APPENDIX F: Conceptual design and description for all the UFTS components in the case of "Mostly water" mode for each Current Storage Site

1. INTERFACES FOR EACH CURRENT STORAGE SITE

Tables N° 4, 5, 6, 7 and 8 of Appendix B.

2. WHITESHELL

Baskets in Silo (See Appendix B, Table N° 4)
From Douglas Point Facility to the Centralised Facility
Quantity of bundles to transport from 2035 to 2064: see Appendix B, Table N° 3.

2.1. Mode and route development

Feasibility of transporting used fuel from the different current storage site to the centralised facility.
Viability of shipping by road and the identification of a preferred shipping route.

« Whiteshell includes a single facility: Whiteshell Laboratories. While the Whiteshell facility was not visited as part of this review, the facility's location, paired with the very small number of used fuel bundles to be transported, suggests that road transport would be the most efficient means of completing the deliveries to either the northern or southern Ontario regions. Accordingly, a specific investigation of rail and/or water links was not conducted.

Recommendation: On the above basis, it is recommended that the small volume of used fuel originating at the Whiteshell facility be transported by road.

The hypothesised routing would involve transport on the Trans Canada Highway to provincial [**<52>**, **<53>**, **<27>** and **<54>**]. »

2.2. Nuclear facility loading

Receive and prepare the used fuel and packages for loading, prepare packages for loading into transportation packages, pre-shipment tests, and prepare transportation package for transfer to a trailer.

See phases 3, 4, 5 of paragraph 2.9 of the present chapter.

2.3. Transporter (vehicle)

Conceptual design of trailer and tractors (phase 6 of table paragraph 2.9)

2.3.1. Trolley with tractor

In order to transfer:

- The baskets from the silo to the packaging (phase 2 of table paragraph 2.9),
- The full packaging from the loading area of the packaging to the transportation area of the transportation cask (phase 5 of table paragraph 2.9).

2.3.2. Trailer for the road transportation (phase 6 of table paragraph 2.9)

- Modified 48 foot flatted trailer with integrated tie-down
- Trailer equipped with hydraulic or air ride suspension to cushion the load
- Trailer equipped with four axles
- One loaded cask per trailer
- 2 drivers and no escort

2.3.3. Tractor for the road transportation (phase 6 of table paragraph 2.9)

- Standard commercial tractor sufficient for the loaded weight
- The weight for the fuelled reference tractor is roughly 9,075 kg.

2.3.4. Weather cover for the road transportation (phase 7 of table paragraph 2.9)

- Rolling removable plastic weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. Two men (one on each side of the trailer) can manually open or close the weather cover which can roll on a rail fixed on the frame of the Transportation cask.

- Holes and a ventilation shaft on the top of the cover are calculated to create an adequate draught around the Transportation cask during the transport. The weather cover is composed with two parts: one with a fixed metallic panel at the rear side, one with a fixed metallic panel at the front side. The weather cover can be taken off from the trailer with a specific frame fixed at the rear side of the frame for the Transportation cask.

2.3.5. Frame of the Transportation cask for the road transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the axles. This frame is fitted to the vehicle with twistlock devices plus a metal fitting designed for the appropriate accelerations. The numbers of attachments for the frame means it is still better to remove the cask from the frame, rather than taking than cask and the frame as unit during intermodal transfers.
The weather cover can rolls on a rail fixed on the frame of the Transportation cask. A drip pan is installed under the frame in order to collect the drain of water coming from the condensation of the Transportation cask. A manual valve with a padlock is installed at the lower level of the drip pan in order to collect the water.

2.3.6. Specific equipment

- GPS antenna (tracking) on the tractor
- Turning light (“Girophare”) on the tractor
- Tools box adapted to the Transportation cask

2.4. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for IFTC/BM: shared facility at the centralised site as developed in paragraph 3.2 of Chapter 3.

- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

2.5. Casks

Conceptual design for the Transportation package and tie-down systems for UFTS:

- Tie-down: similar to the IFTC, Appendix A, Figure N° 15 **<3>**.

- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 5 of Appendix A, Appendix C.

2.6. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Leakage and purging equipment:
  One complete equipment with vacuum pumps and gauges (see phase 4 of table paragraph 2.9)

- Gantry Crane:
  One for loading the baskets from the Transfer flask to the packaging (see phase 3 of table paragraph 2.9)
  One for loading the packaging on the trailer (see phase 6 of table paragraph 2.9)

- Lifting beam:
  One for the lid of the packaging (see phase 3 of table paragraph 2.9)
  One for the Transfer flask (see phase 3 of table paragraph 2.9)
  One for the packaging (see phases 5 and 6 of table paragraph 2.9)
  One for the impact limiter of the packaging (see phase 5 of table paragraph 2.9)

- Decontamination equipment (see paragraph 3.2 of Chapter 3).

2.7. UFTS Transportation system operation

Loading of packages onto the trailer, security, transportation, emergency response:

- Loading of packages onto the trailer, security, transportation as described in phase 6 of table paragraph 2.9

- Emergency response plan: see paragraph 9 of Appendix F.

- Real time tracking: see paragraph 9 of Appendix F.

