DANISH DECOMMISSIONING

Welcome to

The Waste Management Plant

Published by Danish Decommissioning, July 2010

The Custodian

When a new public building is erecred in Denmark, a small part of the funding is reserved for decoration. The Swedish sculptor Pontus Kjerrman was asked to do the decoration for The Store for Low Level Waste when it was erected in 1993. The result was a three meters tall sculpture, cylinder-shaped concrete body upon which is mounted a long-necked bronze head, half-way between a horse and a snake - a mysterious figure, which came to be known as “The Custodian”. His job was – like that of the Waste Management Plant - to guard Denmark’s radioactive waste.

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Introduction

The Waste Management Plant [WMP] handles all radioactive waste produced in Denmark, and users of radioactive substances (hospitals, laboratories and industry) must dispose of them through the WMP.

The WMP was established in 1957, alongside a number of nuclear facilities, as part of the establishment of Risø DTU[1], whose main object was research into nuclear technology with a view to introduce nuclear power reactors to Denmark. However, Denmark never did introduce nuclear power. In 1985, the issue was taken permanently off the political agenda.

In connection with a temporary shutdown in the year 2000, due to a leak in the reactor tank of reactor 3, the board of Risø DTU decided to shut down the nuclear facilities permanently. An assessment showed that the cost of maintenance meant that the continuous research effort could no longer be sustained. Danish Decommissioning [DD] was established in 2003 to decommission the six nuclear facilities. The WMP was along with the other nuclear facilities and their staff transferred to Danish Decommissioning.

The WMP functions today as one of DD's five departments. Because the WMP is needed for handling the waste from the decommissioning project, it will be the last of the six nuclear facilities to be decommissioned. As a replacement, a new and smaller WMP will be built, probably in connection with a final repository for radioactive waste.

The main assignment of the WMP is to receive, treat, characterise and store all nuclear waste in Denmark. The WMP is responsible for the operation and surveillance of the waste storage and also runs a water purification plant for the Risø area, a couple of laboratories, and a laundry and sewing room for the washing and repair of work clothes for DD and Risø DTU. The WMP also collects conventional chemical waste from the Risø area, which is sent for treatment elsewhere.

In connection with the decommissioning of the nuclear facilities at Risø, the WMP contributes with knowledge about the treatment and registration of radioactive waste.

This knowledge will also be used in the preparations for establishing a final repository for LLW and ILW in Denmark. Preliminary studies started in January 2009 and DD will take care of waste characterisation, analysis of storage concepts, and safety. SIS (National Institute of Radiation Protection) and GEUS (Geological Survey of Denmark and Greenland) are also involved in the preliminary studies for the repository. The ongoing process is a matter for political decision but the main points are described in the Parliament's basis for decisions. The WMP will continue to contribute to the repository project with its thorough knowledge and expertise in the handling of radioactive waste.

On rare occasions, the WMP is called out to external suppliers, e.g. to help clear out and clean old laboratories where radioactive isotopes have been used. In these situations, the WMP is assisted by DD's Department of Health Physics (radiation protection), which makes sure the work proceeds safely.

Until the year 2000, research formed an essential part of daily work at the WMP. This is no longer the case. Nevertheless, the WMP continues to work on method development and elucidation in connection with specific tasks, and keep up to date via international conferences and collaboration forums such as IAEA, EAES (European Atomic Energy Society) and NKS (Scandinavian Nuclear Safety Research).

[1] Risø DTU was established in 1958 initially under the name of AEK (Atomic Energy Commission). In this paper we will use its present name Risø DTU regardless of historical context. DTU is the Technical University of Denmark.

The Head of the WMP has an engineering background and the plant employs approximately 17 people with various professional backgrounds, e.g. engineers, laboratory technicians, workmen and laundry assistants.

The Facilities

In addition to offices, the WMP's main building has a distilling plant, bituminisation plant, laboratory, laundry and workshop. In connection to the main building is the waste reception area, where waste is registered, treated and packaged or conditioned. The four waste stores are located nearby.

