

## Four years' operation of the combined disposal and storage facility for low and intermediate level radioactive waste at Himdalen.

The combined disposal and storage facility is located at Himdalen in Aurskog-Høland municipality in the county of Akershus, 25 km from the Institute for Energy Technology's (IFE) waste treatment facility at Kjeller outside Oslo. The Norwegian Radiation Protection Authority (NRPA) authorised the institute to put the new facility into operation in March 1999. The first consignment of radioactive waste was shipped from the institute's storage site to the new facility on 17 March 1999. Since that time about 200 waste consignments with waste packages have been shipped by transport vehicle to the facility.

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In March 1996 Statsbygg (Directorate of Public Construction and Property) submitted an application for a construction licence, accompanied by a number of safety analyses and investigation reports. The NRPA scrutinised the documentation and delivered its report with recommendations and conditions to the Ministry of Health and Social Affairs. Statsbygg was granted the requisite licence in February 1997, and construction started shortly after.

In July 1997 the NRPA received the IFE's application for an operating licence, supported by a safety report. A licence was granted in April 1998. Statsbygg's safety report, containing updated safety analyses and verification with site-specific data, was forwarded to the NRPA in September 1998. By March 1999 all documentation was in place, and the IFE was authorised to put the facility into operation. The IFE's operating licence is valid for 10 years.

### Transport of waste containers to Himdalen

Drums and containers containing radioactive waste that have been stored at IFE Kjeller are sent to Himdalen. At IFE Kjeller the waste packages are reloaded from the storage facility to the transport vehicle by forklift truck. The IFE's radiation protection section checks radiation levels from the packages, and marks them with the correct labels. The transport vehicle is marked in conformity with the ADR international regulations on carriage of dangerous goods by road.



*Forklift truck loading containers onto the transport vehicle at IFE Kjeller.*

An IFE escort vehicle is available to accompany transport vehicles on their journey from Kjeller to Himdalen.

At Himdalen the transport vehicle proceeds to the repository where the waste packages are to be placed. The containers or drums are then secured, one by one, by a special device and lifted by crane to the section where they are put in position.

By now the innermost hall has been filled. As of December 2002, 2500 waste packages were placed in this hall. The IFE can transport 20 drums, or two containers, of waste in a single vehicle journey. The crane has been moved to the next hall and emplacement of waste packages will start there.



*Placing a container in the repository at Himdalen.*

### **Choice of site, licensing and construction process**

The process of finding a site for a repository with capacity for all low and intermediate-level radioactive waste in Norway started in 1989. A committee was appointed to look into technical solutions and possible sites. Its recommendations were published in Norwegian Official Reports 1991:9.

In 1992 Statsbygg published an impact assessment as required by the Building and Planning Act. Three sites were assessed: Killingdal mine in Trøndelag along with Kukollen and Himdalen in Akershus county. The two last-mentioned are located about 25 km from the IFE's facility at

Kjeller. The impact assessment recommended a "rock cavity" facility at Himdalen as the best alternative. The consultation round produced a proposal for a combined disposal and storage facility. This involved placing some of the plutonium-containing waste in the storage section, while all the other short-lived waste would be placed directly in the repository.

In April 1994 the Storting opted for a combined facility, and commissioned a detailed survey of Himdalen. It also recommended that an IAEA-WATRP (International Atomic Agency Waste Management Assessment and Technical Review Programme) should be carried out before construction licence was granted.

In December 1994 the NRPA sent a formal request to the IAEA for such a review. The remit was to look into the legal framework (the Norwegian legislation in question), safety viewed in a long-term perspective and the site selection process. In September 1995 an evaluation meeting was arranged in Oslo at which the WATRP team, comprising five international experts, and the IAEA's representatives met with the Norwegian experts and also visited the IFE and Himdalen. Within the scope of its remit the WATRP team was satisfied, and considered Himdalen, with the technical concept that had been opted for, to be a suitable site.

### **Description of the combined disposal and storage facility**

The facility is located underground. It houses four halls for the waste and a 150 metre long access tunnel, on a slight downward gradient towards to the exit gate, for use by cars and persons.

A service and surveillance building, which also contains a visitors' room, is located close to the access tunnel. The halls have been blasted in such a way that there is about 50 metres of protective bedrock over them. This is intended to protect the facility and the waste against break-ins, plane crashes etc., and not primarily to shield the outside world against radioactive emissions.



*Containers being placed in the innermost section of hall no. 4.*

Each hall contains two concrete vaults consisting of floor and walls. Three halls will be used as a repository for waste packages stacked four layers high.

Once a layer is complete, the waste packages are embedded in concrete before the next layer is started. All space round and between the packages is filled with concrete. Embedding a layer of packages in concrete takes two days. On the first day concrete is poured half way up the containers and or drums. This dries over night. The next day the waste packages are completely covered over with concrete. Two days are spent on the embedding process so as to prevent the packages from floating up. The type of concrete used flows easily enough to level out nicely on its own.

Once the sections in a vault (each vault comprises of two sections) are full, a cover will be cast in concrete. This will be constructed with a watertight membrane so that water from the bedrock runs down the outside of the vault. The fourth hall is identical to the other three, but waste placed here will not be embedded in concrete. This is to enable it to be removed for disposal elsewhere, or to be embedded in concrete when the operating period is over. Waste is not intended to be taken in or out of the facility during the operating period.



*Embedding waste packages in concrete in section 4, hall no. 4.*

The facility is planned to remain in operation up to 2030. The halls will then be back filled in such a way that the draining system functions for a very long time ahead. An institutional control period is planned to last 300-500 years with surveillance, measurements and restrictions placed on the use made of the area around the repository.



*Embedding drums and containers in concrete in section 3 and 4 of hall no. 4.*

### **Radioactive waste in Norway**

Norway has two research reactors, but no nuclear power station. The IFE is the operator for the two research reactors, one in Halden (a 20 MW reactor) and the other at Kjeller (a 2 MW reactor).

The sources of the waste can be summarised as follows:

- Residue from examination of irradiated fuel at the IFE's metallurgical laboratory
- Operating waste from the Halden reactor and JEEP II reactor
- Isotope production (for pharmaceutical use)
- Research (IFE and other institutions)
- Medicine
- Use of sources in the industry
- Laboratory-scale reprocessing plant that was in operation from 1961 to 1968
- Closure of the nuclear facilities

High level waste, spent nuclear fuel, powerful radiation sources, high concentrations of long-lived waste, radium needles and scale from oil production (generated after 1 July 1996) will not be disposed of at Himdalen. Neither will waste from abroad.

#### Quantities and content of radioactivity in the waste

All low and intermediate level waste is received, treated and packed by the IFE at Kjeller. Most of the waste is packed in 210 litre steel drums (with concrete providing protection and stability), but concrete or steel containers, measuring 80x90x120 cm, are also used.

In 1970 it was decided to bury waste drums (210 litres) that at that point were located at IFE Kjeller's site. This was done at a depth of four metres, the drums being stacked in two layers and covered with two metres of clay. No other physical barriers were employed.



*Recovering of the buried drums. Photo: IFE.*



*Section of a steel drum encased in concrete.*

All this waste has now been recovered and repacked for relocation to the Himdalen facility.

Each year 110 –120 drums of waste are generated. About 75 per cent of this waste derives from activities related to the IFE's nuclear facilities. It is estimated that the equivalent of 10,000 drums of low and intermediate-level radioactive waste will be present in Norway in the period to 2030. This includes waste generated during decommissioning of the nuclear facilities. Activity at the Himdalen facility will then total an estimated 520 TBq.



*Repacking of the drums. Photo: IFE.*