2.8. Decommissioning

Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

2.9. Table: Analysis of the operational phases of transport

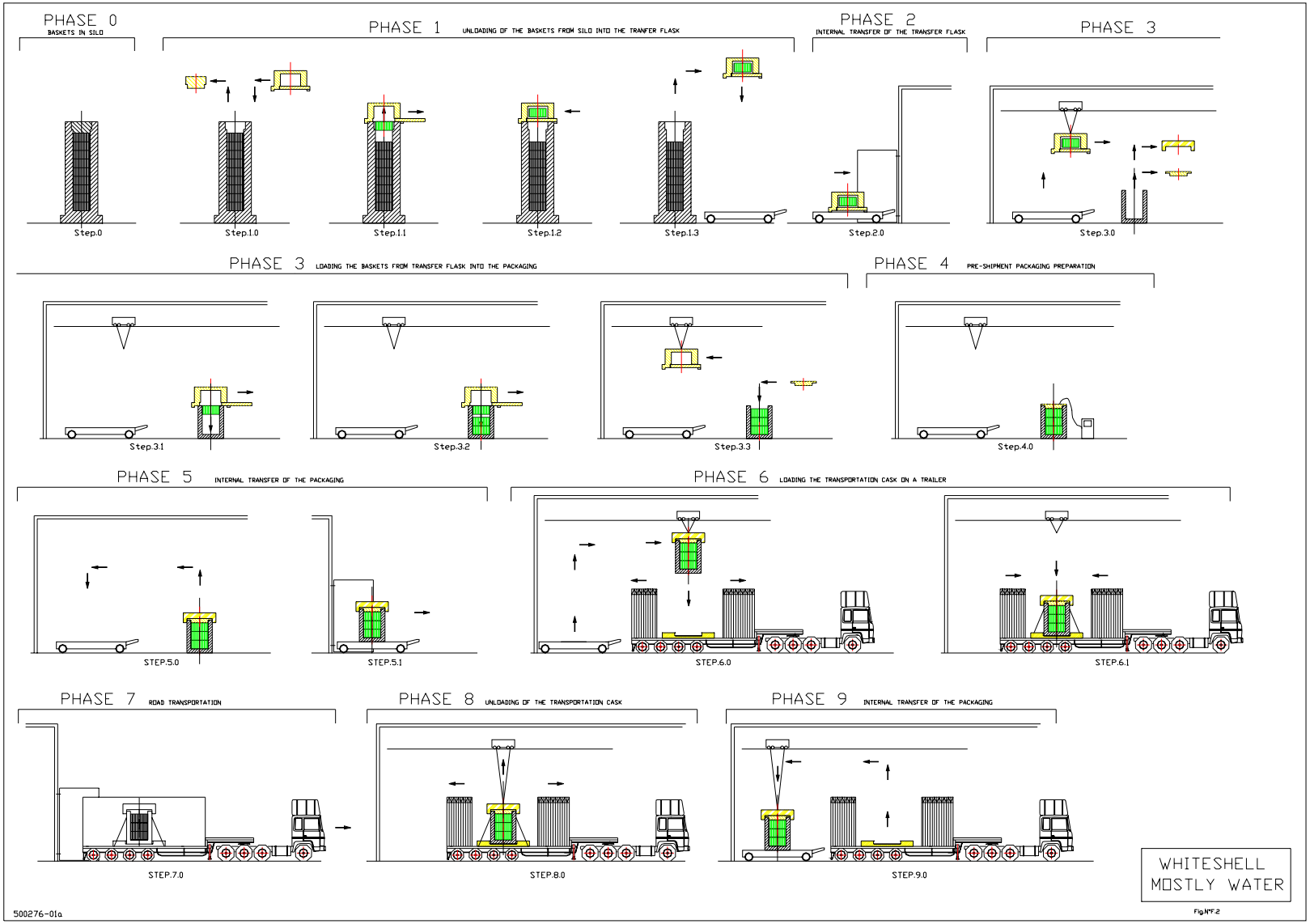
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.2
Phase 0	Baskets in Silo	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 2	Internal transfer of the transfer flask	Interim storage				2.0
Phase 3	Loading the baskets from the transfer flask into the packa-ging. Note(1)	UFTS	With the gantry, take the impact limiter handling tool of the packaging.	Packaging	IFTC/BM : See section 2.4.7.1.3 of D#5 Appendix A, Figure N° 6,	3.0
				Impact limiter handling tool of the packaging		3.0
				Gantry crane	With 2 hoists (of 60 tons for the IFTC/BM and Transfer flask and 10 tons for the impact limiter and the lid of IFTC/BM)	3.0
			Raise the impact limiter and store it in a place			3.0
			With the gantry, take the lid handling tool of the packaging. Bolting of the lid with the associated platform	Lid handling tool of the packaging		3.0
			Raise the lid and store it in a place			3.0
			With the gantry, take the transfer flask	Transfer flask	Similar to Gentilly 2, Appendix A, Figure N°10 : - 8 Shielded fuel transfer cask - 26 tons with 60 bundles basket and with irradiated fuel - “Sliding” gate - Electric hoist for lifting or lowering a basket into the IFTC/BM - Chain - Basket lifting grapple - Shielding	3.0
				Lifting Beam for the Transfer flask		3.0
			Mate the transfer flask with the flask lid of the packaging.		Appendix A, Figure N°9	3.1
			Load the baskets.			3.1, 3.2
			With the gantry, take off the transfer flask			3.3
			With the gantry, close the packaging with the lid.			3.3

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.2
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves,	4.0
			Filling the cavity with helium	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves, compressed air line	
			Leaktightness check	Leaktightness equipement		
			Depressurising the cavity	Vacuum circuit		
Phase 5	Internal transfer of the packaging	UFTS	Radiological control of the packaging	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Approach of the vehicle	Trolley	Trolley with tractor	5.0
			Radiological control of the Trolley	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Installing the impact limiter			5.0
			Loading of the Transportation cask on the Trolley			5.0
			Radiological control of the Transportation cask and the Trolley	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Internal transfer	Tie down		5.1
Phase 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask and of the trailer	Non contamination, Dose Rate	“Smear test”, Radiameter	6.0
			Open the weather cover	Weather cover		6.0
			Loading the Transportation cask on a trailer	Gantry Crane	With 1 hoist (of 60 tons for the IFTC/BM	6.0
				Lifting Beam for packaging	To carry of the IFTC/BM (similar to the lifting beam of IFTC)	6.0
				Trailer (Appendix A, Figures N° 13, 14)	Modified 48 foot flatted trailer with integrated tie-down Trailer equipped with hydraulic or air ride suspension to cushion the load Trailer equipped with four axles One loaded cask per trailer	6.0
				Tractor (Appendix A, Figure N°14)	Standard commercial tractor sufficient for the loaded weight The weight for the fuelled reference tractor is roughly 9,075 kg.	6.0
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15 , **<3>**)	6.1
			Check the condition of Transportation cask , trailer			6.1
			Fit the transport seals			6.1
			Close the weather cover	Weather cover		6.1
			Radiological control of the trailer and of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	6.1

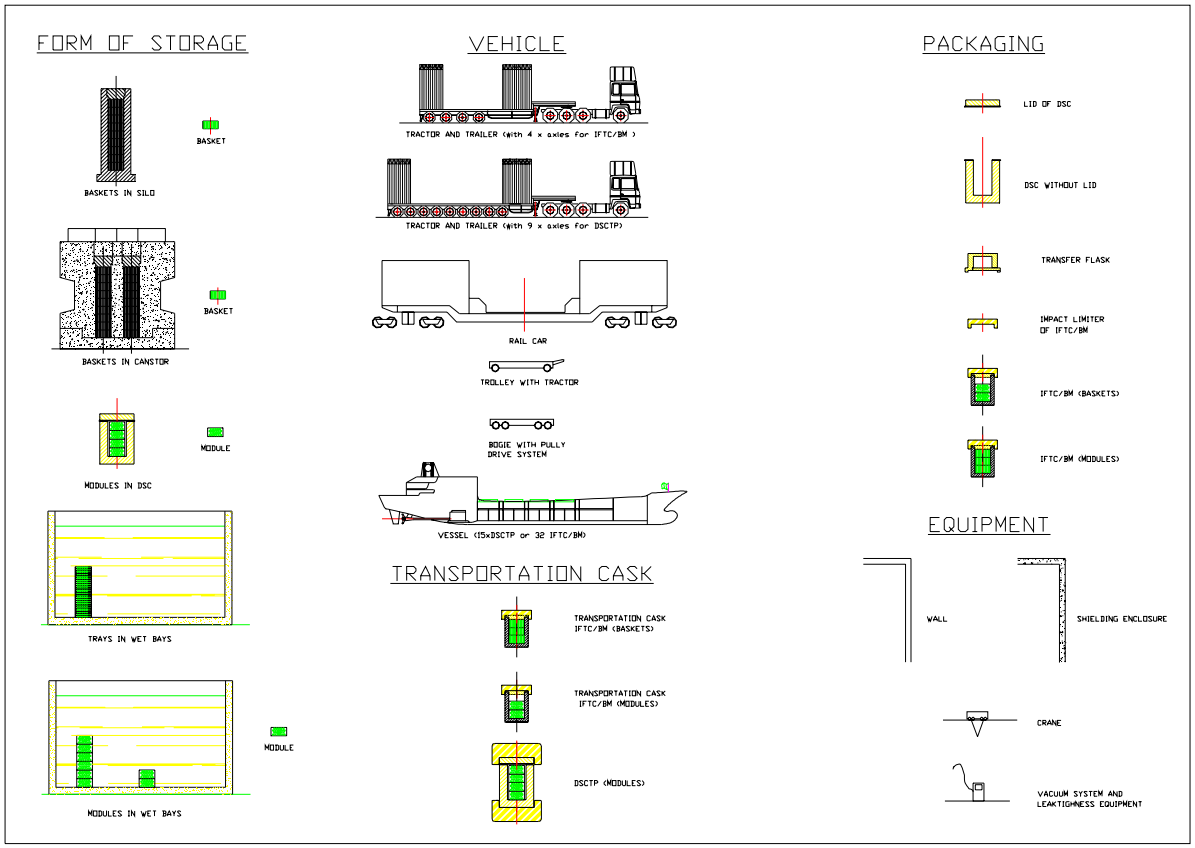
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.2
Cont'd Phase 7	Road transportation	UFTS	Road transportation of the Transportation cask from the Facility to the Centralised Facility			7.0
				Real time tracking	Appendix H	7.0
Phase 8	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			8.0
Phase 9	Internal transfer of loaded Transportation cask	DGR/CES				
Phase 10	Unloading the baskets from the Transportation cask	DGR/CES				
Phase 11	Storage of the baskets on the Centralised Facility	DGR/CES				
Phase 12	Road transportation of the empty Transportation cask from the Centralised Facility	DGR/CES				

