in 2000, and will remain in force for at most 10 years, pending clarification of conceptual and safety related issues. The ERAM repository began operation in 1971, and the disposal phase came to an end in 1998. A licence application for the closure of the repository is being prepared by BfS, who became the responsible operator of the repository after the reunification of Germany in 1990.

The German radioactive waste management and disposal concept is currently being reviewed, and further sites in various host rocks shall be investigated for their suitability. Thus, the Federal Minister for the Environment, Nature Conservation and Reactor Safety (BMU) set up an interdisciplinary expert group (AkEnd) to develop repository site selection criteria and respective procedures on a scientifically sound basis. AkEnd finished its work at the end of 2002 (AkEnd, 2002).

Repository concepts

German responses to the questionnaire relate to (i), the Konrad iron ore mine, (ii), the ERAM repository and (iii), a generic repository for spent fuel and high-level waste in a salt dome. In the case of Konrad, responses do not refer to any technical design or construction details but only to experiences with regard to acceptance questions obtained during the licensing procedure, including a public hearing. In the case of ERAM, many open cavities exist in this former mine with dimensions of up to 140 m in length, 40 m in width and in height. A few of these cavities located on the outskirts of the mine have been used as waste disposal areas, and will be sealed from the remaining inner parts of the mine. All openings will be backfilled to preserve the integrity of the salt barrier. The generic repository is based on an earlier German concept that envisaged the direct disposal of spent fuel rods in self-shielding POLLUX casks in drifts, and the disposal of vitrified high active waste in smaller canisters placed in boreholes. Subsequently the drifts and boreholes would be backfilled with crushed salt. Other engineered barriers in the reference concept were dams for drift sealing, borehole plugs and shaft sealing.

Hungary

Organisations responding to the questionnaire

A joint response from several Hungarian organisations was received.

PURAM – the Public Agency for Radioactive Waste Management – which was established to deal with multilevel tasks associated with the disposal of radioactive waste, interim storage and final disposal of the spent fuel, as well as with the decommissioning of nuclear facilities in Hungary.

HGS – the Hungarian Geological Survey – an independent specialised authority under the supervision of the Ministry of Transport and Economy. Exploration plans and final reports are to be submitted to and licensed by the HGS. In other licensing procedures the HGS is involved as a specialised authority, which means that its consent is a prerequisite of the final licence.

NRIRR – the Frederic Joliot-Curie National Research Institute for Radiobiology and Radiohygiene – which is the professional centre for radiation hygiene and radiation protection in Hungary. NRIRR performs the licensing and controlling of siting, construction, commissioning, operation, modification and closure of a radioactive waste disposal facility.

ETV-ERŐTERV – Spent Fuel and Radioactive Waste Management – which is an independent engineering company working on the fields of conventional and nuclear engineering.

Golder Associates (Hungary) Ltd., which is an independent engineering company working on the fields of hydrology and safety and environmental impact assessments of radioactive waste facilities.

HAEA – the Hungarian Atomic Energy Authority – which is an administrative body with national jurisdiction directed by the Government, with independent duties and regulatory responsibilities in matters related to the peaceful use of atomic energy.

Programme status

A repository is foreseen for low- and intermediate-level waste from the Paks Nuclear power plant, which would be constructed on the outskirts of Bátaapáti village (in the Üveghuta area) at a depth of 200-250 m below the surface, at 0-50 m above sea level in granite of Lower Carboniferous age. The exact location of the disposal area will be defined after additional geological investigations. Design of the layout and of the characteristics of the disposal areas will need to be refined after further geological investigations.

Geological disposal of spent fuel, high-level waste and long-lived intermediate-level waste is also foreseen. Between 1995 and 1998 a short-term programme (STP) was launched to characterise the rock mass known as the Boda Claystone Formation (BCF). The studies, which utilised an exiting mine, concluded that the rock was potentially suitable for disposal of spent fuel and high-level waste. In 2000, a nationwide site screening study was carried out, which identified 32 lithological formations potentially suitable for a deep geological repository. In 2004, surface-based investigations restarted in the Boda area, the aim of which is to identify by 2008 a location for an underground research laboratory for more detailed investigations of the site.

Repository concepts

Hungarian responses to the questionnaire relate to a repository for high-level waste and long-lived intermediate-level waste in the BCF, at an appropriate depth and location yet to be specified.

Japan

Organisations responding to the questionnaire

A response from Japanese organisations was received jointly from JNC and NUMO.

JNC, the Japan Nuclear Cycle Development Institute, is legally in charge of research and development related to the geological disposal of vitrified high-level radioactive waste, and provides a scientific and technical information base to support both the implementing organisation – NUMO, and the regulatory bodies – the Nuclear Safety Commission (NSC) and the Nuclear and Industrial Safety Agency (NISA).

