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The Management of Wastes from the Construction and Operation of the SNF Recovery and Packaging Facilities at Andreeva Bay

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Content of the Presentation

- Introduction to the SNF retrieval and repackaging programme for Andreeva Bay
- The management of contaminated soil and groundwater during the construction of the new SNF management facilities
- The management of contaminated structural wastes
- Waste characterisation approach
- The management of liquid wastes
- The proposed arrangements for SNF removal, repackaging and interim storage and management of the arising wastes
- Outstanding issues
- Conclusions

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Andreeva Bay – Site Topography

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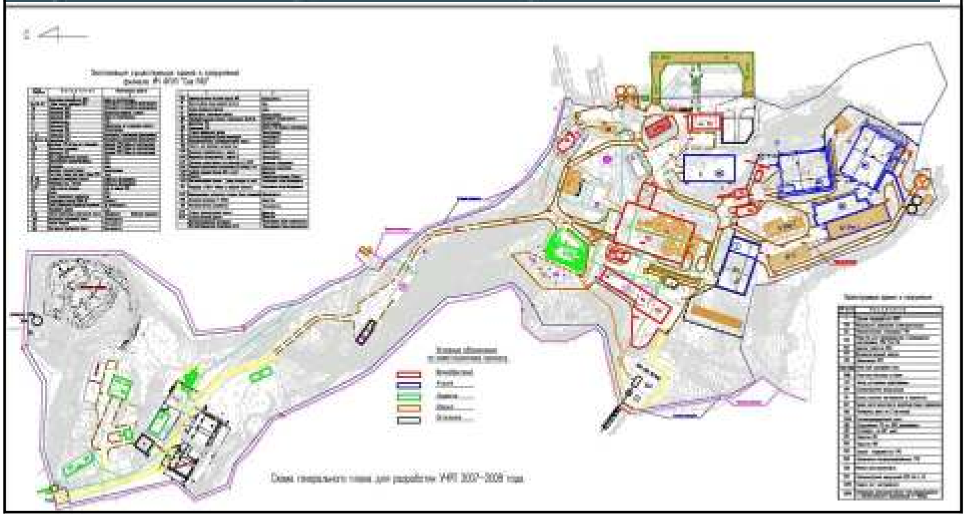
Andreeva Bay Site Plan



Management of contaminated Soil and Groundwater

- The soil around the DSUs (B153 location) shows typical dose rates in the range 1-5 μSv/h (1-10 Bq(^{137}Cs)/g), decreasing to < 1 μSv/h towards the pier.
- B153 is likely to be constructed using cased, reinforced concrete piles, founded in the gneiss rock. Typical piles could be 0.5 m diameter and ~ 2 m spacing. Any soil within the casings is likely to be removed using a rotary auger. This will inevitably mix soils, so averaging specific activity levels.
- B151 is likely to be constructed upon a reinforced concrete pad, so requiring surface soil removal, but not deep excavations. Existing site investigation data suggest that the area proposed for B151 is clear of any significant radioactive contamination. It should not require any special precautions during construction beyond precautionary monitoring.

Management of contaminated Soil and Groundwater (2)

- Only sufficient soil will be removed to allow safe construction. The objective is not local remediation.
- No plans to reuse any removed contaminated soil or rubble as in-fill for foundations, etc.
- All soil removed will be monitored for radioactivity. Any classified as LLW will be removed in Type 5 lidded, carbon steel waste boxes. Filled containers are currently stored in B67 until it is full. Some may then be stored in B201 and B202 prior to treatment. The Type 5 containers are only for on-site use.
- Potential construction of new VLLW disposal facilities on-site will help alleviate interim storage needs (Current Swedish-funded project to identify potential sites for VLLW disposal facilities for 2000-7000 m^3 of containerised waste, Norwegian project to support Russian regulatory development of VLLW concept.

