APPENDIX A

Waste Arisings

Table A1: Fuel container arisings following repackaging events.

A1 Waste Arisings from Facility Repeats

A1 Waste Arisings from Facility Repeats

A1.1 Background

In addition to the requirement to periodically replace fuel containers (described in section A3), the facilities in which the fuel is processed, handled and stored also have finite lives, (see main report Table 3). These facilities will need to be replaced/refurbished on a rolling programme. The replacement of these facilities will generate large quantities of waste. The vast majority of the waste generated will be radiologically clean. The internal surfaces of the shielded cell are the only areas that may require some decontamination prior to release. The shielded cells and the processing buildings will not be required after the initial fuel receipt phase at the CES facility, but are included within this section since they will generate a waste arising, if dismantled at any time prior to the first facility repeat.

A1.2 CVSB

Listed below are the component facilities that comprise the CVSB:

A1.2.1 Processing Building

The processing building comprises the receipt area and the cask processing area, the shielded cell is not included:

Waste volumes	Steel	994 tonnes
	Concrete	2,091 tonnes

A1.2.2 Shielded Cell

The shielded cell is a concrete structure that will provide a shielded boundary for the remote handling and transfer of used fuel:

Waste volumes	Steel	934 tonnes
	Concrete	6,695 tonnes
	Lead Glass	11.5 tonnes

A1.2.3 Cask Storage Building

The cask storage building is the building in which the casks will be stored and monitored. The quantities quoted below are for a single cask storage building and for the total CES requirement of 17 cask storage buildings:

Waste volumes (per storage building)	Steel	1,254 tonnes
	Concrete	4,058 tonnes
Waste volumes (17 off storage buildings)	Steel	21,318 tonnes
	Concrete	68,986 tonnes

A1.2.4 Vault

The vault is a monolithic concrete structure, reinforced with rebar, containing steel storage tubes which house the used fuel baskets. The quantities quoted below are for a single vault and for the total CES requirement of 24 storage vaults:

Waste volumes (per vault)	Steel	140 tonnes
	Concrete	1,680 tonnes
Waste volumes (24 off vaults)	Steel	3,360 tonnes
	Concrete	40,320 tonnes

A1.2.5 Vault Storage Building

The vault storage buildings are the buildings in which the vaults will be sited, which in turn house used fuel baskets. The quantities quoted below are for a single vault storage building and for the total CES requirement of 4 storage buildings:

Waste volumes (per storage building)	Steel	914 tonnes
	Concrete	2,456 tonnes
Waste volumes (4 off storage buildings)	Steel	3,656 tonnes
	Concrete	9,824 tonnes

A1.2.6 CVSB Waste Totals

Steel	**30,262 tonnes**
Concrete	**127,916 tonnes**
Lead Glass	**11.5 tonnes**

A1.3 SMV

Listed below are the component facilities that comprise the SMV:

A1.3.1 Processing Building

The processing building comprises the receipt area and the cask processing area, the shielded cell is not included:

Waste volumes	Steel	694 tonnes
	Concrete	1,349 tonnes

A1.3.2 Shielded Cell

The shielded cell is a concrete structure that will provide a shielded boundary for the remote handling and transfer of used fuel:

Waste volumes	Steel	1,014 tonnes
	Concrete	7,481 tonnes

Lead Glass	14 tonnes

A1.3.3 Surface Modular Vault

The surface modular vault is a concrete structure containing the storage tubes for the used fuel housings (module containment or basket). The concrete structure provides the shielding for the fuel and includes labyrinth inlets for the surface modular vault cooling air. The quantities quoted below are for a single surface modular vault and for the total CES requirement of 6 surface modular vault buildings:

Waste volumes (per surface modular vault)	Steel	9,940 tonnes
	Concrete	87,630 tonnes
Waste volumes (6 off surface modular vaults)	Steel	59,636 tonnes
	Concrete	525,780 tonnes

A1.3.4 Vault Building

The vault building, when related to the SMV, refers to the superstructure over the storage vault. The vault building provides weather protection to the storage vault:

Waste volumes (per vault building)	Steel	744 tonnes
(6 off vault buildings)	Steel	4,464 tonnes

Vault building handling equipment
(including canister handling machine, basket crane, mobile crane and transfer flask)

Steel	674 tonnes

A1.3.5 SMV Waste Totals

Steel	**66,482 tonnes**
Concrete	**534,610 tonnes**
Lead Glass	**14 tonnes**

A1.4 CVST

Listed below are the component facilities that comprise the CVST:

