Dukovany

Repository

Radioactive Waste
Repository Authority


SÚRAO

The Radioactive Waste Repository Authority (RAWRA) is a state organisation established under the provisions of Article 26 of Act 18/1997, on the peaceful uses of nuclear energy and ionising radiation (the Atomic Act) and on amendments to certain other Acts. RAWRA's mission is to ensure the safe disposal of existing and future radioactive waste, in compliance with the requirements of nuclear safety and human and environmental protection.

55 000 m³

1,3 ha

DUKOVANY REPOSITORY

The Dukovany repository was built for the disposal of low-level and intermediate-level radioactive waste generated by the nuclear power sector. It is the Czech Republic's largest and most recently constructed disposal facility, comparable, in terms of its design and safety, with repositories in Western European countries.

This state-owned repository, covering 1.3 hectares, is situated at the Dukovany nuclear power plant site near Třebíč, Moravia.

The construction of the Dukovany repository by ČEZ, the then state-owned Czech Power Company, commenced in 1987 and has been in continuous operation since 1995. At present, drums containing operational radioactive waste principally from the Dukovany and Temelín NPPs are stored at this repository. The 55,000 m^3 storage space (which can accommodate approximately 180,000 drums) provides enough capacity for all the operational waste generated at both Czech nuclear power plants, even if their design life were to be extended to 40 years.

The Dukovany repository is not intended for the disposal of high-level radioactive waste generated by industrial, research or medical facilities nor will it be used for the final emplacement of spent nuclear fuel, a topic which is currently subject to wide debate within the nuclear power sector.

Radioactive waste management is the responsibility of the State

Following the adoption of the Atomic Act (Act 18/1997), the State assumed responsibility for safe radioactive waste disposal within the Czech Republic. Under the provisions of this Act, the Dukovany repository has been in State ownership since 1st January 2000. The Radioactive Waste Repository Authority (RAWRA), a state-owned organisation established under the Atomic Act to undertake all the activities associated with state-guaranteed waste management, is responsible for the operation of the repository.

In addition to operating existing disposal facilities, RAWRA performs a number of other functions associated with the management of all types of radioactive waste as well as with research and development relating to radioactive waste disposal. The efficient use of RAWRA's funds is supervised by RAWRA's Board, the responsibilities of which are set out by the Atomic Act. Membership of the Board comprises representatives from a number of state authorities (the Ministries of Industry and Trade, of Finance and of the Environment), radioactive waste producers and the general public, i.e. three representatives of communities near which operational radioactive waste facilities are situated (Jáchymov, Litoměřice and Rouchovany) and a Member of Parliament. Board members are appointed by the Minister of Industry and Trade.

112 shallow reinforced concrete vaults have been in operation since 1995 with a total storage capacity of 55,000 m^3; the repository can accommodate 180,000 individual 200-litre drums.

A loading crane is used for waste handling.

Radioactive waste storage in an emplacement chamber.

Secur

The safe management of radioactive waste and spent nuclear fuel is both our main priority and an obligation set out by the Peaceful Uses of Nuclear Energy and Ionising Radiation Act. We use methods aimed at providing maximum protection for the public, our staff and the environment from radiation exposure and the release of radioactive substances into the surrounding environment.


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PROTECTION OF THE ENVIRONMENT

Environmental protection is paramount

Radioactive waste disposal is the final step in a long sequence of carefully supervised activities which include waste collection, sorting, storage, conditioning, processing and transportation. All these activities are aimed at ensuring both human and environmental protection.

Radioactive materials, if not handled properly, might pose a serious threat to living organisms; however, they cannot simply be destroyed. Consequently, they need to be isolated from the environment for a certain period of time during which, as a result of natural decay, they break down into other, stable elements. For this reason – i.e. radioactive waste isolation for the required period of time – repositories are constructed.

Solid waste and radioactive materials contained in waste water are disposed of in repositories

Two types of low-level radioactive waste are generated at nuclear power plants: solid waste (such as contaminated protective clothing, equipment and tools, swabs, packing, paper, foil, wiring material, rubble etc.) and waste water. Contaminated waste water undergoes multistage treatment consisting of evaporation, which increases the level of concentration of the solid radioactive materials contained in the water up to 150 grams per litre, and subsequent bituminisation.

Bituminisation is a process by which the residual water contained in the waste water concentrate evaporates on a bitumen (asphalt) film. The solid content of the resulting mixture of radioactive materials and bitumen makes up approximately 30 to 40 percent by weight. This mixture is then loaded into 200-litre galvanised steel drums and left to solidify, whereupon the drums are sealed. Certain special types of radioactive waste, such as slurries and ion exchangers, fall into the category of fluid waste for the treatment of which special technologies are employed.

Solid radioactive waste is first sorted then conditioned, depending on its characteristics. Rubble and certain wiring materials are packed into 200-litre drums as is packing material (especially foil) after compaction. Combustible waste is transported to specialised incinerating plants (Studsvik, Sweden); the ash is then transported back to the repository for disposal.