Management of contaminated Soil and Groundwater (3)

- Limited quantities of chemically-contaminated soil also expected, e.g. from area currently housing emptied fuel oil tanks. They will be removed and stored in Type 5 boxes. Some organic-contaminated could be bio-remediated. They could then be disposed of in the construction waste repository just off-site.
- Issue will be soil clearance levels and bulk monitoring systems, e.g. gamma probes, bucket and conveyor monitors

Potentially contaminated Groundwater

- The results from the large number of monitoring boreholes around the DSUs do not indicate any significant groundwater contamination there. There was a very limited area adjacent to DSU 2B.
- There is no agreement currently on how any such contaminated groundwater might be managed.
- Should significant volumes of contaminated groundwater (GW), which require removal, be exposed in workings during foundation construction, they can be pumped into temporary tank storage, pending later treatment. Potentially, there are 3-4 tanks available for additional LRW storage.
- GW treatment could be on-site, if water is acceptable, in new liquid effluent treatment facility (B1). Alternatives include temporary importation of a mobile LRW treatment plant, e.g. Moscow RADON unit, or transportation by sea to an existing off-site treatment plant.
- Preference is for on-site treatment for both radioactive and chemical contamination with discharge of the cleaned waters into the bay.

Management of contaminated structural Wastes

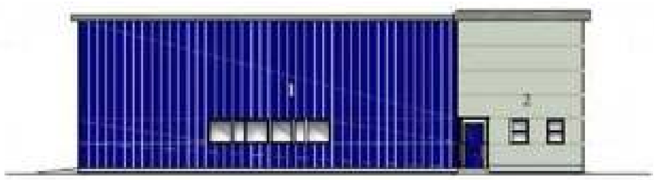
- Concrete slabs and loose debris over the top plugged face of each DSU will be removed to construct the horizontal shielding. In DSUs 2B and 3A contamination from past flooding has left high ^{137}Cs levels, requiring waste to be packaged into shielded containers.
- It is not proposed to decontaminate concrete surfaces, etc, in-situ to reduce dose rates or reduce immediate waste generation. Size reduction will only be undertake locally to facilitate ready removal.
- SNF tube shield plugs also require removal. DSU 2A has steel plugs with Pb bushes. DSUs 2B and 3A have concrete plugs, some in steel shells, and metallic lids. Gamma dose rates on contact up to 40 mSv/h. These may require removal and storage in shielded containers or facilities.
- Currently, there are no shielded boxes or flasks identified to remove safely the contaminated concrete or plugs.

Existing Site Waste Containers

Type 5 1.5 m^3, carbon steel, lidded Waste Box. Stored in B67 when full. For on-site use only

Type 4 Container
For off-site movement

Current Storage Area for New Empty Waste Drums and Containers (B35 Pad)



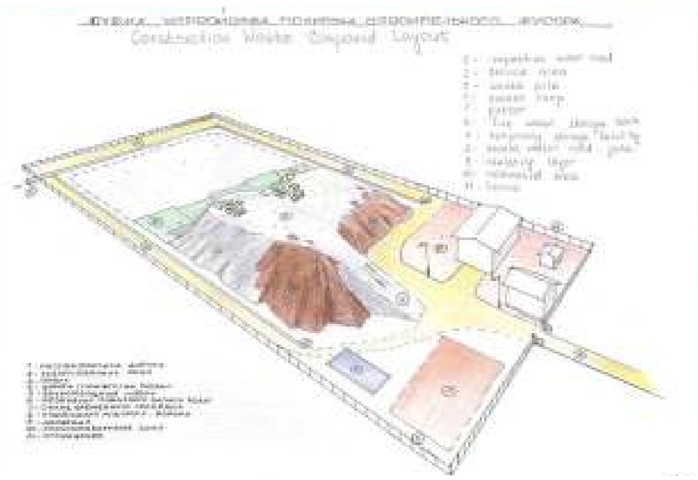
UK Experience with Construction on contaminated Sites