A1.4.1 Processing Building

The processing building comprises the receipt area and the cask processing area, the shielded cell is not included:

Waste volumes	Steel	994 tonnes
	Concrete	2,091 tonnes

A1.4.2 Shielded Cell

The shielded cell is a concrete structure that will provide a shielded boundary for the remote handling and transfer of used fuel:

Waste volumes	Steel	934 tonnes
	Concrete	6,695 tonnes
	Lead Glass	11.5 tonnes

A1.4.3 Vault

The vault is a monolithic concrete structure, reinforced with rebar, containing steel storage tubes which house the used fuel baskets:

Waste volumes (per vault)	Steel	140 tonnes
	Concrete	1,680 tonnes
Waste volumes (24 off vaults)	Steel	3,360 tonnes
	Concrete	40,320 tonnes

A1.4.4 Transfer Tunnel

The transfer tunnel links the processing building and the storage chamber complex. The transfer tunnel provides cover for the fuel transfers, thereby minimising the potential for disruption due to adverse weather:

Waste volumes	Steel	170 tonnes
	Concrete	8,360 tonnes

A1.4.5 Shallow Trench Chamber

The storage chamber is a reinforced concrete structure, constructed within a shallow trench. The storage chamber houses either casks or vaults:

Waste volumes (per chamber)	Steel	2,051 tonnes
	Concrete	39,107 tonnes
Waste volumes (16 off chambers)	Steel	32,816 tonnes
	Concrete	625,712 tonnes
Shallow Trench handling equipment	Steel	72 tonnes

A1.4.6 CVST Waste Totals

Steel	**38,346 tonnes**
Concrete	**683,178 tonnes**
Lead Glass	**11.5 tonnes**

A1.5 CRC

Listed below are the component facilities that comprise the CRC:

A1.5.1 Processing Building

The processing building comprises the receipt area and the cask processing area, the shielded cell is not included:

Waste volumes	Steel	994 tonnes
	Concrete	2,091 tonnes

A1.5.2 Shielded Cell

The shielded cell is a concrete structure that will provide a shielded boundary for the remote handling and transfer of used fuel:

Waste volumes	Steel	934 tonnes
	Concrete	6,695 tonnes
	Lead Glass	11.5 tonnes

A1.5.3 Transfer Tunnel

The transfer tunnel links the processing building and the rock cavern. The transfer tunnel provides cover for the fuel transfers, thereby minimising the potential for disruption due to adverse weather:

Waste volumes	Steel	850 tonnes
	Concrete	41,800 tonnes

A1.5.4 Rock Cavern (concrete structure)

The rock caverns will be ‘cut’ into a suitable rock structure. A concrete floor slab and gantry crane support structure will be constructed within the cavern. These concrete structures will be refurbished or replaced as they reach he end of their service life. A figure of 50% has been used as the division between the concrete structure to be replaced and the concrete structure which will be refurbished:

Waste volumes (per cavern)	Steel	623 tonnes
	Concrete	6,797 tonnes
Waste volumes (10 off caverns)	Steel	6,230 tonnes
	Concrete	67,970 tonne

A1.5.5 CRC Waste Totals

Steel	**9,008 tonnes**
Concrete	**118,556 tonnes**
Lead Glass	**11.5 tonnes**

A2 Waste Arisings from Repackaging Buildings

A2.1 Background

The process of periodically repackaging fuel into new fuel containers requires a dedicated shielded cell suite housed in a repackaging building. The size and configuration of such a building is dependent on which of the four alternatives is selected.

Once the fuel has been transferred into its new fuel container and the existing containers have been decontaminated and sent for disposal, the shielded cell and repackaging building are then treated as waste and can be demolished. The waste arising from the repackaging buildings from the four alternatives is described below, these 4 alternatives assume both baskets and modules are being repackaged at the same event.