Note (1): The removal of the flask and the replacement of the lid have to be co-ordinated, as it done at present (throughout). The IFTC/BM lid could be designed to be suitable for this operation.

This operation has to be repeated three times.


PHASE 0
BASKETS IN SILO
PHASE 1
UNLOADING OF THE BASKETS FROM SILO INTO THE TRANFER FLASK
PHASE 2
INTERNAL TRANSFER OF THE TRANSFER FLASK
PHASE 3
Step.0
Step.1.0
Step.1.1
Step.1.2
Step.1.3
Step.2.0
Step.3.0
PHASE 3
LOADING THE BASKETS FROM TRANSFER FLASK INTO THE PACKAGING
PHASE 4
PRE-SHIPMENT PACKAGING PREPARATION
Step.3.1
Step.3.2
Step.3.3
Step.4.0
PHASE 5
INTERNAL TRANSFER OF THE PACKAGING
PHASE 6
LOADING THE TRANSPORTATION CASK ON A TRAILER
STEP.5.0
STEP.5.1
STEP.6.0
STEP.6.1
PHASE 7
ROAD TRANSPORTATION
PHASE 8
UNLOADING OF THE TRANSPORTATION CASK
PHASE 9
INTERNAL TRANSFER OF THE PACKAGING
STEP.7.0
STEP.8.0
STEP.9.0
WHITESHELL
MOSTLY WATER
500276-01a
Fig.N°.2

Key:


FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (15xDSCTP or 32 IFTC/BM)
TRANSPORTATION CASK
TRANSPORTATION CASK IFTC/BM (BASKETS)
TRANSPORTATION CASK IFTC/BM (MODULES)
DSCTP (MODULES)
PACKAGING
LID OF DSC
DSC WITHOUT LID
TRANSFER FLASK
IMPACT LIMITER OF IFTC/BM
IFTC/BM (BASKETS)
IFTC/BM (MODULES)
EQUIPMENT
WALL
SHIELDING ENCLOSURE
CRANE
VACUUM SYSTEM AND LEAKTIGHNESS EQUIPMENT

3. BRUCE

3.1. Modules in DSC (See Appendix B, Table N° 8)

From BUFDSF to the Centralised Facility
Quantity of bundles to be transported from 2035 to 2064: see appendix B, Table N°3.

3.1.1. Mode and route development

Feasibility of transporting used fuel from the different current storage site to the centralised facility.
Viability of shipping by road and the identification of a preferred shipping route.

Water: Given the location of Bruce on Lake Huron, water transport is feasible [**<52>**, **<53>**, **<54>** and **<59>**]. A dock facility could be constructed on site, allowing for on-site road movements from either the pools or the used fuel dry storage facility. It is anticipated that depth sounding and dredging would be required in addition construction of the marine loading facility.

As outlined below, water could be integrated with a rail transport program, involving development of a marine/rail transfer station. This possibility is further detailed herein.

Recommendation *:* As outlined above under the general review for water transport, a potential transport solution would involve waterborne consolidation of used fuel from several current storage sites and transfer at a water transfer site located either on Lake Huron or on Lake Superior.

The water transfer station for both the southern and northern Ontario options would include the same components:

- A dock;
- A roadway extending to the dock;
- A small switchyard to facilitate rail car placement;
- Road transport to the repository facility.

A building is needed to allow operations, including radiation control activities, to continue during inclement winter conditions. This building would be a simple light structure, but equipped with doors that could be closed in the case of high winds and blowing snow.

3.1.2. Nuclear facility loading

Receive and prepare the used fuel and packages for loading, prepare packages for loading into transportation packages, pre-shipment tests, and prepare transportation package for transfer to a vessel.

See phases 1, 2 and 3 of paragraph 3.1.9 of the present document.

3.1.3. Transporter (vehicle)

3.1.3.1. Vessel (phases 4, 5 of table paragraph 3.1.9)

See section 3.7.1 of Chapter 3.

3.1.3.2. Specific equipment for the vessel transportation

- GPS antenna (tracking) on the vessel (Appendix H)

- Radiation protection kit:
  - Direct reading dosimeter,
  - Film dosimeters,
  - Gamma doses rate meter,
  - Neutron doses rate meter,
  - Counting rate meter,
  - Blank" Measurements performed" forms,
  - Roll of filter papers for smear test,
  - Pairs of overshoes,
  - Vinyl gloves,
  - Disposable breathing mask,
  - Disposable camera with flash

3.1.3.3. Frame of the Transportation cask for the water transportation

Similar to the rail transportation but adapted to the regulation concerning the accelerations.

3.1.3.4. Trailer for the road transportation (phases 6, 7 of table paragraph 3.1.9)

- Modified 48 foot flatted trailer with integrated tie-down
- Trailer equipped with hydraulic suspension to cushion the load
- Trailer equipped with nine axles
- One loaded cask per trailer
- 2 drivers and an escort (see section 3.5.1 Chapter 3)

3.1.3.5. Tractor for the road transportation (phases 6, 7 of table paragraph 3.1.9)

- Standard commercial tractor sufficient for the loaded weight
- The weight for the fuelled reference tractor is roughly 11 t.

3.1.3.6. Weather cover for the road transportation (phases 6, 7 of table paragraph 3.1.9)

- Rolling removable plastic weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. Two men (one on each side of the trailer) can manually open or close the weather cover which can rolls on a rail fixed on the frame of the Transportation cask.