- Many former military and industrial sites contaminated with NORM (U, Th, Ra and other daughters) have been remediated. Most have been remediated to green field status and some to brown field status. Examples include Ditton Manor Park, Rowcroft Barracks Ashford, Woolwich Arsenal, Burscough, AWE Cardiff. In every case contamination, wherever possible, has been removed off-site for disposal. This has been driven by redevelopment requirements, e.g. housing, shopping complexes, light industrial use.
- A very large number of chemically contaminated sites, including with low NORM contamination, have been remediated. In many cases contamination has been retained on-site within constructed disposal cells in low occupancy areas, e.g. landscaped features, car parks, e.g. Black Country Development Corporation, Meadow Hall Shopping Mall, Olympic site, East London.
- Some nuclear industry sites or parts thereof have been remediated to facilitate redevelopment, de-licensing or reduce supervision requirements. Complete removal of contamination with off-site disposal has been practised for most, particularly for delicensing. Examples include Culceth, Southern Storage Area, various Harwell areas. In several cases housing and light industrial development has followed with monitoring as only control.

UK Experience with Construction on contaminated Sites

- On major nuclear sites, such as Sellafield and Dounreay, remediation has usually been undertaken sufficient to allow relatively unimpeded site operations. Final clean-up will await final site decommissioning.
- Remediation approaches on all sites have usually involved extensive pre-remediation characterisation and very careful waste segregation with monitoring. Limited experience of on-site disposal of radioactive contamination, as previously deemed to blight sites permanently.
- Recent change of emphasis of UK Government Policy. This now favours local solutions, i.e. use of local disposal facilities for Very Low Level Wastes (VLLW) (Typically ≤ 4Bg/g), and including on-site disposals. Some operators, e.g. favour higher limit (Very Low Radioactive Material (VLRM) at ≤ 40Bq/g).

Construction Waste Compound for Andreeva Bay



Projected Solid Radioactive Waste Arisings

Existing Accumulation	m^3		m^3
Low Active Waste (LAW)	14082		
Intermediate Active Waste (IAW)	2982		
High Active Waste (HAW)	536		
Total	***17600***	SNF Facilities	***622***
Expected Operational Arisings	m^3		m^3
SNF Facilities	1492	LAW	4852
SRW Handling Facilities	2082	IAW	2807
LRW Handling Facilities	3595	HAW	50
Vehicle Decontamination Facilities	540		
Total	***7709***		***7709***
TOTAL	***25308***		

Predicted Liquid Radioactive Waste Arisings from SNF Facilities

	m^3	Low Salt m^3	Saline m^3
LLW	8540	100	8540
ILW-LLW	3860	1200	
ILW	100		2660
Total	12500		

Waste Characterisation

- No characterisation is planned within the SNF retrieval and interim storage facilities of any waste arisings.
- Monitoring for both γ-radiation and αβ-contamination will be undertaken for radiological protection purposes.
- Any proposed SRW waste characterisation will be undertaken within B203.
- The only measurements to be made on the SNF will be weights and gross γ scans along the length of each SFA in the course of its removal from its original canister.
- No measurements will be made on the SNF for nuclear materials accountancy purposes.

Management of Liquid Wastes

- DSU 2A is very mainly dry. DSUs 2B and 3A have retained water and may in past have flooded. DSU water is very predominantly contaminated with ^{137}Cs and ^{90}Sr, although there is particulate α-activity, particularly towards the base of some channels.
- Proposal is only to remove sufficient DSU water to expose the tops of the SNF canisters for individual SFA removal.
- The water will initially be stored prior to treatment. The storage tanks will require shielding.
- The LRW will be treated to reduce its specific activity from high to low within B153 to permit transport and further treatment in the new Italian-funded plant (B1).

20 m³ Toxic Waste Tanker (Heated) and mounted in an ISO Freight Container for Transportation

Decontamination System

Decontamination Pad No 1 (summer use only)

Decontamination Pad No 2 (all year round use)

Management of Liquid Wastes (2)

- Any decontamination treatment in B153 must be compatible with proposed treatment in B1 and final disposal of the conditioned wastes.
- The pre-treated LRW will be transported by road preferably on a batch basis to B1 plant rather than through construction of a pipeline.
- Currently, the specification, design, location and provisions for the LRW pre-treatment within B153 are of a very preliminary nature.
- Any solid radioactive waste from the B153 LRW pre-treatment, e.g. spent ion exchangers, flocs, etc, will be transported to Building 1 for treatment interim storage. The wastes will require shielding.