Reception

The reception and treatment facilities are designed for small amounts of waste and consist of a single room equipped with a glove box with eight pairs of gloves and equipment for in-drum compacting. There is also an evaporation facility for liquid organic waste and a computer for the registration of waste.

Distilling Plant

The distilling plant handles inorganic liquid waste and has distilled about 110,500 cubic metres of waste water since 1959 – i.e. about 2,125 cubic metres a year, and (until 2002) about 70 tons of dry material in total. The distillation is done by a steam compression with forced circulation. The plant has a capacity of about 1.8 cubic metres per hour. The purification of radioactive waste water by distillation is very effective, but requires a lot of energy. That is why an energy-saving evaporator was installed. The idea is that the heat involved in the distillation is not released, but captured and led back to help pre-heat the water on its way into the evaporator. The evaporator consists of a container with the water to be distilled; this is where the steam is created. Both water and steam are in circulation, during which the cooler incoming water is added to the distillate and the warm mixture passes through a heat exchanger. Here the mixture receives heat from the steam which passes through the heat exchanger under high pressure. The cooled high pressure steam condensates and the still hot condensate now passes through a second heat exchanger, where it gives heat to the water coming into the evaporator. The incoming water is thus pre-heated in three stages: in a heat exchanger before it is mixed with the circulating distillate, on meeting the hotter distillate, and finally in the heat exchanger where it receives heat from the high pressure steam.

Bituminisation Plant

The bituminisation plant is used to turn the dehydrated concentrate from the distillation process into solid form. The plant consists of a dosage tank, a bitumen tank, a bitumen boiler and a filling area. The filling area is linked to the drum storage building via an underground railway. The concentrate from the evaporator is first collected in the dosage tank, from which it is poured in small portions into the bitumen boiler. After each portion, bitumen is added. When there is no more concentrate, the mixture is boiled for 3 hours at 280 °C and dehydrated, so that its volume is reduced from about 60% to just below 50% of the boiler's capacity. Finally, the hot liquid mixture is poured into drums on small trucks in the cellar under the plant. Once cooled, the drums are driven via a remotely controlled underground railway over to the drum storage building, where they are sealed with cement and closed with lids. A typical run of this process will fill 12-14 standard drums. The drums are then placed in the store for radioactive waste appropriate for their radiation level.

Laboratories

The laboratory in the WMP's main building carries out conventional analysis work in connection with inspection of the water purification plant's discharge of nutrients to the nearby Roskilde Fiord. The laboratory also has a classified section where inspection of activity in discharge from distillation and purification plant takes place.

When the decommissioning project began, a new and larger laboratory, the Radiation Laboratory, was built. Exclusively concerned with radioactive measurement of items and samples to characterise the decommissioning waste, the laboratory has advanced measuring remote-handling equipment and glove boxes for the preparation of samples. Samples from radioactive items are stored in a number of lead-lined cupboards.

The glove box in the Radiation Laboratory is used for preparation of samples from the decommissioning.

Laundry and Sewing Room

The WMP has a laundry and sewing room where work clothes from Risø DTU and DD are cleaned and repaired. A special part of the laundry is reserved for the cleaning of potentially contaminated work clothes.

The WMP also runs a conventional water purification facility that covers the whole of the Risø area. The distilled water from the distilling plant is released into Roskilde Fiord via the purification facility.

Storage Facilities

The WMP is in charge of the operation and surveillance of DD's four stores: The LLW Store, the ILW Store, the Centralvej Store, and the Drum Store.

Most of the waste is low-level radioactive waste and is stored in the LLW Store, which can hold about 6000 standard drums in about 1,450 cubic metres. The store is an unshielded surface store and the waste is only shielded from the outside by the concrete lining of the drums.

The Drum Store is a concrete-shielded surface store, with a capacity for about 150 standard drums in two layers taking up about 36 cubic metres. The drums are positioned using a remotely controlled crane

manoeuvred with the help of a camera and monitors. The store is linked to the bituminisation plant in the WMP's main building via an underground railway. Drums that do not contain combustible material are moved from the Drum Store to the bituminisation plant using this underground railway and filled up with bitumen. The store also has a concrete-shielded lock, which is accessed from the waste reception where dismantling of radioactive sources takes place. It is in this lock the drums are filled with the spent sealed sources.