- Holes and a ventilation shaft on the top of the cover are calculated to create an adequate draught around the Transportation cask during the transport. The weather cover is composed with two parts: one with a fixed metallic panel at the rear side, one with a fixed metallic panel at the front side. The weather cover can be taken off from the trailer with a specific frame fixed at the rear side of the frame for the Transportation cask.

3.1.3.7. Frame of the Transportation cask for the road transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the axles. This frame is fitted to the vehicle with twistlock devices plus a metal fitting designed for the appropriate accelerations. The numbers of attachments for the frame means it is still better to remove the cask from the frame, rather than taking than cask and the frame as unit during intermodal transfers.
The weather cover can rolls on a rail fixed on the frame of the Transportation cask. A drip pan is installed under the frame in order to collect the drain of water coming from the condensation of the Transportation cask. A manual valve with a padlock is installed at the lower level of the drip pan in order to collect the water.

3.1.3.8. Specific equipment for the road transportation

- GPS antenna (tracking) on the tractor
- Turning light (“Girophare”) on the tractor
- Tools box adapted to the Transportation cask

3.1.4. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for DSCTP: shared facility at the centralised site (see paragraph 3.2 of Chapter 3).
- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).
- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

3.1.5. Casks

Conceptual design for the Transportation package and tie-down systems for UFTS:

- Tie-down: for DSCTP on trailer similar as described in **<8>**, Appendix A, Figure N° 17.
- Tie-down: for DSCTP on vessel as described in **<8>**, Appendix A, Figure N° 17 (to be adapted to the regulation concerning the accelerations).
- DSCTP: See Chapter 2, section 2.4.7.1.3 of D#5, Appendix A, Figure N° 8, Appendix C.

3.1.6. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Gantry Crane :
  One for the pre-shipment of the packaging (see phases 2, 3 of table paragraph 3.1.9)
  One for loading the Transportation cask on the vessel (see phase 4 of table paragraph 3.1.9).
  One for loading the Transportation cask from the vessel to the trailer (see phase 6 of table paragraph 3.1.9).

The two last gantry cranes can be only one if the vessel has its own crane.

- Lifting beam:
  One for the packaging (see phase 2 of table paragraph 3.1.9)
  One for the impact limiter of the packaging (see phase 2 of table paragraph 3.1.9)
  One for the Transportation cask (see phases 4, 6 of table paragraph 3.1.9)

- Decontamination equipment (see paragraph 3.2 of Chapter 3).

3.1.7. UFTS Transportation system operation

Loading of Transportation cask onto the vessel, trailer, security, transportation, emergency response:

- Loading of Transportation cask onto the vessel, security, transportation as described in phase 4 of table paragraph 3.1.9.

- Loading of Transportation cask onto the trailer, security, transportation as described in phase 6 of table paragraph 3.1.9.

- Emergency response plan: see paragraph 9 of Appendix F.

Real time tracking: see paragraph 9 of Appendix F.

3.1.8. Decommissioning

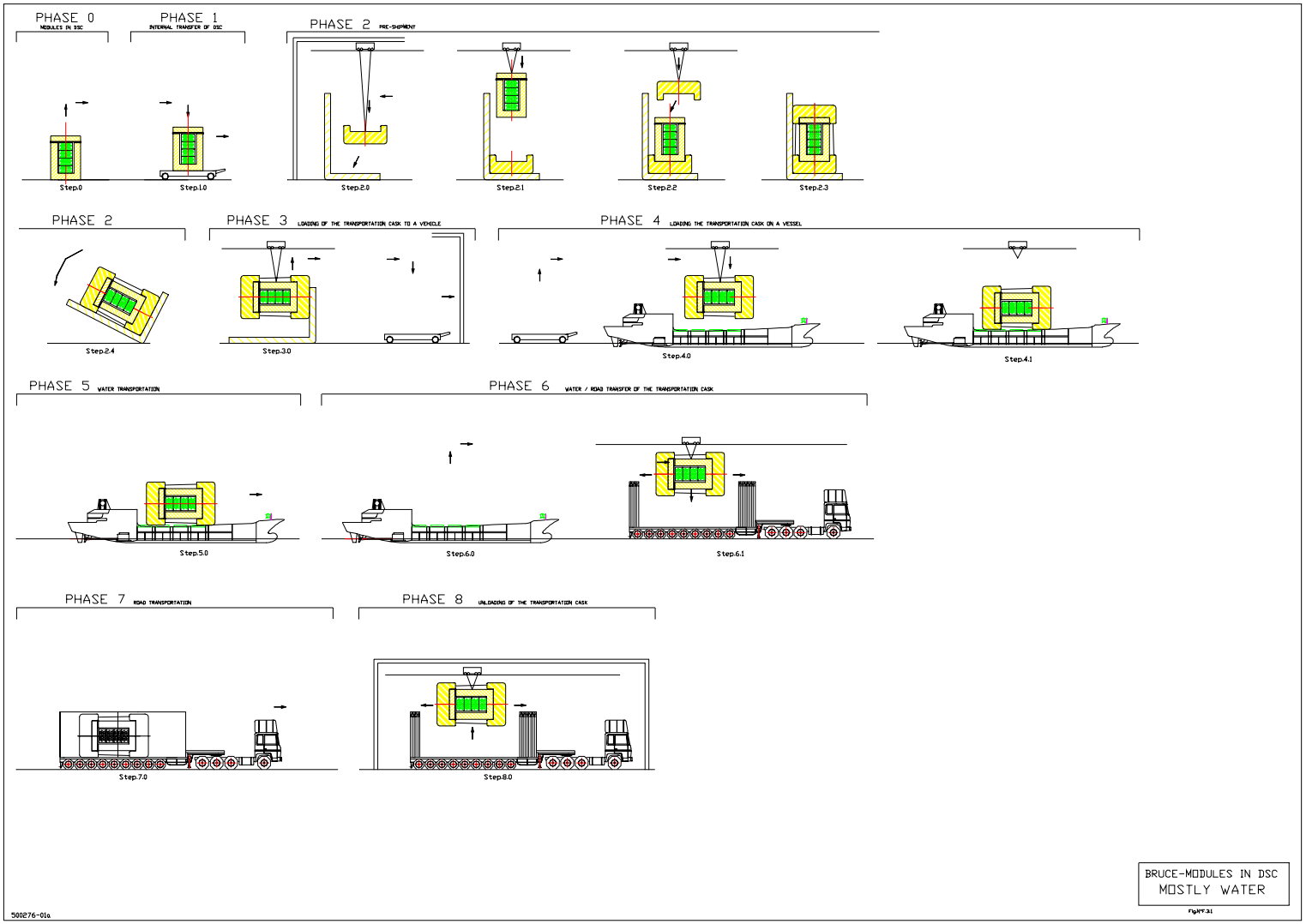
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