Drums containing conditioned waste which meets the strict criteria for acceptability as defined by the State Office for Nuclear Safety (radiation intensity on the surface of the drums etc.) are transferred in specially-designed transport containers to the Dukovany repository where the waste drums, along with accompanying documentation, are accepted by RAWRA through which responsibility for the safe disposal of the radioactive waste is accepted by the State. Waste characteristics (radionuclide activity, weight, leachability, radiation intensity on the surface of individual drums) are detailed in the relevant accompanying documentation. The entire process of waste conditioning is regularly checked to verify the authenticity of data submitted by radioactive waste producers.

Radioactive waste with a high radiation dose on the surface of the drums is transported in shielding containers.

Measurement of the radiation dose on the surface of a drum.

Radioactive waste disposed of in an emplacement chamber.

Respons

We are well aware of our responsibility for the results achieved and for RAWRA's efficient financial management. Our performance is subject to regular quality control audits. Reports on repository operation and any impacts on the environment are submitted both to the relevant inspection authorities and the general public.


ibility

The repository is a complex structure

The Dukovany repository consists of 112 shallow reinforced concrete vaults arranged in four rows of 28 vaults each. The size of each vault is 5.3 by 5.4 by 17.3 metres; if the available capacity of such vaults is exploited to the optimal level, each vault can accommodate approximately 1600 individual 200-litre drums.

A gantry crane travels along a track above the emplacement vaults. The operator's cabin is shielded to protect the operator from radiation exposure. The waste drums, after being accepted by RAWRA, are placed on a mobile platform (a transport truck) and then hoisted by the crane above a pre-determined vault and placed within it. The precise position of each drum is recorded immediately after its emplacement in the vault. This data provides detailed information on the emplacement of each drum and the distribution of radioactive materials within the repository as a whole.

Once the vault is full, the space between the drums is filled with concrete backfill and the vault covered with a thick sheet of polyethylene which prevents rainwater from infiltrating the vault. Finally, each vault is covered with a thick concrete panel. When the repository finally reaches full capacity, the vaults will be covered by a number of insulating and drainage layers. The repository will then be closed and guarded and its impact on the surrounding environment constantly monitored. The period of surveillance and monitoring of the repository site is estimated at about 300 years after which the radioactivity of the waste disposed of at the site will have decreased enough so as not to pose any threat to the environment and to allow the site to be used for other purposes.

Repository safety is at a high level

The undesirable release of radioactive materials from the repository site into the surrounding environment might occur as a result of water flow through the site. In order to prevent such an occurrence, a system of engineered barriers has been installed. This system consists of insulating layers isolating the inner space of the vaults from the surrounding environment, i.e. the vault's concrete walls, the concrete backfill that surrounds the waste drums within the emplacement vault, as well as the drums themselves and the bitumen with which certain waste is mixed. In addition to these engineered barriers, natural barriers, i.e. the geological properties of the repository site, also protect the surrounding environment. The Dukovany repository is sited on impermeable Quaternary clay sediments. Since the repository is of the above-ground type, there is no threat of groundwater penetration.

Whilst vaults are being filled, they are protected from rainfall by a mobile roof. Two drainage systems have been built at the repository the purpose of which is to monitor the isolating capacity of the repository. These systems are designed to collect water from the immediate vicinity of the repository in a retention tank where its radioactivity level can then be checked. Should the water be found to be contaminated, it will be handled as waste water issuing from a nuclear power plant.

The pouring of concrete over an emplacement vault.

Covering the vault with panels.

Finalising the closure of the vault by the laying of concrete over the surface of the panels.

Techno

We employ the most advanced technologies available for radioactive waste management. Special laboratory and dosimetry equipment is used to determine with great accuracy the composition of the radionuclides contained in any material. Advanced methods are also employed for radioactive waste processing and treatment as well as the operation of repositories. Thanks to longstanding international cooperation, we first acquire the very latest expertise and then adapt it for practical local application.

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REPOSITORY SECURITY

Long-term repository security is ensured by ongoing safety analysis

Before a repository can be built and put into operation, its operator – in this case, the Radioactive Waste Repository Authority – has to ensure the security of the surrounding environment during repository operation and after its closure.

The security of a repository during operation is monitored according to a specially-designed monitoring programme. It is expected that the Dukovany repository will be in operation up to 2100. Its closure will be followed by a 300-year period of so-called institutional inspection. During this period, the repository site will be fenced and guarded constantly, and the potential occurrence of hazardous substances in the monitoring network will be closely monitored. A safety report must be presented prior to the construction and commissioning of any repository in order to prove that it will not pose any threat to the surrounding environment even in the post-closure period. The safety report on the Dukovany repository demonstrates, among other things, that statutory requirements concerning radiation protection will be met even if so unlikely an event as a plane crash occurs at the repository.