A2.2 CVSB

Listed below are the component facilities that comprise the CVSB Repackaging Building:

A2.2.1 Basket Repackaging Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the remote handling and transfer of used basket fuel:

Waste volumes	Steel	493 tonnes
	Concrete	5,283 tonnes
	Lead Glass	7.7 tonnes

A2.2.2 Basket Decontamination Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the decontamination and remote handling of used fuel baskets:

Waste volumes	Steel	161 tonnes
	Concrete	1,403 tonnes
	Lead Glass	3.8 tonnes

A2.2.3 Module Repackaging Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the remote handling and transfer of used module fuel:

Waste volumes	Steel	587 tonnes
	Concrete	6,244 tonnes
	Lead Glass	11.5 tonnes

A2.2.4 Module Decontamination Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the decontamination and remote handling of used fuel modules:

Waste volumes	Steel	153 tonnes
	Concrete	1,350 tonnes
	Lead Glass	3.8 tonnes

A2.2.5 Cask & Lid Decontamination Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the decontamination and remote handling used module storage casks and lids:

Waste volumes	Steel	435 tonnes
	Concrete	2,623 tonnes
	Lead Glass	9.6 tonnes

A2.2.6 Processing Building

The processing building comprises the receipt area, export area and the cask processing area, the shielded cells are not included:

Waste volumes	Steel	2,296 tonnes
	Concrete	5,341 tonnes

A2.2.7 CVSB Waste Totals

Steel	**4,125 tonnes**
Concrete	**22,244 tonnes**
Lead Glass	**36 tonnes**

A2.3 SMV

Listed below are the component facilities that comprise the SMV Repackaging Building:

A2.3.1 Basket Repackaging Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the remote handling and transfer of used basket fuel:

Waste volumes	Steel	493 tonnes
	Concrete	5,283 tonnes
	Lead Glass	7.7 tonnes

A2.3.2 Basket Decontamination Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the decontamination and remote handling of used fuel baskets:

Waste volumes	Steel	161 tonnes
	Concrete	1,403 tonnes
	Lead Glass	3.8 tonnes

A2.3.3 Module Canister Repackaging Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the remote handling and transfer of used module fuel:

Waste volumes	Steel	753 tonnes
	Concrete	7,234 tonnes
	Lead Glass	9.1 tonnes

A2.3.4 Module Canister Decontamination Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the decontamination and remote handling of used module canisters:

Waste volumes	Steel	290 tonnes
	Concrete	3,058 tonnes
	Lead Glass	3.8 tonnes

A2.3.5 Module Decontamination Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the decontamination and remote handling of used fuel modules:

Waste volumes	Steel	153 tonnes
	Concrete	1,350 tonnes
	Lead Glass	3.8 tonnes

A2.3.6 Processing Building

The processing building comprises the receipt area, export area and the cask processing area, the shielded cells are not included:

Waste volumes	Steel	1,642 tonnes
	Concrete	3,540 tonnes

A2.3.7 SMV Waste Totals

Steel	**3,492 tonnes**
Concrete	**21,868 tonnes**
Lead Glass	**38 tonnes**

A2.4 CVST

Listed below are the component facilities that comprise the CVST Repackaging Building:

A2.4.1 Basket Repackaging Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the remote handling and transfer of used basket fuel:

Waste volumes	Steel	493 tonnes
	Concrete	5,283 tonnes
	Lead Glass	7.7 tonnes

A2.4.2 Basket Decontamination Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the decontamination and remote handling of used fuel baskets:

Waste volumes	Steel	161 tonnes
	Concrete	1,403 tonnes
	Lead Glass	3.8 tonnes

A2.4.3 Module Repackaging Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the remote handling and transfer of used module fuel:

Waste volumes	Steel	587 tonnes
	Concrete	6,244 tonnes
	Lead Glass	11.5 tonnes

A2.4.4 Module Decontamination Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the decontamination and remote handling of used fuel modules:

Waste volumes	Steel	153 tonnes
	Concrete	1,350 tonnes
	Lead Glass	3.8 tonnes

A2.4.5 Cask & Lid Decontamination Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the decontamination and remote handling used module storage casks and lids:

Waste volumes	Steel	435 tonnes
	Concrete	2,623 tonnes
	Lead Glass	9.6 tonnes

A2.4.6 Processing Building

The processing building comprises the receipt area, export area and the cask processing area, the shielded cells are not included:

Waste volumes	Steel	2,296 tonnes
	Concrete	5,341 tonnes

A2.4.7 CVST Waste Totals

Steel	**4,125 tonnes**
Concrete	**22,244 tonnes**
Lead Glass	**36 tonnes**

A2.5 CRC

Listed below are the component facilities that comprise the CRC Repackaging Building:

A2.5.1 Basket Repackaging Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the remote handling and transfer of used basket fuel:

Waste volumes	Steel	675 tonnes
	Concrete	5,665 tonnes
	Lead Glass	7.7 tonnes

A2.5.2 Basket Decontamination Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the decontamination and remote handling of used fuel baskets:

Waste volumes	Steel	161 tonnes
	Concrete	1,403 tonnes
	Lead Glass	3.8 tonnes

A2.5.3 Module Repackaging Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the remote handling and transfer of used module fuel:

Waste volumes	Steel	587 tonnes
	Concrete	6,244 tonnes
	Lead Glass	11.5 tonnes

A2.5.4 Module Decontamination Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the decontamination and remote handling of used fuel modules:

Waste volumes	Steel	153 tonnes
	Concrete	1,350 tonnes
	Lead Glass	3.8 tonnes

A2.5.5 Cask & Lid Decontamination Shielded Cell

This shielded cell is a concrete structure that will provide a shielded boundary for the decontamination and remote handling used module storage casks and lids:

Waste volumes	Steel	435 tonnes
	Concrete	2,623 tonnes
	Lead Glass	9.6 tonnes

A2.5.6 Processing Building

The processing building comprises the receipt area, export area and the cask processing area, the shielded cells are not included:

Waste volumes	Steel	2,171 tonnes
	Concrete	4,631 tonnes

A2.5.7 CRC Waste Totals

Steel	**4,182 tonnes**
Concrete	**21,916 tonnes**
Lead Glass	**36 tonnes**

A3 Waste Arisings from the Disposal of Fuel Containers

A3.1 Background

The periodic repackaging of fuel will generate quantities of steel and concrete, some of which may be contaminated by contact with, or through leakage from fuel bundles. Given the total fuel inventory (approximately 3.6 million bundles) this will be a significant periodic waste arising. It is assumed that the repackaging event and therefore the decontamination and disposal of redundant fuel containers extends over a 30 year period. Depending on the dry storage alternative, various forms of solid waste will arise as spent fuel containers. (Refer table A1)

Waste fuel container types comprise:

- Spent (module and basket) casks
- Spent modules
- Spent module canisters
- Spent baskets

A3.2 Spent Cask Waste Arisings

For CVSB and CVST, assuming 3,274,431 fuel bundles are stored in 8,528 storage casks, this equates to 533,000 tonnes of material.

For CRC, assuming 3,557,451 fuel bundles are stored in 9,202 storage casks, this equates to 575,125 tonnes of material.

The assessed weight of a storage cask is taken as 62.5 tonnes, comprising 6.5 tonnes steel and 56 tonnes of concrete.

A3.3 Spent Module Waste Arisings

Assuming 3,274,431 fuel bundles are stored in 34,112 modules, this equates to 6,992 tonnes of material.

A module has dimensions 990mm x 1290mm x 600mm and occupies 0.767m³. The weight of a module is 205kg.

A3.4 Spent Module Canister Waste Arisings

Assuming 3,274,431 fuel bundles are stored in 8528 module canisters, this equates to 34,964 tonnes of material.

A module canister has dimensions diameter 1800mm x 2570mm and occupies 6.54m³. The weight of a module is 4,100kg.

A3.5 Spent Basket Waste Arisings

Assuming 283,020 fuel bundles are stored in 4,717 baskets, this equates to 2,123 tonnes of material.

A basket has dimensions diameter 1067mm x 533mm and occupies 0.476m³. The weight of a basket is 450kg.

A4 Total Waste Arisings for Each CES Alternative

The total waste arisings for each alternative have been derived from estimates of the material quantities and the frequency with which they are anticipated to arise. They therefore reflect the waste arisings from the demolition of storage complexes, given their differing service lives and the waste generated in the repackaging of fuel containers. A nominal cycle of 300 years has been used throughout the four alternatives to allow comparison of the overall waste arisings. Within that 300 year cycle, there may be a number of facility repeat, and repackaging events, for the alternative under consideration

In some instances, the repackaging timescale for different fuel container types is not co-incident (for examples, modules and baskets). A percentage of the waste arisings from the demolition of the repackaging facility has therefore been included, based on the relative contribution of the fuel form to the overall volume of the repackaging building and shielded cell structures constructed.

Fuel container waste arisings have been calculated from figures derived in Section A3 above, and from quantities identified in Table A1.

The estimates do not include the material quantities of ancillary buildings on the CES site, although this is expected to be common across the four alternatives.

