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RADIOAKTIVNÍCH
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Dukovany repository

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Czech Radioactive Waste
Repository Authority (SÚRAO)

Dukovany repository

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Basic information

Mankind has lived alongside radioactivity for hundreds of thousands of years. In the last two centuries, he has even learned to use it for his own benefit. In the fields of medicine, energy and many others, radioactive elements form a key part of many unique and irreplaceable technologies. However, their application generates undesirable waste that must be safely isolated from the environment. Radioactive waste is classified according to the place of origin; this is the largest group in terms of volume and activity and consists of so-called operational waste from the nuclear power sector. The second group of radioactive waste consists of so-called institutional waste which is created in the health, industry, agriculture and research sectors.

The only safe way to permanently dispose of radioactive waste is to treat and dispose of it in a way that ensures its isolation from all components of the environment.

The Dukovany repository occupies an area of 1.3 hectares and consists of concrete chambers built on the surface. The facility is located within the Dukovany nuclear power plant complex and is intended primarily for the disposal of low-level waste resulting from the operation of the Czech Republic's two nuclear power plants. The repository is not used, nor is it intended for, the storage or disposal of spent nuclear fuel. The repository was put into operation in 1995 and is the most recently constructed of the Czech Republic's three operational repositories.



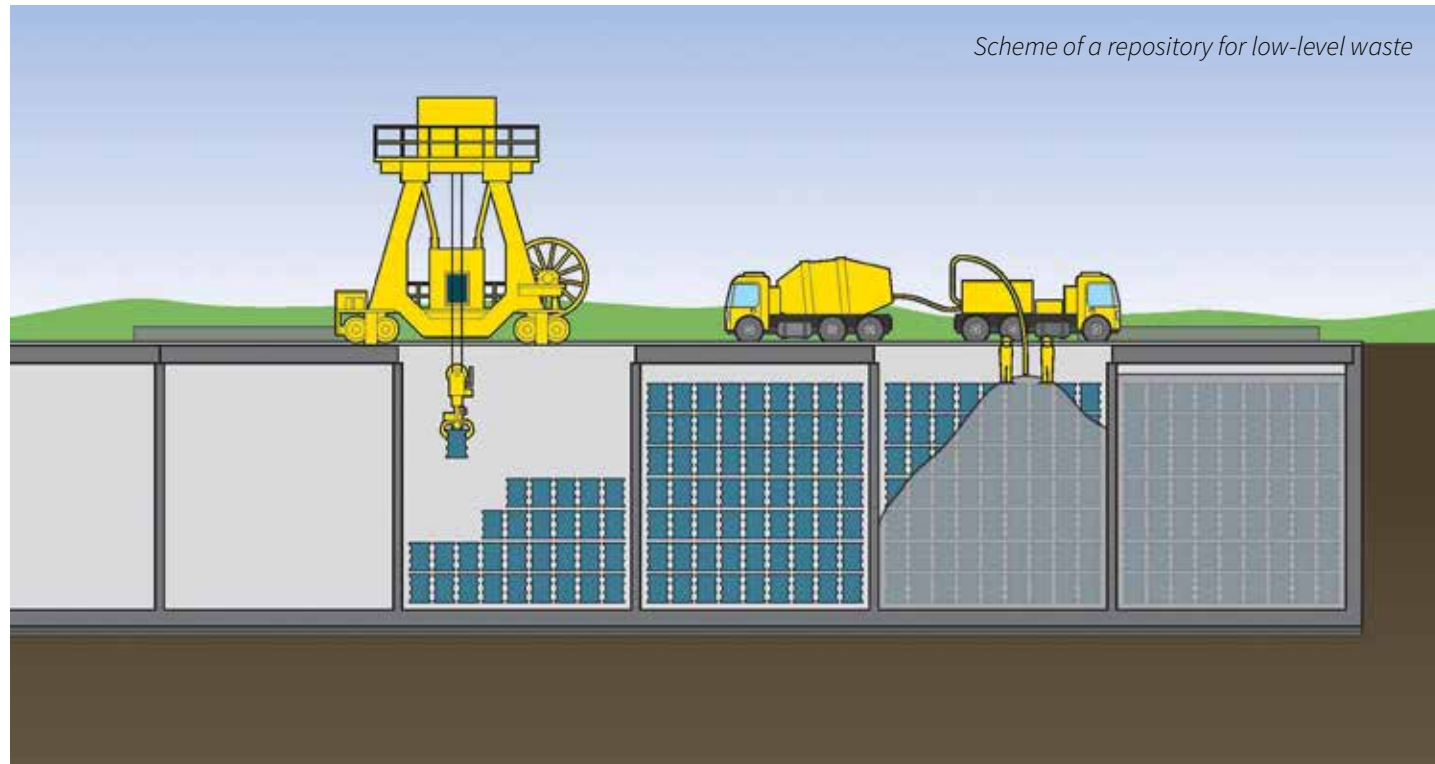
Radioactive waste disposal

The main criteria for the disposal of radioactive waste is the protection of humans and the environment

The disposal of radioactive waste makes up the final step in a series of carefully controlled activities. The collection and classification of the waste is followed by its processing and treatment which depends on the type and category of waste. Following the treatment stage, the waste is transported to the relevant repository. The purpose of this series of carefully planned activities is to protect both humans and the environment to the maximum. Radioactive substances may pose a threat to living organisms if they are not handled carefully. Since it cannot be destroyed, radioactive waste must be isolated from the environment for as long as it takes for the radioactive substances to become harmless to the environment due to the action of spontaneous processes. This is the function of repositories, i.e. to provide for the isolation of radioactive waste for the necessary time period.



Scheme of a repository for low-level waste



Solid waste and substances contained in waste water are disposed of at the repository