The Centralvej Store is a concrete shielded and sunken surface store and consists of sections with pits or pipes. Every section consists of a steel box cast in concrete at least 60 cm thick. The store has 4 pits, which are used for obsolete waste, and they have a capacity of about 200 cubic metres and are closed with 20 cm thick lids of armoured concrete. There are two types of pipe. One is about 4 metres deep and big enough to hold 210-litre[2] standard drums, while the other type is for smaller 30 litre bins in stainless steel. The pipes are closed with 100 cm and 80 cm thick concrete plugs, respectively. The store is equipped with a 10-ton overhead crane for lifting a transport flask made of lead, which is used when handling the 30-litre stainless steel bins.

The ILW Store is an unshielded surface store for waste from the decommissioning of the nuclear facilities. It has a capacity of about 1,530 cubic metres, corresponding to 162 10-foot 9.45 cubic metre ISO containers. This capacity will be expanded by about 30% in 2010.

Finally, close to the WMP is a store of uranium ore from Kvanefjeld in Greenland and tailings from experiments in extracting uranium from the ore. The tailings are sunk in water-filled basins to prevent the release of radon.

Waste Amounts

In 2009, the WMP had about 2,050 cubic metres of waste placed in the four stores:

- 4,900 210-litre standard drums
- 1,400 large drums (280 litres)
- 65 steel bins (30 litres)
- 28 steel containers (4.3 cubic metres)
- 16 ISO containers (9.5 cubic metres)
- Nearly 200 cubic metres of waste in pits
- 3,400 cubic metres of uranium ore and tailings from extraction trials (potential waste)
- About 2,260 cubic metres expected from the decommissioning of the nuclear facilities.

The stored waste is characterized as LLW and ILW. 95 % contains isotopes with a short or medium half-life[3]. In this connection, ^{60}Co and ^{137}Cs are the most important isotopes and in this type of waste the content of long-lived isotopes is very low. The LLW goes in the LLW Store, where the dose rate of the individual waste unit (the drum) may not exceed 5 mSv/h 1 metre from the surface.

Low and medium radioactive waste with a higher content of long-lived[4] isotopes (α- and ß-emitters) comes from the operation of the reactors, the Hot Cell facility and external suppliers (large single sources, depleted uranium). There is also a small amount of radiated fuel that needs special treatment.

Containers with dose rates above 50 mSv/h on the surface are placed in the shielded Centralvej Store, sometimes just temporarily in the case of containers with short-lived isotopes.

[2] External volume.
[3] Short-lived: T½ <= 30 years
[4] T½ > 30 years

Overview of low and medium level radioactive waste in Denmark (2008):

		Weight/volume	Radioactivity, TBq
1	Low radioactive, Conditioned	1,200 m^3	5
	Medium radioactive, Not conditioned	125 t	430*****
2	Irradiated uranium (233 kg)	0.23 t	753 (fission products) 32 (α-emitters)
3	Waste (tailings) and ore left from uranium extraction trials	4,800 t	0.1
4	Decommissioning waste, heavy water (special waste)	1,738 t 120 kg	150 6

*) including 18 TBq long-lived β/γ- and 4 TBq α-emitters.

Type and Origin

The waste comes from over 50 years of research at Risø DTU and from schools, hospitals and industry. In the future, the decommissioning project will add quite a bit of waste and external suppliers will add approximately 6–8 cubic meters p.a.

A great deal of the waste comes from Risø DTU in the form of slightly ^{90}Sr-polluted soil from the agricultural department's plant experiments and ordinary mixed waste from the classified laboratories. Also, a significant amount of ore and tailings from the uranium extraction project is still stored in the area.

Waste from the operation of the reactors is made up of cuttings, radiation rigs and the aluminium pipes in which silicon rods were packed during radiation. Waste from the Hot Cell facility consists primarily of cuttings and contaminated filters from experiments in the production of fuel elements.