A4.2 CVSB

Within the 300 year cycle, the waste arisings from the following activities have been included:

CVSB	**Steel Totals**	**Concrete Totals**
Processing cell and shielded cell for initial receipt of fuel at the CES facility	1928	8786
Facility repeats for all storage buildings (storage casks and vaults) (3 repeats)	74922	236430
Facility repeats for vaults (3 repeats)	10080	120960
Cask repackaging buildings and shielded cells (3 events, including 1 event with transfer of fuel to new	8817	34773

modules)		
Basket to basket repackaging (1 event)	1279	8060
Storage cask waste arisings (3 events)	166296	1432704
Module arisings (1 event)	6993	
Basket arisings (1 event)	2123	
Totals	**272,438**	**1,841,713**

A4.3 SMV

Within the 300 year cycle, the waste arisings from the following activities have been included:

SMV	**Steel Totals**	**Concrete Totals**
Processing cell and shielded cell for initial receipt of fuel at the CES facility	1708	8830
Facility repeats for all modular vault buildings (3 repeats)	194322	1577340
Module canister to module canister and basket to basket repackaging building and shielded cells (1 event)	3492	21868
Module canister arisings (1 event)	34964	
Module arisings (1 event)	6993	
Basket arisings (1 event)	2123	
Totals	**243,602**	**1,608,038**

A4.4 CVST

Within the 300 year cycle, the waste arisings from the following activities have been included:

CVST	**Steel Totals**	**Concrete Totals**
Processing cell and shielded cell for initial receipt of fuel at the CES facility	1928	8786
Facility repeats for all storage chambers (storage casks and vaults) (1.5 repeats)	49479	951108
Facility repeats for vaults (3 repeats)	10080	120960
Cask repackaging buildings and shielded cells (3 events, including 1 event with transfer of fuel to new modules)	8817	34773
Basket to basket repackaging (1 event)	1279	8060
Storage cask waste arisings (3 events)	166296	1432704
Module arisings (1 events)	6993	
Basket arisings (1 event)	2123	
Totals	**246,995**	**2,556,391**

Note: An allowance of factor of 1.5 has been applied to the facility repeat for storage chambers. Only one renewal of storage chambers will take place (after 200 years) within the 300 year cycle. However, two renewals will occur in the next 300 year cycle (after 400 and 600 years respectively)

A4.5 CRC

Within the 300 year cycle, the waste arisings from the following activities have been included:

CRC	**Steel Totals**	**Concrete Totals**
Processing cell and shielded cell for initial receipt of fuel at the CES facility	1928	8786
Storage cavern refurbishment (1 repeat)	6230	67970
Cask repackaging buildings and shielded cells (3 events, including 1 event with transfer of fuel to new modules)	8778	40305
Basket to basket repackaging (1 event)	2926	13371
Storage cask waste arisings (3 events)	179439	1545936
Module arisings (3 events)	6993	
Basket arisings (1 event)	2123	
Totals	**208,417**	**1,676,368**

In addition, the CRC alternative, 1.9 million cubic meters of broken rock is generated during initial cavern excavation.

A5 Fuel Container Decontamination

The CES alternatives that require the periodic repackaging of storage casks and module canisters will generate a stream of spent modules, from which fuel bundles have been discharged. All the CES alternatives require the periodic repackaging of fuel baskets and will therefore generate a stream of spent baskets, from which fuel bundles have been discharged. Modules and baskets are potentially contaminated, either as a result of initial fuel loading underwater, before discharge from reactor site wet storage facilities, or later, through defective fuel leakage during extended dry storage. Similarly, module canisters are potentially contaminated, either as a result of initial fuel loading or later, through defective fuel leakage during extended dry storage.

All activities will be performed remotely initially, using the least aggressive procedures first. Once surface contamination has been reduced to appropriate levels, man entry to the shielded cell is permissible, and ‘hands on’ procedures can be applied.
Shielded cell internal walls and floor finishes can be regularly decontaminated, by swabbing or sparge water ring actuation.
Ventilation services are arranged to draw air in from areas of lower contamination, to areas of highest contamination, such that the spread of contamination is minimised.

A5.1 Cask Component Examination and Separation

General assumptions:

1. Cask exterior surface has already passed contamination examination
2. Decontamination facility is remote from repackaging facility
3. Decontamination facility receives casks via the cask transporter route
4. Decontamination facility comprises a shielded cell, which serves cask body, and cask lids on separate lines.
5. Craneage, appropriate to the component form is present within the cell.
6. As precautionary measure, assume cask internals are contaminated, until proven otherwise.

Initial orientation: Cask and lid are in normal configuration.

- Manually remove any transit clamps connecting cask body to cask lid.
- Attach a lid lifting tri-form attachment point to cask lid.
- Manoeuvre assembly into shielded cell suite receipt bay using cask transporter.
- Set down cask and withdraw transporter, close outer shield door.
- Open inner shield door, travel crane out to cask and pick up.
- Set down cask within shielded cell.
- Remotely measure count rate from cask assembly.
- Remotely engage cask lid lifting attachment point and remove cask lid.
- Remotely measure count rate from module hull and above cask payload void.
- Transfer cask lid to a parallel line, for a separate decontamination sequence.