Nuclear power plants produce two types of low-level waste - solid waste (e.g. contaminated protective equipment, cleaning cloths, packaging materials, paper, foils, wiring materials, construction debris, etc.) and contaminated waste water which is subjected to multi-stage treatment consisting primarily of evaporation, which leads to a concentration of dissolved solid radioactive substances of up to 150 g per litre. The concentrate thus formed is then bituminised, a process that involves the evaporation of residual water from the wastewater concentrate on a bitumen (asphalt) film. The result is a mixture of radioactive materials and bitumen in which the content of solids remaining following evaporation amounts to around

30 to 40 percent by weight. This mixture is then disposed of in galvanised 200-litre drums which are sealed once the waste has solidified. Liquid waste includes certain special types of waste forms such as sludges and ion exchangers, which must be treated via the application of special technologies. Solid radioactive waste is first classified and subsequently treated according to its properties. Contaminated construction debris, wiring materials and packaging materials (especially foils) are disposed of in 200-litre drums, the latter category following compression. Combustible waste is sent for incineration at a special facility at Studsvik in Sweden, following which the ash is returned to the Czech Republic for disposal.



The operation of the repository is financed from the nuclear account



In accordance with the Atomic Act, the costs associated with the operation of the Dukovany repository are covered by the so-called nuclear account, to which all producers of radioactive waste in the Czech Republic are required to contribute. The funds collected in the nuclear account are intended to cover the costs of radioactive waste management. Currently, the cost of operating the Dukovany repository stands at approximately CZK 22 million per year.

As of 2019, the nuclear power plant operator pays **CZK 55 for each MWh of electricity generated.**

Other producers pay for the disposal of their radioactive waste per (roughly) 200-litre disposal package in the amount of **CZK 33,189 per package.**

As of 31 December 2018, the nuclear account held **CZK 28.4 billion.**

Receiving, inspection and disposal at the Dukovany repository

The Dukovany repository was built within the complex of the Dukovany nuclear power plant and is used for the disposal of low-level operational waste from the energy sector. It is the largest low-level waste repository in the Czech Republic and has been in continuous operation since 1995. The total disposal volume of the Dukovany repository amounts to 55,000 m³; its capacity is sufficient for the disposal of the waste from both Czech nuclear power plants throughout their lifetimes, even if new generating units are built.



1

1 Once SÚRAO takes over responsibility for the waste drums, they are stacked on a rolling ramp. Provided the waste meets acceptability conditions, the drums are then moved to the pre-selected disposal chamber.



2

2 The disposal process includes the recording of the location of each drum, its contents, weight, composition of radionuclides and date and place of origin, thus allowing for the accurate monitoring of the repository.



3

3 A gantry crane, operated from a cabin shielded from the effects of radioactive radiation, travels along tracks located along the outer edges of the disposal chamber complex.