Most of the waste from external suppliers comes from hospitals and laboratories, but the industrial and educational sectors are also significant suppliers. External waste typically consists of paper, cloth, wood, plastic, metal, glass, rubber – unsorted and as a mixture of combustible and non-combustible material. The greater part of the spent sealed sources, e.g. ^{192}Ir, is delivered by external suppliers too.

In 2000, waste from research and silicon radiation accounted for 60–70% of the amount received, while the contribution from external suppliers made up the rest. In the period from 1960 to 2000, the WMP received 88 tonnes of waste from external suppliers and 196 tonnes from Risø DTU, a total of 284 tonnes[5].

The vast majority of the waste produced as a result of the decommissioning (mostly in the form of aluminium, stainless steel, steel, lead and concrete), is packed, sorted and characterised as a part of the decommissioning. The WMP treats and conditions the secondary waste from the decommissioning. This includes covering materials (e.g. plastic film), protective clothing (gloves, shoes), cleaning waste (paper, cloth, and vacuum-cleaner bags), tools and small amounts of metal.

[5] The figures for 1960-1976 are uncertain.

The approximately 3,400 cubic metres of uranium ore and tailings contain uranium and thorium and their associated daughter products in concentrations that are 100 times greater than in typical Danish soil. Risø DTU brought home the uranium ore from Kvanefjeld in Greenland to conduct an experiment with extracting uranium from the ore naturally.

Handling Solid Waste

The vast majority of the waste handled by the WMP is solid waste from external suppliers. In addition, there is the secondary operational waste from the decommissioning, which in 2008 made up less than 8 % of the total amount.

The handling of solid waste runs through the following phases: reception, treatment, packaging/conditioning, transport and storage.

Flow charge for solid waste

<table>
<tr><th>Waste</th><th>Transport</th><th>Reception</th><th>Separation</th><th>Treat-ment</th><th>Packing</th><th>Transport</th><th>Storage</th></tr>
<tr><td rowspan="2">Solid</td><td rowspan="2">→</td><td rowspan="2">Registra-tion</td><td>Sources</td><td>→</td><td>Electroplated drum, lined with concrete</td><td>→</td><td></td></tr>
<tr><td>Scrap and other waste for compac-tion</td><td>Com-paction</td><td>Drum, lined with concrete</td><td>→</td><td></td></tr>
</table>

Most of the solid waste from Risø DTU and the other Danish users is collected by the WMP, which has a weekly round to regular customers in the eastern part of Zealand. When there is a need for it, the WMP collects waste from other parts of Denmark. The biggest customers are hospitals, pharmaceutical companies, and companies that carry out industrial quality assurance, such as checking welds.

The collected waste is initially sorted. The combustible is separated from the non-combustible, and aluminium and heavy metals are separated from steel and stainless steel. Long-lived sources are separated for special treatment. Insofar as it is possible, the waste is compacted or alternatively broken up to reduce the volume. If health physicists determine it is safe, radioactive sources are removed from their containers and placed in special drums.

Most of the waste, combustible as well as non-combustible, is compacted and stored.

Solid waste is pressed together during in-drum compaction under an effective pressure of 5 tonnes. The waste is held in place by a plate, which is finally pressed tight inside the drum. The space between the plate inside and the drum's lid is filled with a seal of concrete. Before the lid is mounted, its rubber packing is removed so that the concrete seal can dry and any degassing can take place.

Drums containing metal can be filled up with a mixture of concentrate and bitumen, before they are sealed with concrete and stored. Before being filled with bitumen, these drums are placed in shielded storage to allow the radiation level to fall. When filled with bitumen, the drum's radiation level falls further. If the level drops below 5 mSv/h at a distance of 1 metre the drum can be moved to an unshielded store.

There are cases when obsolete waste cannot be subjected to standard conditioning, but instead must be stored without any kind of treatment. Other exceptional cases include ampoules with gas (e.g. ^{85}Kr) and

organic material: Gas ampoules are cast in a 2-litre steel container and placed in the bottom of a standard drum (the ram of the compacting equipment does not touch the container) and organic material, e.g. an animal used for experiment, is also placed at the bottom of a standard drum and covered with cement powder, which due to the liquid from the putrefaction process will in time harden to concrete.