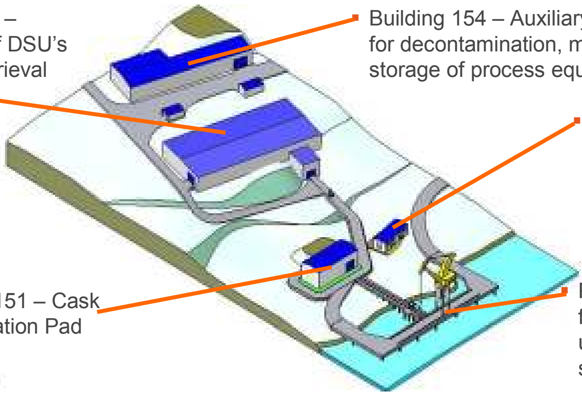
The on-site flask for the transportation of low activity liquid waste

Proposed Arrangement for SNF Removal

- Remove fuel on an individual SFA basis via retrieval machine
  - *Individual SFA removal avoids potential criticality*
- Any SFAs, which cannot be removed from canister, remove with canister
  - *Overpack old canisters with SFA and transfer to TUK-108*
  - *Unrecoverable SFA's are transported off-site in overpacked canisters in TUK-108 casks*
  - *Any manipulation required to remove damaged/corroded SNF from canisters takes place elsewhere*
- Transfer SFA's to new canisters using shielded equipment, i.e. no hot cells
- Transfer new canister to TUK-108
- Transfer TUK-108 to transport pad located near the pier
- Ship to Murmansk
- Transport by rail to Mayak

The new SNF Handling and Support Facilities

- Building 153 – Protection of DSU's and SNF retrieval processes

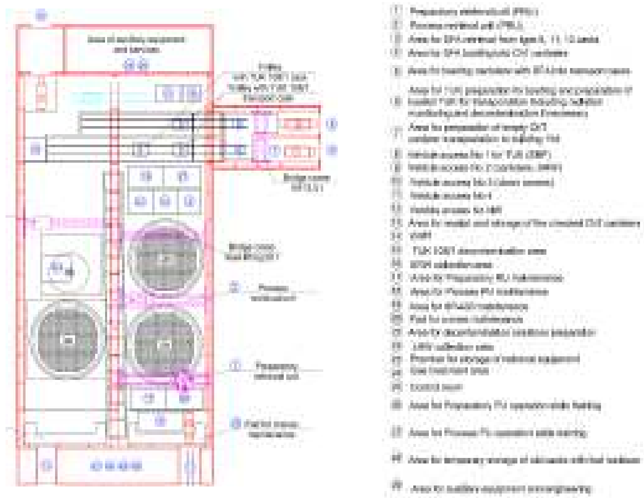


Building 154 – Auxiliary support building for decontamination, maintenance and storage of process equipment

- Building 50 – Radiochemical Laboratory and radiometric monitoring
- Building 151 – Cask Accumulation Pad
- Pier and crane for loading / unloading from ships

Type 6 and 11 Casks above DSU 2A

Building 153 – Plan View



The horizontal Shielding Arrangements

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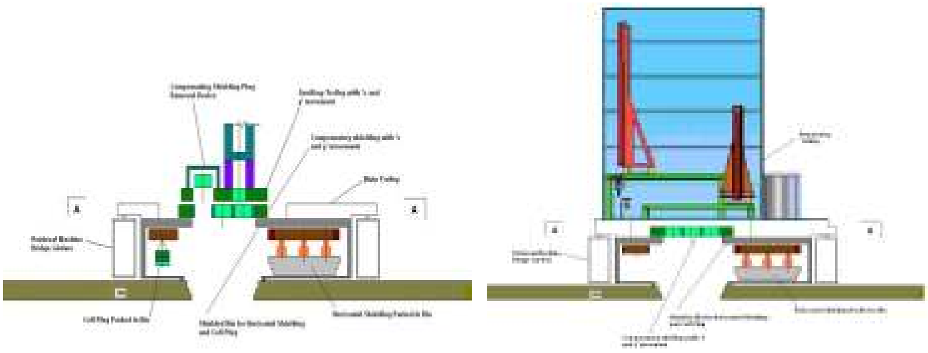
The horizontal Shielding and Removal Arrangements