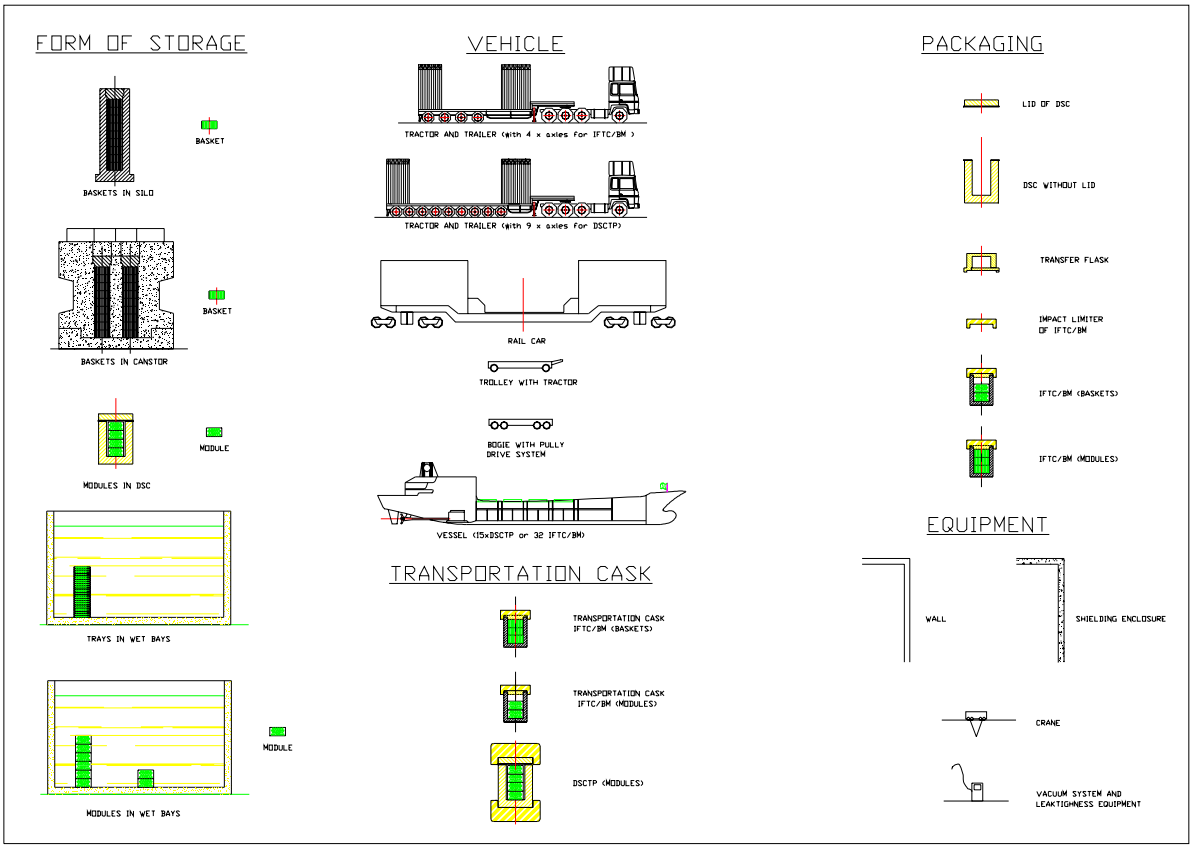
3.1.9. Table: Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.3.1
Phase 0	Modules in DSC	Interim storage	Initial phase			0
Phase 1	Internal transfer of the DSC	Interim storage			DSC, Appendix A, Figure N°7	1.0
Phase 2	Pre-shipment packaging preparation **<8>**	UFTS	Radiological control of the packaging	Non contamination, Dose Rate	"Smear test", Radiameter	2.0
				Transportation cask	DSCTP, Appendix A, Figure N° 8	
				Weather cover		
			Load impact limiter onto rotation frame	Gantry crane	With 1 hoist (of 120 tons for the DSCTP)	2.0
				Rotation frame		
				Lifting Beam impact limiter		
			Place DSC in bottom impact limiter	Lifting Beam for packaging		2.1
			Place Top impact limiter			2.2
			Attach wire rape assemblies			2.3
			Rotate frame	Rotation equipment to rotate the frame		2.4
Phase 3	Loading the Transportation cask on a vehicle and internal transfer	UFTS		Trolley	Trolley with tractor	3.0
Phase 4	Loading the Transportation cask on a vessel	UFTS	Radiological control of the hold and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	4.0
			Lift package in horizontal position	Gantry Crane (on the vessel)	With 1 hoist (of 120 tons for the DSCTP)	4.0
			Lower package onto the hold of the vessel and tie-downs	Vessel	Section 3.7.1 of Chapter 3 Appendix A, Figure N°18	4.0
			Package loaded onto the hold of the vessel and tie-downs secured			4.1
			Check the condition of the packaging, hold			4.1
			Close the upper deck			4. 1
			Fit the transport seals			4.1
			Radiological control of the hold and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	4.1
Phase 5	Water transportation	UFTS	Water transportation of the Transportation cask from the site to the water rail terminal		Protection equipment and materiel necessary to prevent radiation hazards: radiation protection kit	5.0
				Real Time Tacking	Appendix H	5.0

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.3.1
Phase 6	Transfer of the Transportation cask from the vessel to a trailer	UFTS	Radiological control of the hold, the Transportation cask and the trailer		"Smear test", Radiameter	6.0, 6.1
			Open the weather covers of the trailer	Weather covers		
			Loading the packaging from the vessel to the trailer	Gantry Crane (on the vessel)	With 1 hoist (of 120 tons for the DSCTP)	
				Lifting Beam for Transportation cask	**<8>**	
				Trailer (Appendix A, Figure N°12,)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic suspension to cushion the load - Trailer equipped with nine axles - One loaded cask per trailer	
				Tractor (Appendix A, Figure N°14)	- Standard commercial tractor sufficient for the loaded weight - The weight for the fuelled reference tractor is roughly 11 t.	
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the DSCTP for the rail (Appendix A, Figure N°17 , **<8>**)	
			Check the condition of the packaging, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the hold , the trailer and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 7	Road transportation	UFTS	Road transportation of the Transportation cask from the water road terminal to the Centralised Facility			7.0
				Real time Tracking	Appendix H	
Phase 8	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			8.0
Phase 9	Internal transfer of the packaging	DGR/CES				


PHASE 0
MODULES IN DSC
PHASE 1
INTERNAL TRANSFER OF DSC
PHASE 2
PRE-SHIPMENT
Step.0
Step.1.0
Step.2.0
Step.2.1
Step.2.2
Step.2.3
PHASE 2
PHASE 3
LOADING OF THE TRANSPORTATION CASK TO A VEHICLE
PHASE 4
LOADING THE TRANSPORTATION CASK ON A VESSEL
Step.2.4
Step.3.0
Step.4.0
Step.4.1
PHASE 5
WATER TRANSPORTATION
PHASE 6
WATER / ROAD TRANSFER OF THE TRANSPORTATION CASK
Step.5.0
Step.6.0
Step.6.1
PHASE 7
ROAD TRANSPORTATION
PHASE 8
UNLOADING OF THE TRANSPORTATION CASK
Step.7.0
Step.8.0
BRUCE-MODULES IN DSC
MOSTLY WATER
500276-01a

Key:


FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (15xDSCTP or 32 IFTC/BM)
TRANSPORTATION CASK
TRANSPORTATION CASK IFTC/BM (BASKETS)
TRANSPORTATION CASK IFTC/BM (MODULES)
DSCTP (MODULES)
PACKAGING
LID OF DSC
DSC WITHOUT LID
TRANSFER FLASK
IMPACT LIMITER OF IFTC/BM
IFTC/BM (BASKETS)
IFTC/BM (MODULES)
EQUIPMENT
WALL
SHIELDING ENCLOSURE
CRANE
VACUUM SYSTEM AND LEAKTIGHNESS EQUIPMENT

3.2. Trays in wet bays (See Appendix B, Table N° 6)

From Bruce B to the Centralised Facility
Quantity of bundles *to be transported* from 2035 to 2064: see Appendix B, Table N° 3.