Handling Liquid Waste

The handling of liquid waste runs through the same phases as the solid waste: reception, treatment, packaging/conditioning, transport and storage.

Flow charge for liquid waste

Waste	Trans-port	Reception	Sepa-ration	Treatment	Packing	Transport	Stor-age
Fluid	→	Registra-tion	Distillation	Concentration and Suspension in bitumen	Electroplated barrel, lined with concrete	→	
			Evapora-tion	Concentration	Ordinary coated Barrel, lined with concrete	→	

The treatment of liquid waste is aimed at binding the liquid's radioactive isotopes in a solid form.

Most of the liquid waste is inorganic and originates from the Risø area. It is collected in tanks, until it is collected by the WMP. It is transferred to 100-cubic-metre storage tanks in the distilling plant. A small part of the total amount of liquid waste comes from external customers (about 600 litres p.a. over the last 5 years).

Liquid delivered in cans is treated in different ways according to whether it is inorganic, non-combustible, combustible or organic.

Most of it is inorganic, and non-combustible liquids can be poured directly into the WMP's Distilling plant, where it is dehydrated and the remaining concentrate is encapsulated in bitumen.

Distillation and Bituminisation

The treatment of liquid waste in the distillation plant is two-phased. The actual distilling is followed by a separate process in which the radioactive concentrate from the distilling is mixed with bitumen and then poured into drums with waste.

The concentrate that emerges from the dehydration is a brown, alkaline and viscous substance. It is mixed with and boiled in liquid bitumen for about 24 hours, the last 2–3 hours at about 280 ^{o}C, to drive out all moisture. Moreover this breaks down any organic compounds. The end-product is dry and 30–40% of it consists of crystals of soluble salts (Na_2SO_4, NaCl, K salts, phosphates, etc.) and sludge particles (dust, clay, precipitated iron). Other material can be added to the mixture, such as small amounts of used ion-exchange resin, if required.

The total amount of radioactivity collected in the concentrate is for

^{60}Co:	1.6 GBq
^{90}Sr:	10.6 GBq
^{137}Cs:	15.1 GBq
^{238}U:	0.5 GBq
Pu[6]	0.5 GBq

The figures have been normalised for the year 2000, but are subject to considerable uncertainty.
A standard drum can hold about 113 kg bitumen mixture, of which about 45 kg is the dry material from the dehydration.

The Waste Management Plant has produced a total of about 1,300 waste units with dehydrated concentrate. About 900 of these were produced in the above-mentioned way, where the concentrate is mixed with bitumen and where the process achieves a complete drying of the concentrate due to the high degassing temperatures. The remaining 400 waste units were produced in the plant's first period from 1959 to 1970, when the method of mixing with bitumen was not in use. The dehydration used then was not effective enough to completely dry the concentrate. The concentrate was poured into the drums without being mixed with bitumen and the 400 drums show signs of the concentrate's aggressive salts. These corroded drums have since been repacked in 280-litre drums.

Dehydration

Organic liquids are set aside for dehydration in an indoor dehydration drum, i.e. a standard drum equipped with suction extraction. The dehydration process consists of two phases: a simple evaporation and a conditioning with extraction. Since the evaporation does not dehydrate the liquid completely, the concentrate is mixed with a highly absorbent granulate.

A dehydration drum takes several years to fill up, and since the start of the plant less than 10 drums have been produced.

Organic liquids are dehydrated by use of a standard drum equipped with suction extraction.

Containers

DD operates with two main categories of containers, one of which is used for the storing of waste, while the other is used for its internal movement between treatment and measurement facilities.