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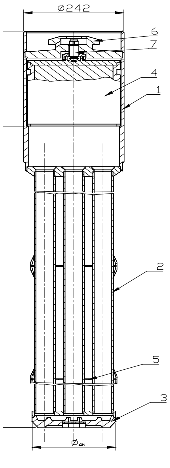
Proposed Process for SNF Removal

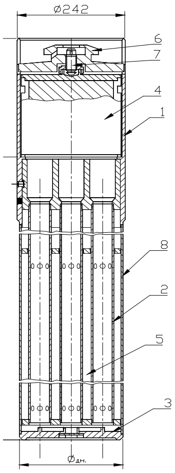
- Remove any DSU water to such level as to expose tops of the SNF canisters. Preference is for extraction from channels without SNF canisters, relying on interconnections between channels. In addition, filtering in-channel to be used to avoid particulate carry-over
- Remove horizontal shielding segments and cell cover to provide access to tops of canisters. Any old plugs, surface debris, etc, would have been removed during earlier construction of the horizontal shielding.
- Position preparatory machine above channel.
- Remove any debris or water present.
- Remove top plug of canister. If necessary, cut out bayonets, etc, sufficiently to allow plug to release, etc, for removal. The top plug and any debris from cutting, etc, will become solid waste.

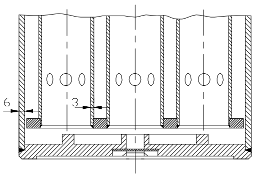
Proposed Process for SNF Removal (2)

- Insert temporary shield plug and replace horizontal shielding.
- Remove preparatory machine and replace with removal machine over position.
- Remove horizontal shielding section and temporary shield plug.
- Proceed to remove intact spent fuel assemblies (SFA) individually. Tests to be applied to accept SFA removal:
  - i) SFA will move and is not stuck;
  - ii) SFA is within acceptable weight tolerance; and
  - iii) SFA visually acceptable
  - iv) Gross γ-scan

SNF Canister Details and State

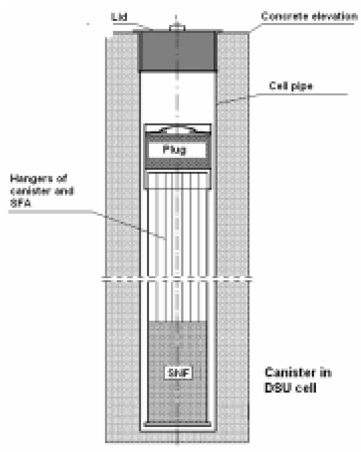




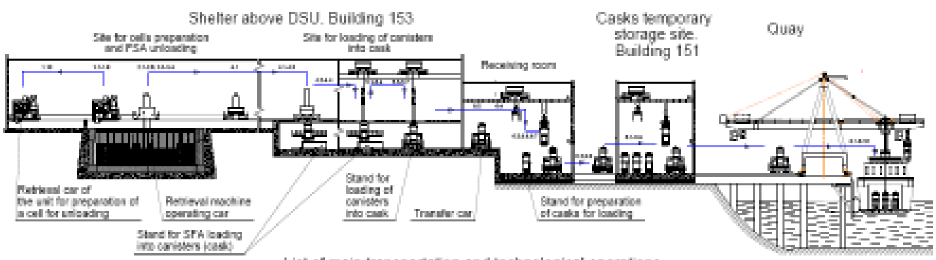


Proposed Process for SNF Removal (3)

- If any SFA is stuck or is incomplete, it will be left. If any fails any of the other tests, it will be loaded into one of the oversized canisters for damaged fuel.
- The SFAs are extracted into a drum within the retrieval machine, which can hold up to 7 SFA. Upon filling, the retrieval machine will be relocated above a loading cask, which contains individual canisters to accommodate the different fuel variants. The SFA will then be unloaded into the appropriate new canister.
- After a canister has been filled, it will be transferred using a flask from the loading cask to an adjacent TUK 18 or TUK 108 dual purpose transport and interim storage cask.