3.2.1. Mode and route development

Feasibility of transporting used fuel from the different current storage site to the centralised facility.
Viability of shipping by road and the identification of a preferred shipping route.

Water: Given the location of Bruce on Lake Huron, water transport is feasible [**<52>**, **<53>**, **<54>** and **<59>**]. A dock facility could be constructed on site, allowing for on-site road movements from either the pools or the used fuel dry storage facility. It is anticipated that depth sounding and dredging would be required in addition construction of the marine loading facility.

As outlined below, water could be integrated with a rail transport program, involving development of a marine/rail transfer station. This possibility is further detailed herein.

Recommendation*:* As outlined above under the general review for water transport, a potential transport solution would involve waterborne consolidation of used fuel from several current storage sites and transfer at a water transfer site located either on Lake Huron or on Lake Superior.

In the event that a repository or extended storage facility is sited in southern Ontario, it would be technically feasible to construct the water transfer station on or near Bruce. In this case, the recommended mode of transport for Bruce used fuel would be rail (rail transport to the final repository). See Appendix D, Section 3.

In the event that a repository or extended storage facility is sited in northern Ontario, used fuel originating at Bruce could also be consolidated on a vessel for subsequent shipment to the Lake Superior water transfer station. It is assumed that rail transport would similarly be available from the transfer station to the repository site. In this case, the recommended mode of transport for Bruce used fuel would be water/rail.

The water transfer station for both the southern and northern Ontario options would include the same components:

- A dock;
- A rail siding extending to the dock;
- A small switchyard to facilitate rail car placement;
- Rail from the transfer station to the main line and/or to the repository facility.

If transport from Bruce were made by water/rail (under the northern Ontario option), the hypothesised routing would involve water transport from the site, through Lake Huron, into Lake Superior to the marine transfer station. The loaded casks would then be transported by rail to the repository

If transport from Bruce were made by rail alone (under the southern Ontario option), the hypothesised routing would involve transport from the site to the main rail line. See Appendix D, Section 3.

3.2.2. Nuclear facility loading

Receive and prepare the used fuel and packages for loading, prepare packages for loading into transportation packages, pre-shipment tests, and prepare transportation package for transfer to a vessel.

See phases 3, 4 of paragraph 3.2.9 of the present document.

3.2.3. Transporter (vehicle)

3.2.3.1. Trolley with tractor

In order to transfer:

- The full packaging from the loading area of the packaging to the transportation area of the transportation cask (phases 2 to 5 of table paragraph 3.2.9).

3.2.3.2. Vessel (phase 5 of table paragraph 3.2.9)

See section 3.7.1 of Chapter 3.

3.2.3.3. Specific equipment for the vessel transportation

- GPS antenna (tracking) on the vessel (Appendix H)
- Radiation protection kit:
  - Direct reading dosimeter,
  - Film dosimeters,
  - Gamma doses rate meter,
  - Neutron doses rate meter,
  - Counting rate meter,
  - Blank" Measurements performed" forms,
  - Roll of filter papers for smear test,
  - Pairs of overshoes,
  - Vinyl gloves,
  - Disposable breathing mask,
  - Disposable camera with flash

3.2.3.4. Frame of the Transportation cask for the water transportation

Similar to the rail transportation but adapted to the regulation concerning the accelerations.

3.2.3.5. Trailer for the road transportation (phase 7 of table paragraph 3.2.9)

- Modified 48 foot flatted trailer with integrated tie-down
- Trailer equipped with hydraulic suspension to cushion the load
- Trailer equipped with four axles
- One loaded cask per trailer
- 2 drivers and no escort

3.2.3.6. Tractor for the road transportation (phase 7 of table paragraph 3.2.9)

- Standard commercial tractor sufficient for the loaded weight
- The weight for the fuelled reference tractor is roughly 9,075 kg.

3.2.3.7. Weather cover for the road transportation (phase 7 of table paragraph 3.2.9)

- Rolling removable plastic weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. Two men (one on each side of the trailer) can manually open or close the weather cover which can rolls on a rail fixed on the frame of the Transportation cask.

- Holes and a ventilation shaft on the top of the cover are calculated to create an adequate draught around the Transportation cask during the transport. The weather cover is composed with two parts: one with a fixed metallic panel at the rear side, one with a fixed metallic panel at the front side. The weather cover can be taken off from the trailer with a specific frame fixed at the rear side of the frame for the Transportation cask.

3.2.3.8. Frame of the Transportation cask for the road transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the axles. This frame is fitted to the vehicle with twistlock devices plus a metal fitting designed for the appropriate accelerations. The numbers of attachments for the frame means it is still better to remove the cask from the frame, rather than taking than cask and the frame as unit during intermodal transfers.
The weather cover can rolls on a rail fixed on the frame of the Transportation cask. A drip pan is installed under the frame in order to collect the drain of water coming from the condensation of the Transportation cask. A manual valve with a padlock is installed at the lower level of the drip pan in order to collect the water.

3.2.3.9. Specific equipment for the road transportation

- GPS antenna (tracking) on the tractor
- Turning light (“Girophare”) on the tractor
- Tools box adapted to the Transportation cask

3.2.4. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for IFTC/BM: shared facility at the centralised site as developed in paragraph 3.2 of Chapter 3.

- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

3.2.5. Casks

Conceptual design for the Transportation package and tie-down systems for UFTS:

- Tie-down: Similar to the IFTC for road **<3** >, but adapted to the accelerations of vessel.

- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 5 of Appendix A, Appendix C.

3.2.6. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Leakage and purging equipment :
  One complete equipment with vacuum pumps and gauges (see phase 4 of table paragraph 3.2.9)

- Gantry Crane:
  One for the pre-shipment of the packaging (see phases 3, 4 of table paragraph 3.2.9)
  One for loading the Transportation cask on the vessel (see phase 5 of table paragraph 3.2.9).
  One for loading the Transportation cask on the trailer (see phase 7 of table paragraph 3.2.9).

The two last gantry cranes can be only one if the vessel has its own crane.

- Lifting beam:
  One for the packaging and Transportation cask (see phases 3 to 5 of table paragraph 3.2.9)
  One for the impact limiter of the packaging (see phase 4 of table paragraph 3.2.9)
  One for the Transportation cask (see phase 7 of table paragraph 3.2.9)

- Decontamination equipment (see paragraph 3.2 of Chapter 3).