NUMO, the Nuclear Waste Management Organisation of Japan, is legally in charge of implementation, including repository site selection, developing relevant licence applications and construction, operation and closure of a repository for the geological disposal of vitrified high-level waste from the reprocessing of spent nuclear fuel.

Programme status

The Japanese programme for geological disposal of high-level waste has moved from feasibility studies to an implementing phase. As laid down in Japanese law, the siting process will consist of three steps. Firstly, Preliminary Investigation Areas (PIAs) for potential candidate sites will be nominated based on site-specific literature surveys focusing on long-term stability of the geological environment. Secondly, Detailed Investigation Area(s) (DIAs) for candidate site(s) will be selected from the PIAs following surface-based investigations, including boreholes, carried out to evaluate the characteristics of the geological environment. Thirdly, detailed site characterisation, including underground research facilities, will lead to selection of the site for repository construction. In 2002, NUMO announced the start of open solicitation of volunteer municipalities for PIAs with publication of an information package and has been at the first stage of the siting process since that time. According to the present schedule, repository operation may start as early as the mid-2030s.

Repository concepts

Japanese responses to the questionnaire were based on a reference engineered barrier system in which the vitrified high-level waste encapsulated in steel overpacks is emplaced in disposal tunnels or pits with surrounding compacted bentonite/sand buffer. A range of siting environments for repository construction would be possible depending on the volunteer sites. They could have different characteristics, including, for example, inland and coastal areas (geographic aspects), mountainous, hilly and plain areas (topographic aspects) and areas with crystalline or sedimentary rocks (geological aspects). The underground facilities will be constructed in stable rock formations at least 300 m below the surface in accordance with Japanese legal requirements.

Spain

Organisations responding to the questionnaire

Responses were received from Enresa, which is the Spanish implementing organisation responsible for the management of radioactive wastes.

Programme status

The Spanish high-level waste management programme is at the stage of generic feasibility studies. Preliminary studies for identification of favourable host formations have been carried out in the past, but no active programme of site selection is in progress at present.

Repository concepts

Spanish responses to the questionnaire were based on conceptual designs for spent fuel repositories in salt, clay, and granite. Safety assessment exercises for repositories in granite and clay have been carried out (two iterations per host rock). The most recent exercises are ENRESA 2000 (granite) and ENRESA 2003 (clay).

Sweden

Organisations responding to the questionnaire

Responses from Swedish organisations were received from SKB and jointly from SKI and SSI.

SKB – the Swedish Nuclear Fuel and Waste Management Company – is the implementing organisation in Sweden.

SKI – the Swedish Nuclear Power Inspectorate –which is charged with (i), the supervision of the nuclear industry programme for development of a system for deep geological disposal of spent nuclear fuel and long-lived nuclear wastes, (ii), review of licence applications and providing comments to the government as a basis for its decisions, (iii), supervision of the construction, commissioning, operation and decommissioning of facilities, and (iv), supervision of the closure of repositories.

SSI – the Swedish Radiation Protection Authority – which, in the context of radioactive waste disposal, is charged with (i), regulation and supervision of occupational radiological health, (ii), defining the standard and promulgation of guidance for post-closure risk and environmental protection, and (iii), supervision in relation to the above regulatory activities.

Both SKI and SSI take part in the dialogue between stakeholders as a preparation for the licensing procedure for facilities, most notably an encapsulation plant and a repository for spent fuel.

Programme status

The two principal tasks in the Swedish programme are to locate, build and operate (i), a geological repository for spent nuclear fuel and (ii), an encapsulation plant in which the spent fuel will be placed in canisters before being emplaced in the repository.

SKB is currently pursuing site investigations for a geological repository for spent nuclear fuel at two potential locations in the municipalities of Östhammar and Oskarshamn. The aim is to build a deep repository at one of these candidate sites, provided that the bedrock and other relevant conditions are found suitable. Moreover, the detailed basis for construction of spent fuel canisters is being developed.

In November 2006, an application to build the encapsulation plant will be made. At the end of 2009, according to current (autumn 2006) plans, the application for final siting and construction of a repository will be made

Repository concepts

Swedish responses to the questionnaire were based on disposal according to the KBS-3 concept. The concept involves encapsulation of spent fuel elements in corrosion resistant copper canisters with inserts of iron for handling of mechanical loads. The canisters are emplaced in a mined repository at a

depth of about 500 m in saturated crystalline rock, and surrounded by a buffer of compacted bentonite clay. The most detailed plans consider a vertical emplacement of canisters, but horizontal emplacement is also considered a feasible option.

Switzerland

Organisations responding to the questionnaire

Responses were received from Nagra, the Swiss National Cooperative for the Disposal of Radioactive Waste, which is responsible for developing geological repositories for the safe disposal of all categories of radioactive waste. This includes the preparation of the necessary scientific and technical basis.