A5.2 Cask Body Decontamination

Refer Figure 8.1.

- Remotely measure count rate from cask body closure flange region and internal void.
- Map areas of highest contamination on cask body closure flange region and c internal void.
- Vacuum cask body closure flange region and internal void.
- Remotely measure count rate from cask body closure flange region and from internal void.
- Re-map areas of highest contamination on cask body closure flange region and internal void.
- Locally swab cask body closure flange region and internal void.
- Remotely measure count rate from cask body closure flange region and internal void.
- Re-map areas of highest contamination on cask body closure flange region and internal void.
- Masking cask exterior, apply spray water wash to cask body closure flange region and internal void.

NB. It will be necessary to pump extract any wash waters accumulating in the cask void, since the storage cask drain route is sealed by a blanking plug, during service life. The extraction rate should match the delivery rate, to ensure any accumulation of contaminant does not settle on cask internal base plate and lower void walls. Convey all used wash-waters to the active drainage system.

- Allow all wetted affected areas to dry.
- Remotely measure count rate from cask body closure flange region and internal void.
- Re-map areas of highest contamination on cask body closure flange region and internal void.
- Once contamination levels have been reduced sufficiently to permit man access to the shielded cell, repeat decontamination monitoring and perform ‘hands on’ decontamination activities appropriate to the final waste disposal route.

- Hoist cask body, open inner shield door, and long travel crane out into shielded cell suite export bay, and deposit cask body through containment hatch onto a suitable trolley. Return crane into shielded cell.
- Withdraw trolley, close outer roller shutter door and transfer cask body to buffer storage area, to be prepared for off-site shipment.

A5.3 Cask Lid Decontamination

Refer Fig.8.2.

Initial orientation: Cask lid is positioned held on suitable lifting attachment for subsequent decontamination operations.

- Remotely measure count rate from cask lid underside.
- Map areas of highest contamination on cask lid underside.
- Vacuum cask lid.
- Remotely measure count rate from cask lid underside.
- Re-map areas of highest contamination on cask lid underside.
- Locally swab cask lid underside.
- Remotely measure count rate from cask lid underside.
- Re-map areas of highest contamination on cask lid underside.
- Transfer cask lid to decontamination booth.
- Apply spray water wash to cask lid underside. Wash sequence ensures that spray waters progressively wash contaminants off cask lid surfaces (from top, to sides to bottom). Convey all used wash-waters to active drainage system.
- Allow all wetted affected areas to dry.
- Remotely measure count rate from cask lid.
- Re-map areas of highest contamination on cask lid.
- Once contamination levels have been reduced sufficiently to permit man access to the shielded cell, repeat decontamination monitoring and perform ‘hands on’ decontamination activities appropriate to the final waste disposal route.
- Transfer cask lid to discharge port. Open shield hatch and lower cask lid into export bay, onto pallet or suitable stillage. Close the shield hatch.
- Open outer discharge bay door, and retrieve cask lid on pallet or stillage using forklift truck or similar.
- Transfer cask lid to a buffer storage area, to be prepared for off-site shipment.

A5.4 Module Decontamination

The following description assumes modules (4 off) have been extracted from a storage cask body or from a module canister. Such batches are transferred to a dedicated decontamination cell, under the repackaging cell suite (Refer Fig. 8.3)

The 4 off modules are treated in turn. Direct contact between personnel and modules residing at this position is restricted by a shield wall, over which modules are lifted, during remote handling operations only.

Initial orientation: Module hull is held on suitable lifting attachment for subsequent decontamination operations.

- Remotely measure count rate from module hull.
- Map areas of highest contamination on module hull.
- Vacuum module hull, including tubular bores.
- Remotely measure count rate from module hull.
- Re-map areas of highest contamination on module hull.
- Locally swab module hull.
- Remotely measure count rate from module hull.
- Re-map areas of highest contamination on module hull.
- Transfer module hull to decontamination booth.
- Apply spray water wash to module hull. Wash sequence ensures that spray waters progressively wash contaminants off module hull surfaces (from top, to sides to bottom). Convey all used wash-waters to the active drainage system.
- Allow all wetted affected areas to dry.
- Remotely measure count rate from module hull.
- Re-map areas of highest contamination on module hull.
- Once contamination levels have been reduced sufficiently to permit man access to the shielded cell, repeat decontamination monitoring and perform ‘hands on’ decontamination activities appropriate to the final waste disposal route.
- Transfer cask lid to discharge port. Open shield hatch and lower module hull into discharge bay, onto pallet or suitable stillage. Close shield hatch.
- Open outer discharge bay door, and retrieve module hull on pallet or stillage using forklift truck or similar.
- Transfer module hull(s) to a buffer storage area, to be prepared for off-site shipment.