DD has 6 kinds of storage containers: 210 and 280-litre drums, 19.0 and 9.4-cubic-metre ISO containers, 4.25-cubic-metre steel boxes and 30-litre steel bins. The steel bins and boxes are used for scrap, used fuel elements and radioactive filters. ISO containers and steel boxes are used for decommissioning waste – the latter also for repackaging of old corroded drums. The drums are used for waste from external suppliers and secondary waste from the decommissioning. For historical reasons, DD operates with variants of some of the container types. For the internal movement of waste from demolition to measurement and decon-

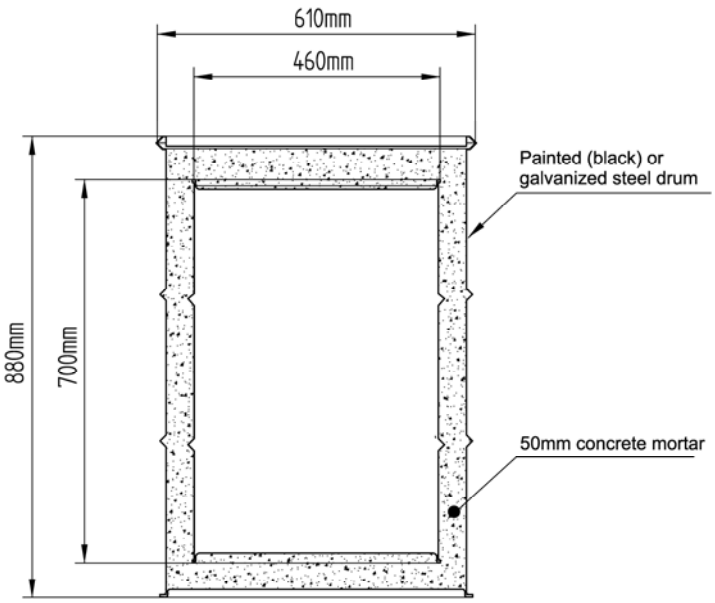
[6] 238 + 239 + 240

tamination facilities, 400-litre aluminium containers are usually used. In addition, several types of smaller containers are used for the transport of samples, small radioactive source containers made of lead, and plastic bags.

Most of the containers are only approved for temporary storage. But the big steel boxes are constructed and prepared in accordance with instructions that fulfil current requirements for final storage. Their plate thickness is 10 mm, and they can take a load of up to 13 tones. The lid can be sealed with bitumen, but the container is equipped with a gas lock, which allows the release of any gases.

The standard container, used for the conditioning of external waste and secondary waste from the decommissioning, is a black-painted, concrete-lined steel drum of approximately 210-litres with a 110-litre inner-drum.

This is filled to a height of about 65 cm, equivalent to a waste volume of 108 litres. The concrete lining makes up about 124 litres. The lining increases the drum's strength and carrying capacity, and protects against corrosion. Moreover, the lining shields against radiation and restrains nuclides or delays their spread in a future final storage. An empty drum weighs about 210 kg.



Standard concrete-lined steel drum is the standard used for external waste.

Drums of the same construction, but with the outer drum galvanised, are used for waste with relatively high dose rates. This type makes up about 10% of the total number of drums stored at the Waste Management Plant. The waste in them comes from the operation of the reactors, the Hot Cell Facility, or the department for isotope production, but segregated radioactive sources, such as ^{241}Am, are also packaged in this type of container.

The Registration of Waste

All waste treated and stored at the WMP is registered in DD's waste documentation system, ADS. This system was developed specially for DD and is based on client-server technology and accessed via a web-based user interface.

The registration of waste fulfils several purposes: it has to divide the waste into radiation categories, form the basis for documentation, provide data for inventory calculations, and form the basis for the calculation of the payments external suppliers must make. The registration includes both conventional and radiological data as well as data about the movement and history of the waste.