4

4 The gantry crane during the disposal of a waste package.



5



7

5 The dimensions of each chamber are 5.3 × 5.4 × 17.3 m, which provides enough volume for the disposal of approximately 1 600 200-litre drums.



6

6 Once a disposal chamber reaches full capacity, the free spaces between the drums are filled with a concrete mixture.

7 The chamber is then covered with thick layer of polyethylene which prevents the penetration of rainwater, and is then covered with concrete protective panels.

8 The Dukovany repository consists of 112 steel-reinforced concrete structures each of which is arranged in four rows of 28 chambers.

9 The capacity of the repository is sufficient for the disposal of the waste from both Czech nuclear power plants throughout their lifetimes, even if new generating units are built.



8



9

Two types of low-level waste are generated by nuclear power plants – solid waste (contaminated protective equipment, cleaning cloths, packaging materials, paper, foil, construction debris, etc.) and waste water. Following treatment, they can be safely disposed of.

Safety is our main priority

Drums containing treated radioactive waste that meet all the conditions set by the State Office for Nuclear Safety (e.g. safety compliance, the weight of the drums and radionuclide activity) are transported in special containers to the Dukovany radioactive waste repository.

The waste drums - together with the relevant documentation – are accepted by SÚRAO, whereupon the state takes over responsibility for the safe disposal of the waste. The properties of the waste (radionuclide activity, weight, leachability and dose on the surface of the drum) are recorded in the documentation that accompanies each drum.

The Dukovany repository consists of 112 steel-reinforced concrete structures each of which is arranged in four rows of 28 chambers. The dimensions of each chamber are 5.3 × 5.4 × 17.3 m, which provides enough volume for the optimal disposal of approximately 1 600 200-litre drums. A gantry crane, operated from a cabin shielded from the effects of radioactive radiation, travels along tracks located along the outer edges of the disposal chamber complex. This allows for the handling of both the drums intended for emplacement in the chambers and the concrete panels which seal the chambers. Once SÚRAO has accepted the waste drums, they are unloaded onto a mobile ramp, from where the gantry crane positions them above the disposal chamber and lowers them into their designated positions. The position of each drum is carefully recorded, which

allows for the accurate monitoring of the position of the waste packages in the repository and the exact distribution of the various radioactive substances. Once the chamber is completely filled, the free space between the drums is filled with a concrete mixture and the chamber is covered with a thick layer of polyethylene to prevent the entry of rain water. Once the repository has been completely filled, the chambers will be insulated from above by means of several insulation and drainage layers. The repository will then be closed and guarded and its environmental impact will be closely monitored. It is estimated that the repository will be monitored for approximately 300 years prior to the releasing of the site for other purposes; following this period of time, the radioactivity of the disposed of waste will have decreased to such an extent that it will no longer endanger the environment.

The Dukovany repository was built for the disposal of exclusively low-level radioactive waste generated in the nuclear power industry. The repository, which is owned by the State, is located within the Dukovany nuclear power plant complex in the municipality of Rouchovany in the Třebíč district and occupies an area of 1.3

hectares. The construction of the Dukovany repository was initiated by the ČEZ, a.s. power company (at that time the state-owned Czech Power Company) as early as in 1987 and it has been in continuous operation since 1995. It serves for the disposal of operational waste mainly from the Dukovany and Temelín nuclear power plants. The total disposal space of 55,000 m³ (approximately 180,000 drums) is sufficient for the disposal of all the operational waste from both power plants, even if their planned lifetimes are extended.



Environmental Protection

In order to prevent the unintentional release of radioactive substances from the repository into the environment via the flow of water through the repository, a barrier system has been constructed consisting of several components, i.e. the insulating layers that separate the interior of the disposal chambers from the environment, the construction design of the chambers themselves, the concrete filling between the waste drums, the walls of the drums and the

bitumen matrix in which much of the waste is solidified. In addition to these so-called engineered barriers, the geological characteristics of the wider area also contribute to the isolation function of the repository - the area in which the Dukovany repository is located consists of Quaternary clayey sediments that are impermeable to water. Since the repository is not fixed in the ground, there is no danger of the entry of groundwater. The chambers that are being filled are

protected from precipitation by a mobile shelter. Two drainage systems have been built for the monitoring of the insulation function of the repository. They have been designed so that water that drains from the vicinity of the repository is collected in a control well that allows for the monitoring of possible radioactivity. If the water were found to be contaminated, it would be treated as waste water from the power plant.