A5.5 Module Canister Decontamination

The SMV alternative generates a stream of spent module canisters, from which fuel modules have been discharged. They are discharged from the repackaging cell and transferred to a shielded cell, before undergoing a decontamination sequence (Refer Fig.8.4).
The following description assumes individual module canisters have been generated as a result of fuel transfer operations.

General assumptions:

1. All empty modules hulls (from SMV) have already been discharged in repackaging operations.
2. Decontamination facility is connected to the repackaging facility
3. Decontamination facility receives module canisters (singly) via the spent module canister transfer port
4. Decontamination facility comprises a series of interconnected shielded cells, progressively decontaminating the module canister.
5. Craneage, appropriate to the component form is present.
6. As precautionary measure, assume the module is contaminated, until proven otherwise.
7. The module canister assembly comprises a welded body and a lid. The lid/body seal weld has previously been removed as a result of module removal activities. The module canister shell decontamination is described. A separate sequence for the monitoring and

decontamination of the module canister will be executed, but many of the steps will be similar to the shell sequences. A decontamination booth dedicated to the decontamination of module canister lids will be required.

8. Module canister shells will be monitored on receipt at the decontamination cell suite, to establish the presence of surface contaminants.
9. The module canister components are extracted from a ‘dirty storage location’. Direct contact between personnel and module canister components residing at this position is restricted by a shield wall, over which module canister components are lifted, during remote handling operations only.

Initial orientation: Module canister shell is held on suitable lifting attachment for subsequent decontamination operations.

- Remotely measure count rate from module canister shell.
- Map areas of highest contamination on module canister shell.
- Vacuum module canister shell, including lifting features.
- Remotely measure count rate from module canister shell.
- Re-map areas of highest contamination on module canister shell.
- Locally swab module canister shell.
- Remotely measure count rate from module canister shell.
- Re-map areas of highest contamination on module canister shell.
- Transfer module canister shell to decontamination booth.
- Apply spray water wash to module canister shell. Wash sequence ensures that spray waters progressively wash contaminants off module canister shell surfaces (from top, to sides to bottom).

NB. Both the internal and external surfaces of the module canister require decontamination. As there is no drainage route for wash waters from the interior of the module canister, these will have to be pumped from within the module canister shell. Convey all used wash-waters to active drainage system.

- Allow all wetted affected areas to dry.
- Remotely measure count rate from module canister shell.
- Re-map areas of highest contamination on module canister shell.
- Once contamination levels have been reduced sufficiently to permit man access to the shielded cell, repeat decontamination monitoring and perform ‘hands on’ decontamination activities appropriate to the final waste disposal route.
- Transfer cask lid to discharge port. Open shield hatch and lower module canister shell into discharge bay suitable stillage. Close shield hatch.
- Open outer discharge bay door, and retrieve module canister shell on stillage using forklift truck or similar.
- Transfer module canister shell to a buffer storage area, to be prepared for off-site shipment.

A5.6 Basket Decontamination

The following description assumes individual baskets have been generated as a result of fuel transfer operations. They have been discharged from the repackaging cell and transferred to a decontamination cell, before undergoing a separate decontamination sequence. In the case of a basket cask, up to seven baskets can result from each repackaging operation (refer Fig.8.5).

Basket assemblies arriving at the decontamination facility effectively comprise two sub assemblies, the basket lid and basket base. The lid sub assembly comprises a circular top plate, with a peripheral plate barrel suspended below. The base subassembly comprises the circular base-plate, intervening grid plate and the central lifting pintle. The decontamination processes will be effected after the separation of these two subassemblies which has taken place within to the decontamination cell, All subsequent operations describe the decontamination of a component. Given their circular plan, the processes are similar for the two component types. It will be necessary to customise the monitoring operations and decontamination booth profiles to suit.