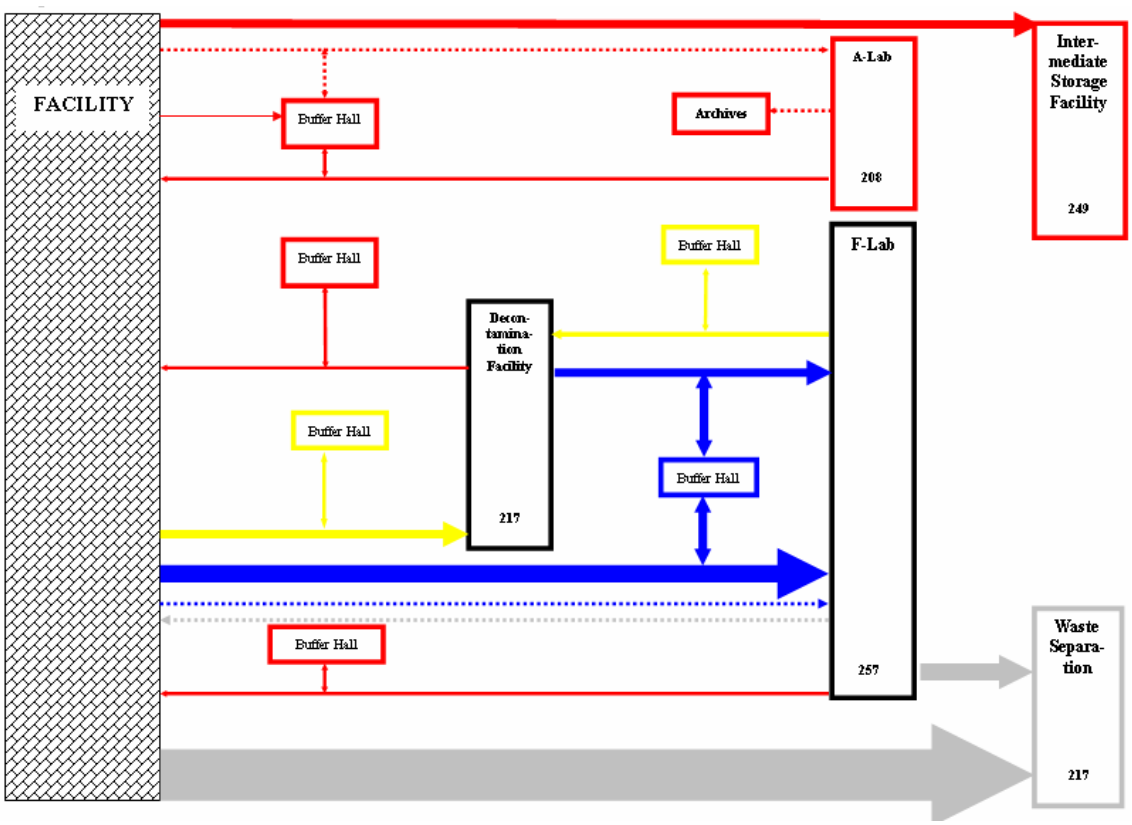
The registration of waste is started as early as possible. External waste is registered on the delivery note filled out by the supplier before transport takes place. The supplier must attach comprehensive documentation. Sometimes the documentation is deficient or has been lost in connection with the delivery of older material from, for example, the clearing of old laboratories. This is also the case for some of DD's earliest registrations of waste.

The waste is characterised both conventionally and radiologically. In addition to the weight, volume, composition of material and combustibility, the conventional characterisation includes also its geometry, homogeneity, class of danger and the option of a more detailed material description. The radiological characterisation includes information on isotope content, radioactivity, dose rate and contamination.

An item's localisation and history come with the waste unit, which consists of waste + container. Obsolete items, which in reality are not packed, are given a virtual container in the registration system. This maintains the underlying principle of the registration that an item's localisation and history can be established via the waste unit.

Once registered in ADS, a waste item is characterised to decide whether it must be stored as radioactive waste or can be released as conventional waste. Before the measurement, the item is marked as neutral, indicating that the item has not yet been characterised. The result of the characterisation attaches the waste item to a particular flow category: Red, Yellow, Blue or White. Red means that the item is radioactive waste, yellow that it can perhaps be decontaminated, and blue that it must be measured before being finally categorised as red or white. White waste is released waste.