Repository safety

The safety of the repository during its operation is monitored to the extent set out by the monitoring programme. The Dukovany repository will, according to current assumptions, remain in operation until 2100. Closure will be followed by a three-hundred-year period of so-called institutional control, during which time the facility will be fenced off and guarded and the potential leakage of dangerous substances will be closely monitored via a network of monitoring points. The fact that the repository will pose no threat to

its surroundings during this time period was determined by a safety report compiled prior to the construction and opening of the facility, and safety will also be demonstrated following its eventual closure. Compliance with radiation protection requirements was demonstrated in the safety analysis that formed an integral part of the safety report. The safety analysis is required to consider a wide range of factors based on the collection of all the available data on the repository by experts in a number of fields,

including information on the waste itself (radionuclide composition, processing method, waste package decay rate and radionuclide release), on the design of the repository (concrete chambers on the surface, underground components) and data on local climate conditions and the hydrological and hydrogeological conditions in the surroundings of the facility. Some of the data is known precisely, for example the thickness and material of the waste container, while other data is based on expert predictions.

Monitoring

The purpose of radioactive waste disposal is to protect the environment from the potential undesirable effects of radioactive radiation. In order to avoid any doubt as to the fulfilment of this objective, the site and its immediate vicinity must be continuously monitored. The requirements for radiation monitoring are set out in the Atomic Act and the relevant decree issued by the State Office

for Nuclear Safety (SUJB). The planning and conducting of all inspections and measurement activities is conducted in accordance with the monitoring programme approved by the SUJB.

Water samples are taken regularly from rainwater drainage and monitoring wells located in the vicinity of the repository, the analysis of which indicates that no

leakage of radionuclides has occurred from the disposed of waste to date. Repository staff are monitored on a regular basis and visitors to the facility are checked when leaving the facility. Records of the doses received by these persons show that they are consistently well below the legal limit.

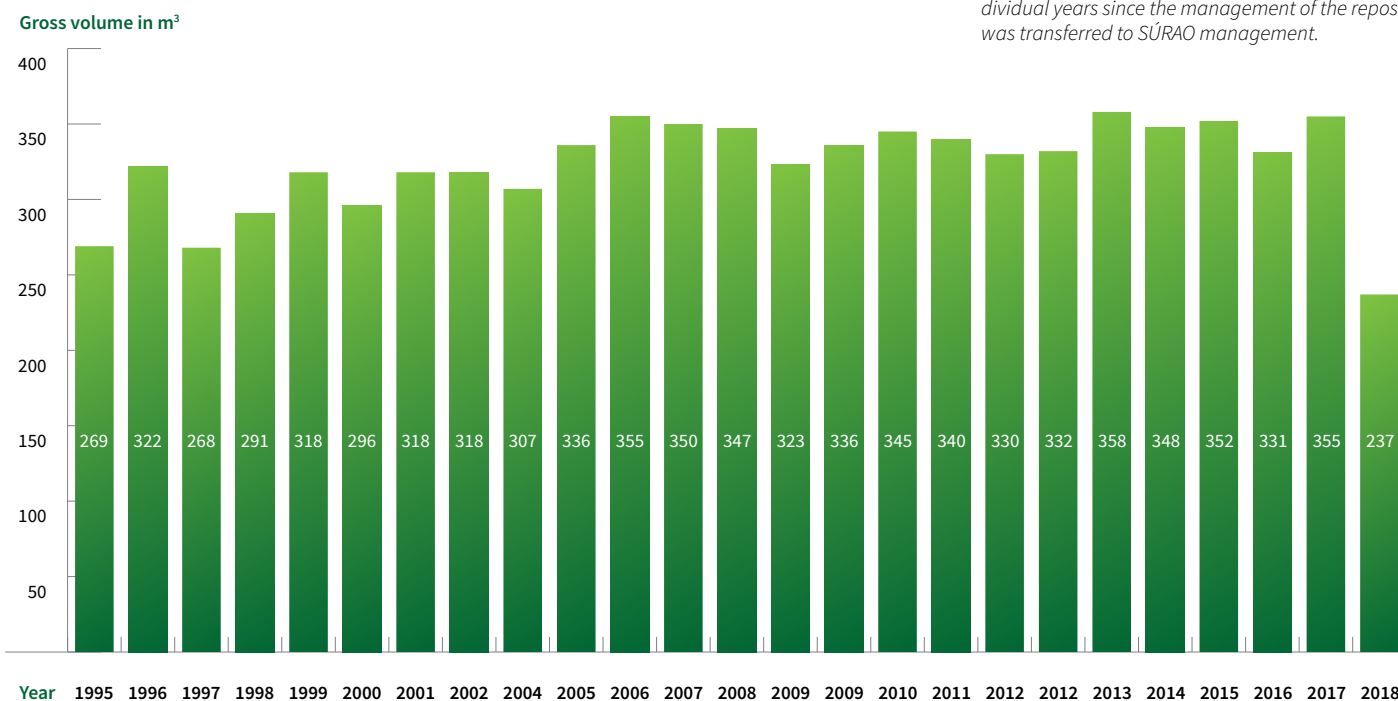
History of the country's only surface repository