General assumptions:

1. All empty baskets have already been discharged in repackaging operations.
2. Decontamination facility is connected to the repackaging facility
3. Decontamination facility receives baskets (singly) via the spent basket transfer port
4. Decontamination facility comprises a series of interconnected shielded cells, progressively decontaminating the basket.
5. Craneage, appropriate to the component form is present.
6. As precautionary measure, assume the basket is contaminated, until proven otherwise.
7. Basket components will be monitored on receipt at the decontamination cell suite, to establish the presence of surface contaminants.
8. A buffer storage capability of up to 7 off ‘dirty’ baskets is established at one end of the cell. Each basket component is extracted from a ‘dirty storage row’ and each basket is treated in turn. Direct contact between personnel and baskets residing at this position is restricted by a shield wall, over which baskets are lifted, during remote handling operations only.

Initial orientation: Basket component is held on suitable lifting attachment for subsequent decontamination operations.

- Remotely measure count rate from basket component.
- Map areas of highest contamination on basket component.
- Vacuum basket component, including tubular bore of lifting pintle.
- Remotely measure count rate from basket component.
- Re-map areas of highest contamination on basket component.
- Locally swab basket component.
- Remotely measure count rate from basket component.
- Re-map areas of highest contamination on basket component.
- Transfer basket component to decontamination booth.
- Apply spray water wash to basket component. Wash sequence ensures that spray waters progressively wash contaminants off basket component surfaces (from top, to sides to bottom). Convey all used wash-waters to active drainage system.
- Allow all wetted affected areas to dry.
- Remotely measure count rate from basket component.
- Re-map areas of highest contamination on basket component.
- Once contamination levels have been reduced sufficiently to permit man access to the shielded cell, repeat decontamination monitoring and perform ‘hands on’ decontamination activities appropriate to the final waste disposal route.
- Transfer cask lid to discharge port. Open shield hatch and lower basket component into discharge bay, onto pallet, or suitable stillage. Close shield hatch.

- Open outer discharge bay door, and retrieve basket component on pallet or stillage using forklift truck or similar.
- Transfer basket component to buffer storage area, to be prepared for off-site shipment.

A5.7 General Decontamination and Recovery

In the event that there is a handler failure during the normal decontamination processes, the handlers within the decontamination cells will be recovered to decontamination/maintenance facilities. Handler movements will be accomplished by the operation of remote recovery drives, actuated by through wall lances, such that any contaminated package could be set down within the cell. In the event of long travel failure, the handlers will be recovered by means of recovery cables (part of the cable reeling system).

Periodically, the cells and equipment (principally the handlers and decontamination equipment) within the decontamination suite will be subject to decontamination routines themselves. To establish the extent of contamination accumulation, the cranes and equipment should be monitored with greater frequency during active commissioning, to establish the projected build up and dispersal of contaminants within the cell. At levels which permit man access to the cells, monitoring, vacuuming, local swabbing and local washing should be implemented, balancing the need to maintain man access for maintenance purposes against the generation of the minimum of waste arisings.

Table A1: Fuel container arisings following repackaging events.

Alternative	Fuel container weights	Total No of casks	Total No of baskets	Total No of modules	Total No of module canisters	Daily No of casks	Daily No of baskets	Daily No of modules	Daily No of module canisters
CVSB									
Casks	62.5 tonne	8528				*1.23* **(76.9)**			
Modules	0.205 tonne			34112				*4.94* **(*1.01*)**	
Module canisters	4.1 tonne								
Baskets	0.45 tonne		4717				*0.68***(0.31)**		
SMV									
Casks	62.5 tonne								
Modules	0.205 tonne			34112				*4.94* **(*1.01*)**	
Module canisters	4.1 tonne				8528				*1.23* **(5.04)**
Baskets	0.45 tonne		4717				*0.68* **(0.31)**		
CVST									
Casks	62.5 tonne	8528				*1.23* **(76.9)**			
Modules	0.205 tonne			34112				*4.94* **(*1.01*)**	
Module canisters	4.1 tonne								
Baskets	0.45 tonne		4717				*0.68* **(0.31)**		
CRC									
Casks	62.5 tonne	9202				*1.33* **(83.1)**			
Modules	0.205 tonne			34112				*4.94* **(*1.01*)**	
Module canisters	4.1 tonne								
Baskets	0.45 tonne		4717				*0.68* **(0.31)**		
(Not in baskets)	**3274431**								
(In baskets)	**283020**								

Notes:
Repackaging takes place over a 30-year duration. Repackaging facility operates 230 days per year. Therefore waste fuel container arisings calculated over that period.
Daily totals in *Italics*, daily weights in **(bold)**.