Programme status

Two types of repositories are foreseen in Switzerland: (i) a repository for the disposal of spent fuel, vitrified high-level waste and long-lived intermediate-level waste and (ii) a repository for the disposal of low- and intermediate-level waste arising from the operation and decommissioning of Swiss nuclear power plants and from medicine, industry and research.

Within the spent fuel, vitrified high-level waste and long-lived intermediate-level repository programme, Project *Entsorgungsnachweis* ("Disposal Feasibility") was submitted to the Federal Government at the end of 2002 for review. This project has the aim to demonstrate that a safe repository can be implemented and that a corresponding site exists within Switzerland. The review of the project by the Swiss authorities, which came to positive conclusions, was completed in August 2005, and was followed by a broad, three-month public consultation phase. No additional technical issues (compared with the authorities review findings) were identified in the public consultation phase. Based on the results of the review and the public consultation phase, the Swiss Government (the Federal Council) concluded on 28 June 2006 that disposal feasibility of SF/HLW/ILW in Switzerland had been successfully demonstrated.

In the case of low- and intermediate-level waste (L/ILW) programme, a repository project at Wellenberg, Canton of Nidwalden, had to be abandoned on political grounds after the population of the Canton of Nidwalden rejected the plans for the proposed underground investigations in 2002.

For both the HLW and the L/ILW programmes, the next stage will focus on the definition and implementation of a site selection process. As a first step in the siting process the Federal Office of Energy is currently preparing a document defining a site selection procedure along with the corresponding criteria. It is expected that the Swiss Government will approve this site selection procedure in 2007 after a period of broad consultation with the cantons, the neighbouring countries and different interest groups. The siting process will allow extensive public participation.

Repository concepts

Swiss responses to the questionnaire relate to the repository for spent fuel, vitrified high-level waste and long-lived intermediate-level wastes analysed in Project Entsorgungsnachweis. The host rock is the Opalinus Clay in the Zürcher Weinland in northern Switzerland. This is an over-consolidated clay stone of Middle Jurassic age. In the investigation area, the clay forms a layer about 100 m thick and is embedded in the so-called confining units, with properties similar to the Opalinus Clay and with thicknesses of about 100 m above and about 160 m below the host rock. The proposed repository would be constructed at about 650 m below surface. Steel canisters containing

either spent fuel or high-level waste would be emplaced coaxially within a system of parallel tunnels constructed in the centre of the formation. The tunnels would be backfilled with compacted bentonite. Intermediate-level waste would be emplaced in larger-diameter tunnels, backfilled with a cementitious mortar. Access to the system of tunnels would be provided, during construction and operation, by a spiral ramp. A vertical construction/ventilation shaft is also foreseen.

United Kingdom

Organisations responding to the questionnaire

Responses were received from Nirex – the organisation responsible for supporting UK Government policy by developing and advising on safe, environmentally sound, and publicly acceptable options for the long-term management of radioactive materials in the United Kingdom, i.e. Nirex is an implementing organisation.

Programme status

In the United Kingdom there has been a period of consultation regarding the options for long-term radioactive waste management, undertaken on behalf of Government by an independent Committee on Radioactive Waste Management (CoRWM). CoRWM has recently published its report in which it recommends deep geological disposal as the preferred option for the long-term management of radioactive wastes. However, a site for such a repository has yet to be identified and current safety assessments are therefore undertaken on a generic basis.

Repository concepts

In order to be able to continue to provide advice on the conditioning and packaging of wastes to waste producers, Nirex has developed a generic phased geological repository concept for the disposal of intermediate-level waste and some low-level waste, which provides the basis for the questionnaire responses. In this concept, the waste would typically be grouted into steel drums or concrete boxes and placed in vaults excavated at several hundred metres depth in a geological environment. At a time determined by future generations, the vaults would be backfilled with the cement-based Nirex Reference Vault Backfill and the shafts and access-ways sealed.

United States

Organisations responding to the questionnaire

Responses from United States organisations were received from the US DOE, US EPA and US NRC.

US DOE – the United States Department of Energy – manages the Yucca Mountain Project for the geological disposal of spent-fuel and high-level waste through its Office of Repository Development (ORD). The main role of the ORD is to develop and obtain a licence for Yucca Mountain and to build and operate a repository at Yucca Mountain if the US NRC grants a licence to do so. The US DOE also is the developer, owner, and licensee for the Waste Isolation Pilot Plant (WIPP) deep geological repository for disposal of long-lived transuranic (intermediate level) radioactive waste in New Mexico.

US EPA – the United States Environmental Protection Agency – through its Office of Radiation and Indoor Air (ORIA), Radiation Protection Division (RPD) (i), establishes public health and

environmental radiation protection standards for land disposal of spent nuclear fuel, high-level waste, and transuranic radioactive waste and (ii), serves as the "certifying" (licensing) authority and oversees continuing operation of WIPP, a repository for disposal of WIPP.