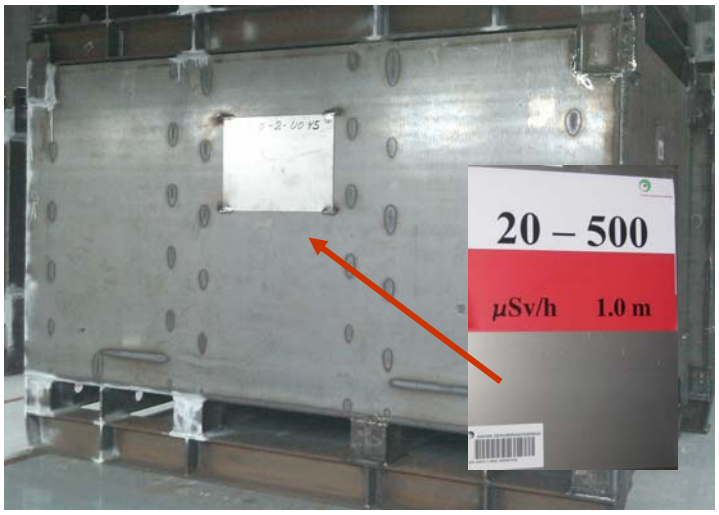
The figure below shows the registration flow. The places – localities, areas and routes – are all linked to a particular flow, which colour represents the different categories of waste.



Flow charge for units of waste. The dotted line represents samples. A-Lab = The Radiation Laboratory, F-Lab = The Release Laboratory.

Items and containers are identified with unique numbers, which are automatically set up in the system. The same applies to localities and areas in localities. The numbers are printed out as bar codes that are glued on to the delivery note, the container and the localities and areas too. When an item is transferred to a container, it is linked to the container by consecutive reads of the item and container bar codes.

When the container is full and closed or sealed, it is linked to a transport unit, from which it is transferred to the destination by consecutive electronic reads of the bar code on the container and the destination. The localisation of the waste takes place via its container (the waste unit).



Storage containers are marked with a double identification. In addition to the bar code, the container is marked with a serial number with origins in either DD's own series or an external manufacturer's series. A waste unit is also marked with a category which clearly indicates the radiation level of the unit.

The other containers, transport containers, used for moving waste to and from measurement and treatment facilities, are only given a bar code.

Storage containers are marked with double identification; a bar code and a serial number. A waste unit it is also marked with a category clearly indicating radiation level as shown in the enlargement.

Waste Storage

The choice of storage is made on the basis of measurements of dose rate and – in most cases – also the content of ^{137}Cs and ^{60}Co in the waste unit. The measurements decide whether the unit is to be stored in shielded or unshielded storage. DD has set a limit of 50 mSv/h on the surface (~ 5 mSv/h at 1 metre's distance). Irrespective of the origin of the waste, the vast majority of the drums end in the Store for Low-Level Waste.

Drums transferred to the Store for Low-Level Waste must be characterized. The measurement is made in four positions in the middle of the drum, and in each position the dose rate is measured first and then a spectrometric measurement is made. The dose rate is found with a Geiger-Müller tube, and it is measured continuously at 1 metre's distance from the drum's centre, which is 67 cm from its surface. The results are used by the operator for the settings (distance and collimator) for the following spectrometric measurement using a NaI probe. This measurement takes 60 sec. The set up operates with three measuring distances from the drum's surface: 100, 200 and 280 cm.

The results from the measurement of dose rate are used to categorise the drums in green (<= 0.01 mSv/h), yellow (> 0.01mSv/h and <= 5 mSv/h) and red (> 5 mSv/h), all limits established by measurement at 1 metre's distance from the drum's surface.
This categorisation determines the stacking of the drums, so that drums with the lowest dose rates shield for the 'hotter' drums whenever possible: the red innermost, the green outermost. The drums are provided with a clear label that shows which category each drum belongs to.

At the Drum Store the drums are stacked pyramidal. The drums holding the lowest level of radiation are placed at the front. The drums are numbered twice: with hand-painted figures that continue the original series and with (very small) bar codes for a new computer-generated series (the red and green labels).

In the Store for Low-Level Waste, there are two kinds of drums: A standard drum of 210 litres and a slightly bigger grey drum of 280 litres. The drums are stacked in four layers. Most of the big 280-litre drums contain a standard drum which condition after many years of storage had deteriorated due to corrosion, and which therefore was repacked. These drums include the above-mentioned drums with pure dehydrated concentrate.

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