In order to prove that requirements on radiation protection are met, safety analysis is performed as part of the safety report. Safety analysis consists of a number of stages. During the first stage, specialists collect all the available data on the repository comprising not only information on waste disposed of at the repository (the content of different radionuclides, method of waste treatment, disintegration rate of waste packages and release of radionuclides) and the design of the repository (surface concrete vaults, underground facilities etc.) but also data on local climatic conditions, hydrological and hydrogeological conditions in the surrounding area etc. Some of the data can be determined precisely, e.g. the material used for and the thickness of waste packages, while for other data a value range can be determined such as the size of a potential fracture in the repository wall through which water might penetrate into the waste packages. In such cases, a conservative approach is taken in which “worst case scenario” data is used for safety analysis purposes.

In the next stage, any event which might occur within the confines of the repository or any event potentially occurring outside it which might have an impact on the repository are identified in compliance with recommendations issued by the International Atomic Energy Agency (IAEA). Events potentially occurring during repository operation under normal as well as exceptional or purely hypothetical conditions (plane crash at the repository, terrorist attack etc.) are listed based upon which an appraisal is made of all potential closed repository behaviour scenarios which might lead to a release of hazardous substances into the surrounding environment. In addition, the maximum amounts of radioactive material which might influence the radiation consequences under each scenario, e.g. the amounts that might be released into the air, groundwater, soil or vegetation, are calculated for each scenario using special software applications. The assessment of the safety of workers during the operational period of the repository and the assessment of the consequences of exceptional events form part of the safety analysis procedure.

Radiation consequences under each scenario are expressed in terms of the exposure dose of persons. The permissible values of exposure dose which, when respected, guarantee that radiation protection requirements are met, are defined in legislation. Limits and criteria for safe repository operation and criteria regarding the waste (waste drums) to be disposed of at the repository (acceptability criteria) are clearly specified based on the results of safety analysis. For example, one of the limits concerns the maximum activity of individual radionuclides in a single waste drum, an emplacement vault or the repository as a whole. Such limits and criteria are included in the safety report which is then approved by the State Office for Nuclear Safety, the highest level nuclear supervisory institution in the Czech Republic.

A large number of scenarios describing various events that might occur during the operational and post-operational periods have been taken into account in the Dukovany repository safety study, particularly the assessment of the radiation burden impacting upon workers during waste handling and the assessment of the consequences of exceptional events, such as the fall of a drum, fire etc. In addition, a so-called normal development scenario (based on the originally envisaged behaviour of the repository system) has been prepared for the post-operational period together with an alternative scenario which considers the so-called bathtub effect and various other scenarios which consider the utilisation of the repository site in the distant future by which time knowledge of the existence of the former repository will have been forgotten.

A safety report is prepared pertaining to the current situation which is used for planning permission and building permit proceedings as well as for the commencement of the test operation and subsequent commercial operation of a repository. The safety report is usually updated every five years during the operational period. This allows the operator of the repository to respond to changes concerning repository operation, both of a legislative and technological character, which might occur during that time.

MONITORING

The repository's impact on the environment is constantly and carefully monitored

As already mentioned, environmental protection is an important aspect of radioactive waste disposal. To exclude any doubts that this requirement is being met, monitoring of the repository site and the surrounding area must be carried out regularly, as required by the Atomic Act and relevant State Office for Nuclear Safety regulations. The Office has approved a Monitoring Programme according to which inspections are planned and conducted. As part of the monitoring of the repository's impact on the environment, samples of water from boreholes are taken regularly for analysis. Monitoring commences in fact before the repository is commissioned so that the initial results can be compared with those of each subsequent test. Should the test results exceed acceptable values, the origin of such a release of radionuclides must be identified and appropriate corrective measures taken.

Repository operating costs are met from the Nuclear Account

According to the Atomic Act, all costs associated with the operation of the Dukovany repository are met from the Nuclear Account which consists of payments made by each and every radioactive waste producer in the Czech Republic. Funds deposited in this Account are earmarked for covering the costs of radioactive waste management. The operating costs of the Dukovany repository amount currently to approximately CZK 12 million per annum.

The Dukovany repository is not the only repository in the Czech Republic

RAWRA is responsible for the operation of a further two Czech repositories – the Richard repository near Litoměřice and the Bratrství repository near Jáchymov. In addition, the now-closed Hostim repository near Beroun is monitored by RAWRA once a year.

Institutional waste generated by the industrial, research and medical sectors is disposed of at the Richard repository while the Bratrství repository is designed solely for the disposal of waste containing naturally occurring radionuclides, that is radionuclides that occur in nature, namely radium and uranium.

Detailed information on radioactive waste disposal can be obtained at RAWRA information and visitor centres

Anyone wishing to learn more about radioactive waste disposal techniques and disposal facilities is invited to contact RAWRA personally, by telephone, e-mail or post. We look forward to meeting you either at our information centre at RAWRA's headquarters in Prague or at the visitor centre at the Richard repository near Litoměřice. A small exhibition on the Dukovany repository and similar facilities in other countries can be visited at RAWRA's information centre at the public library in Rouchovany. Information can also be found on RAWRA's website: www.rawra.cz.

Published by **RAWRA** in 2009
Design and production by **KUKLIK**

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