US NRC – the United States Nuclear Regulatory Commission – is responsible for reviewing a licence application for a potential high-level waste geological repository (submitted by the US DOE) and making a safety decision according to regulations at Code of Federal Regulations, Title 10, Part 63 (10 CFR Part 63). If the US DOE is granted a licence, US NRC will oversee the development of the repository (e.g., subject to US NRC inspection and enforcement of its regulations).

Programme status

WIPP opened in 1999 and has received more than 3 400 shipments from eight sites. It is expected to operate for roughly 30 more years.

In 1993, the US EPA issued its final generic standards for land disposal of spent nuclear fuel, high-level waste and transuranic waste (Code of Federal Regulations, Title 40, Part 191 (40 CFR Part 191)). These standards apply to operation of the WIPP. As the approving regulatory authority, the US EPA also issued compliance criteria to interpret and implement the generic Part 191 standards at WIPP (40 CFR Part 194). In May 1998, US EPA approved the US DOE's certification application for the WIPP. In March 1999, the first shipments of trans-uranic waste to the WIPP took place. US DOE must apply for re-certification every five years, and submitted its application in March 2004. The US EPA is currently in the process of reviewing the re-certification application and expects to make a final decision in early 2006.

The Energy Policy Act of 1992 directed the US EPA to develop site-specific standards for the proposed repository at Yucca Mountain, Nevada (the Waste Isolation Pilot Plant Withdrawal Act of 1992 exempted Yucca Mountain from US EPA's Part 191 standards). The US EPA issued its standards (40 CFR Part 197) in 2001. A legal challenge to the time of compliance resulted in the standards being vacated and remanded to the US EPA for revision. The US EPA is currently in the process of revising its standards.

In 2002, the U.S. Congress and President accepted the recommendation from the Secretary of Energy and designated the Yucca Mountain Site in Nevada for development. The first step in that development is to submit a Licence Application to the U.S. Nuclear Regulatory Commission. The US DOE is in the process of preparing a licence application for a potential repository at Yucca Mountain, Nevada. That licence application is under continued development as the US EPA completes changes to its safety standards and is planned to be submitted as soon as practicable, but no firm date has yet been announced. The Nuclear Regulatory Commission (US NRC) is in the process of modifying its licensing regulations at 10 CFR Part 63 consistent with changes in US EPA's revised standards in 40 CFR Part 197. US DOE's license application must address the modified 10 CFR Part 63, which regulation incorporates the revised 40 CFR Part 197 standard.

Repository concepts

US responses to the questionnaire concerning the Yucca Mountain repository concept describe Yucca Mountain as a desert ridge of layered ash-flow and ash-fall volcanic tuffs, deposited more than approximately 10 million years ago. The thick rock sequence allows the emplacement of waste about halfway between the surface and the water table, which lies about 600 m below the mountain crest. The site is relatively isolated and sits in a closed hydrologic basin, so no radionuclide releases via the groundwater pathway will reach rivers or oceans, or major population centres. Three primary types of

waste will be emplaced at Yucca Mountain: (1) spent nuclear fuel rods from all commercial nuclear reactors in the US, (2) vitrified high-level waste glass owned by the US DOE and mainly derived from weapons production, and (3) spent nuclear fuel from US DOE and other government owned or sponsored reactors. The waste is contained in highly durable waste packages made from a nickel-chromium-molybdenum alloy (Alloy 22), and are to be emplaced horizontally in drifts. Titanium drip shields protect the waste packages from potentially corrosive dripping water and falling rocks.

WIPP is located in a relatively flat, arid region. The host rock consists of Permian salt beds formed about 250 million years ago, suggesting long-term geological stability. The primary salt formation is about 2 000 feet thick, beginning 260 metres (850 feet) below the surface. Project facilities include excavated rooms about 650 metres (2 150 feet) below the surface. Ground water below the salt layer is saline and non-potable. WIPP handles materials contaminated with transuranic isotopes during atomic energy defence activities, such as cleaning rags and other contaminated refuse, equipment, tools, protective gear, and sludge. Contact-handled waste does not require special packaging and is placed in excavated rooms (panels). Remote-handled waste will be placed in boreholes in the salt layer between the larger rooms. Over time, it is expected that the salt will encapsulate the waste and provide natural sealing and shielding.

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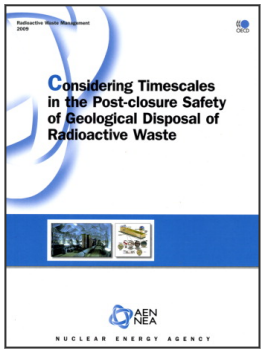

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