3.2.7. UFTS Transportation system operation

Loading of packages onto the vessel, rail car, security, transportation, emergency response:

- Loading of Transportation cask onto the vessel, security, transportation as described in phase 5 of table paragraph 3.2.9.

- Loading of Transportation cask onto the trailer, security, transportation as described in phase 7 of table paragraph 3.2.9.

- Emergency response plan: see paragraph 9 of Appendix F.

- Real time tracking: see paragraph 9 of Appendix F.

3.2.8. Decommissioning

Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

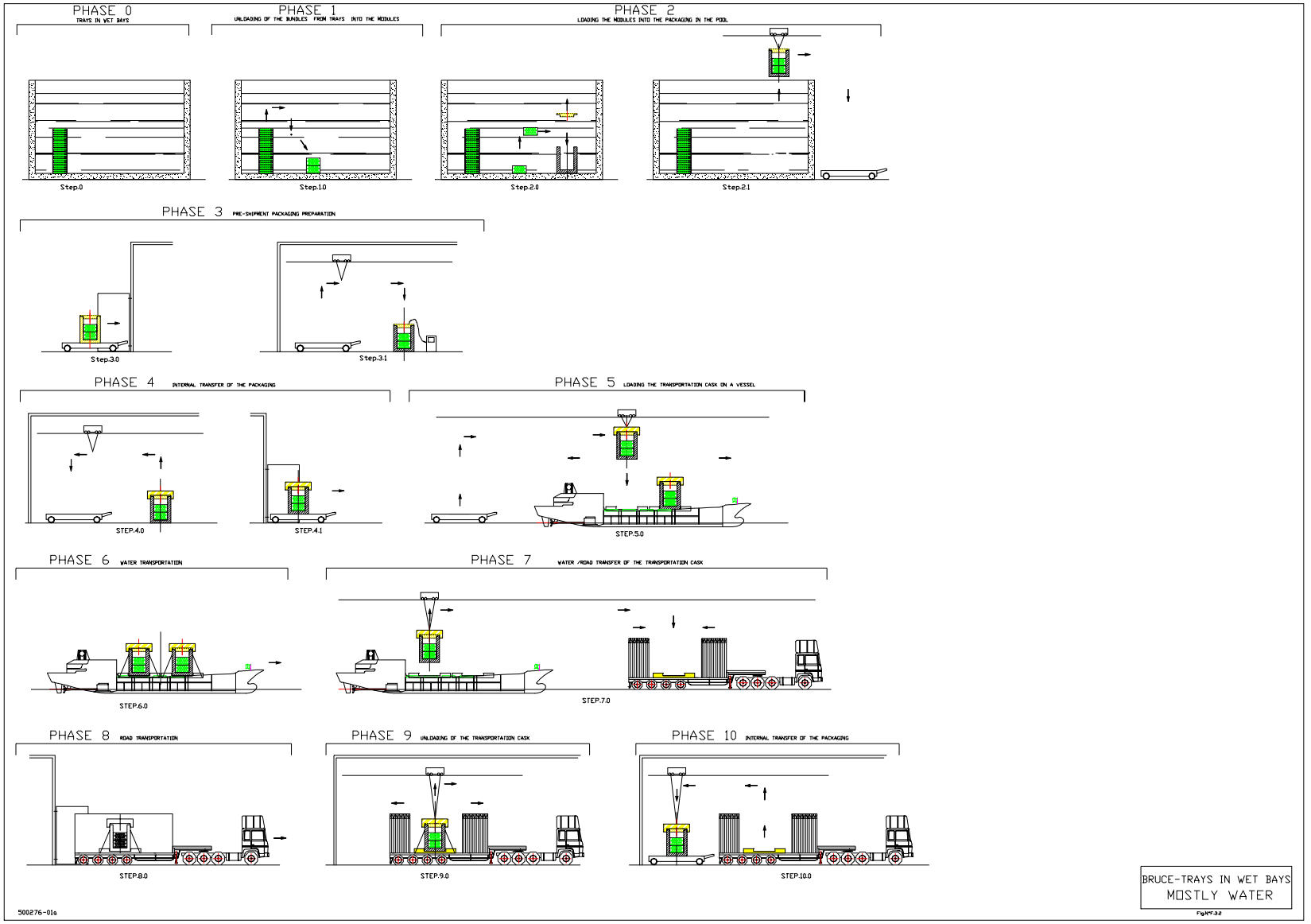
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