Process Sequence for SNF Movement

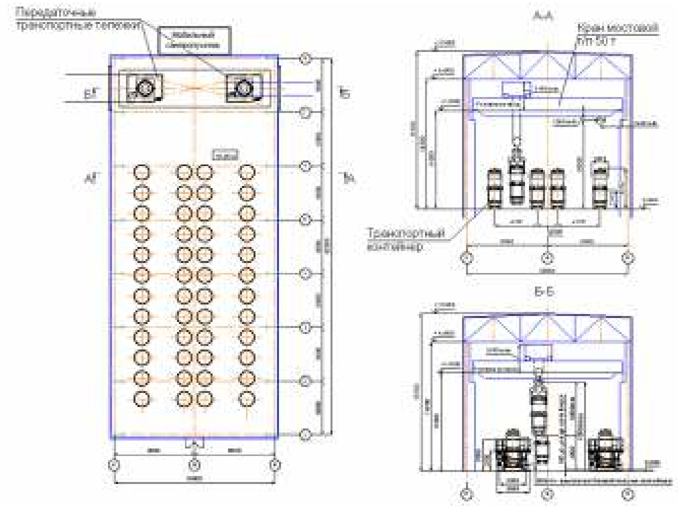


List of main transportation and technological operations
Flow Diagram based on the Spent Nuclear Fuel Facilities

Proposed Process for SNF Removal (4)

- After the TK 18/TUK 108 cask has been filled with full canisters, it will be removed to B151 for interim storage prior to shipment off-site by sea to Murmansk and hence by rail to Mayak. The cask will be monitored and checked for any contamination through each transport stage.
- Canisters within the DSU, which contain non-intact fuel or fuel fragments, will be extracted from channels into the retrieval machine. The machine will then transfer the canister into an overpack canister located within the loading cask.
- The overpacked canisters will be inserted into a TK 18 or TUK108 cask with a modified internal basket.
- The DSUs will be unloaded in the order 2A, 2B and 3A.
- No recovery is planned of any fuel fragments/particulates remaining in the DSU channels. They will be left to await final decommissioning of the DSUs. Structural surveys have confirmed that the concrete structures of the DSUs are sound, in good condition and with low carbonation.
- The recovery arrangement places an onus upon Mayak to develop a new head-end capability to handle both damaged fuel and any fragments in overpacked canisters.

Cask Interim Store - Building 151



Outstanding Issues

- There is a need for Waste Acceptance Criteria (WAC), both internally within Andreeva Bay and externally in respect of wastes to be stored at Saida Bay and ultimately disposed of in a national or regional repository. Multiple stage processing is inefficient. Once wastes have been cemented, further processing other than overpacking will be very difficult. Even overpacking will reduce effective volume utilisation and significantly increase handling and disposal costs. The development of generic WAC is not difficult and there is much experience worldwide.
- There is a need for agreement on a limited, standard set of licensed containers for waste packaging to facilitate efficient design and handling.
- A shielding strategy is needed for waste packages. The use of shielded packages is inefficient and expensive, particularly for interim storage and disposal.
- A strategy for the final status of the site is needed to avoid increasing future liabilities and unnecessary remedial works.

Outstanding Issues (2)

- Allied to the previous point, a strategy for the management of large volume, low overall activity, contaminated wastes, e.g. soil and construction debris from decommissioning is needed for the site. Integral to this is the availability of local VLLW and LLW disposal routes.
- The issue of localised treatment of radioactive liquid waste within the Andreeva Bay site needs comprehensive resolution.

Conclusions

- The UK programme at Andreeva Bay is directed at the improvement in the safety and security of the SNF through the retrieval, repackaging and ultimately relocation to a more secure site at Mayak. It will achieve this for the bulk of the SNF.
- Significant levels of radioactivity, including limited amounts of SNF will remain in the DSUs to await final decommissioning.
- A strategy for the safe and secure management of the DSUs post bulk SNF removal before and through final decommissioning is absent and will be required. It will be considered within the decommissioning safety documentation.
- There are still a number of waste management issues to be resolved to ensure the effective implementation of the SNF retrieval programme.