The construction of the Dukovany radioactive waste repository was initiated by the ČEZ power company (at that time the state-owned Czech Power Company) in 1987. The repository was designed to accommodate all the operational waste

from Czech (formerly Czechoslovak) nuclear power plants, even in the event that their planned lifetimes should be extended. The repository consists of 112 steel-reinforced concrete structures each of which is arranged in four rows of 28

chambers. The disposal space covers an area of 13 370 m² and the repository has a disposal capacity of 55 000 m³. The repository was put into operation in 1995.

Graph showing the volume of waste disposed of in individual years since the management of the repository was transferred to SÚRAO management.



Three repositories are currently in operation in the Czech Republic

In addition to the Dukovany repository, SÚRAO also manages two other repositories in the Czech Republic – the Richard repository near Litoměřice and the Bratrství repository near Jáchymov.

Richard repository – Litoměřice



This repository is located near the town of Litoměřice in part of the underground complex of the former Richard II limestone mine. The repository has served for the disposal of institutional waste since 1964, i.e. the repository has been under safe operation for 55 years.

Bratrství repository – Jáchymov



The Bratrství repository is located in part of a former uranium mine of the same name near the town of Jáchymov. The repository has been in operation since 1974 and is intended exclusively for waste from the health care, industry and research sectors containing only naturally-occurring radionuclides.

Czech Radioactive Waste Repository Authority (SÚRAO)

Our task is to safely dispose of current and future radioactive waste in accordance with the relevant requirements for nuclear safety and the radiation protection of humans and the environment.

SÚRAO was established on 1 June 1997 by the Ministry of Industry and Trade as a state organisation. Since 1 January 2001, SÚRAO has been a state organisational unit in accordance with Section 51 of Act No. 219/2000 Coll. The activities of the Authority are regulated by the Atomic Act.

The State is responsible for the safe disposal of all radioactive waste in the

Czech Republic. Pursuant to the original Atomic Act (Act No. 18/1997 Coll.), SÚRAO was entrusted with the safe operation of repositories and the disposal of radioactive waste.

Up to the end of 1991, radioactive waste management and final disposal was the responsibility of the Institute for the Research, Production and Utilisation

of Radioisotopes. From 1992, when the country's waste repositories were privatised, such activities were conducted by NYCOM, a.s. followed by ARAO, a.s. In accordance with the original Atomic Act, waste repositories were subsequently transferred to state ownership and SÚRAO was entrusted with the safe operation of repositories and the disposal of radioactive waste.



One of SÚRAO's most important activities is the operation of low- and medium-level waste repositories. We are responsible for the management of all radioactive waste repositories in the Czech Republic, i.e. the Richard institutional waste repository near Litoměřice, the Dukovany repository intended for the disposal of operational waste from the nuclear energy sector and the Bratrství repository for the disposal of low- and medium-level waste containing only naturally-occurring radionuclides. We also coordinate research concerning the preparation and construction of a deep geological repository for the disposal of spent nuclear fuel and high-level radioactive waste.

In addition, we monitor the impact of repositories on the environment and maintain records of the radioactive waste accepted for disposal and its producers. Last but not least, we also coordinate research and development in the field of radioactive waste management, concerning which close scientific and research cooperation and the exchange of information at the international level form an integral part.

Information centres:
SÚRAO, Prague
Richard repository, Litoměřice
Bratrství repository, Jáchymov
Dukovany repository, Rouchovany
Bystřice nad Pernštejnem



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