3.2.9. Table: Analysis of the operational phases of transport

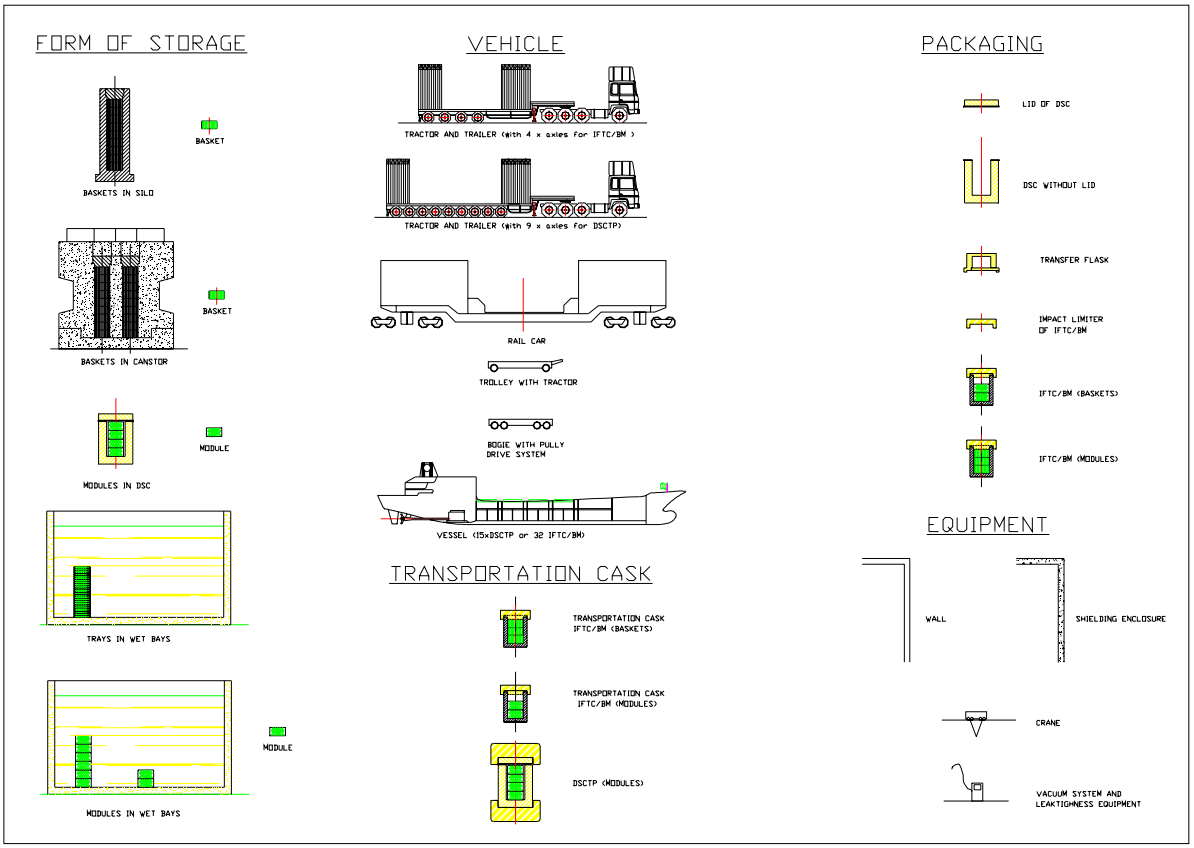
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.3.2
Phase 0	Trays in wet bays	Interim storage	Initial phase			0
Phase 1	Unloading of the bundles from the trays into the modules	Interim storage				1.0
Phase 2	Loading the modules into the packaging in the pool	UFTS	Loading the modules into the packaging in the pool		Identical than the IFCT in the pool Decontamination of the IFTC/BM: identical as IFTC **<3>**	2.0, 2.1
				Packaging	IFTC/BM : See chapter 2., section 2.4.7.1.3 of D#5 Appendix A, Figure N° 5	
Phase 3	Pre-shipment packaging preparation	UFTS	Drainage			3.0, 3.2
			Drying the cavity	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves,	
			Filling the cavity with helium	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves, compressed air line	
			Leaktightness check	Leaktightness equipement		
			Depressurising the cavity	Vacuum circuit		
			Unloading of the packaging from the trolley	Gantry Crane	With 2 hoists (of 60 tons for the IFTC/BM and 10 tons for the impact limiter)	
Phase 4	Internal transfer of the packaging	UFTS	Radiological control of the packaging	Non contamination, Dose Rate	“Smear test”, Radiameter	4.0, 4.1
			Approach of the Trolley	Trolley	Trolley with tractor	
			Radiological control of the Trolley	Non contamination, Dose Rate	“Smear test”, Radiameter	
			Installing the impact limiter			
			Loading of the full Transportation cask on Trolley			
			Radiological control of the Transportation cask and the Trolley	Non contamination, Dose Rate	“Smear test”, Radiameter	
			Internal transfer	Tie down		
Phase 5	Loading the Transportation cask on a vessel	UFTS	Radiological control of the Transportation cask and the hold	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0,5.1
			Loading the Transportation cask on the hold of the vessel	Gantry Crane (on the vessel)	With 1 hoist (of 60 tons for the IFTC/BM	
				Lifting Beam for packaging	To carry of the IFTC/BM (similar to the IFTC, **<3>)**	
				Vessel	Section 3.7.1 of Chapter 3 Appendix A, Figure N°18	
			Transportation cask tie-down on the hold	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**)	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.3.2
			Check the condition of the Transportation cask, hold			
			Fit the transport seals			
			Close the upper deck			
			Radiological control of the hold and the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	
Phase 6	Water transportation	UFTS	Water transportation of the Transportation cask from the site to the water rail terminal		Protection equipment and materiel necessary to prevent radiation hazards : radiation protection kit	6.0
Phase 7	Transfer of the Transportation cask from the vessel to a trailer	UFTS	Radiological control of the hold, the Transportation cask and the trailer		“Smear test”, Radiameter	7.0, 7.1
			Open the weather covers of the trailer	Weather covers		
			Loading the packaging from the vessel to the trailer	Gantry Crane (on the vessel)	With 1 hoist (of 60 tons for the IFTC/BM	
				Lifting Beam for Transportation cask	To carry of the IFTC/BM (similar to the IFTC, **<3>)**	
				Real Time Tracking	Appendix H	
				Trailer (Appendix A, Figures N°13, 14)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic suspension to cushion the load - Trailer equipped with four axles - One loaded cask per trailer	
				Tractor (Appendix A, Figure N°14)	- Standard commercial tractor sufficient for the loaded weight - The weight for the fuelled reference tractor is roughly 9,075 kg.	
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the IFTC for the trailer (Appendix A, Figure N°15 , **<3>**)	
			Check the condition of the packaging, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the hold , the trailer and of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.3.2
Phase 8	Road transportation	UFTS	Road transportation of the Transportation cask from the water road terminal to the Centralised Facility			8.0
				Real time Tracking	Appendix H	
Phase 9	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			9.0
Phase 10	Internal transfer of the packaging	DGR/CES				


PHASE 0
TRAYS IN WET BAYS
PHASE 1
UNLOADING OF THE BUNDLES FROM TRAYS INTO THE MODULES
PHASE 2
LOADING THE MODULES INTO THE PACKAGING IN THE POOL
Step.0
Step.1.0
Step.2.0
Step.2.1
PHASE 3 PRE-SHIPMENT PACKAGING PREPARATION
Step.3.0
Step.3.1
PHASE 4 INTERNAL TRANSFER OF THE PACKAGING
PHASE 5 LOADING THE TRANSPORTATION CASK ON A VESSEL
STEP.4.0
STEP.4.1
STEP.5.0
PHASE 6 WATER TRANSPORTATION
PHASE 7 WATER /ROAD TRANSFER OF THE TRANSPORTATION CASK
STEP.6.0
STEP.7.0
PHASE 8 ROAD TRANSPORTATION
PHASE 9 UNLOADING OF THE TRANSPORTATION CASK
PHASE 10 INTERNAL TRANSFER OF THE PACKAGING
STEP.8.0
STEP.9.0
STEP.10.0
500276-01a
BRUCE-TRAYS IN WET BAYS
MOSTLY WATER
FIGURE 3.2

Key:


FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (15xDSCTP or 32 IFTC/BM)
TRANSPORTATION CASK
TRANSPORTATION CASK IFTC/BM (BASKETS)
TRANSPORTATION CASK IFTC/BM (MODULES)
DSCTP (MODULES)
PACKAGING
LID OF DSC
DSC WITHOUT LID
TRANSFER FLASK
IMPACT LIMITER OF IFTC/BM
IFTC/BM (BASKETS)
IFTC/BM (MODULES)
EQUIPMENT
WALL
SHIELDING ENCLOSURE
CRANE
VACUUM SYSTEM AND LEAKTIGHNESS EQUIPMENT

3.3. Baskets in Silo (See Appendix B, Table N°4)

From Douglas Point Facility to the Centralised Facility
Quantity of bundles to be transported from 2035 to 2064: see Appendix B, Table N° 3.

3.3.1. Mode and route development

Feasibility of transporting used fuel from the different current storage site to the centralised facility.
Viability of shipping by road and the identification of a preferred shipping route.

Water: Given the location of Bruce on Lake Huron, water transport is feasible [**<52>**, **<53>**, **<54>** and **<59>**]. A dock facility could be constructed on site, allowing for on-site road movements from either the pools or the used fuel dry storage facility. It is anticipated that depth sounding and dredging would be required in addition construction of the marine loading facility.

As outlined below, water could be integrated with a rail transport program, involving development of a marine/rail transfer station. This possibility is further detailed herein

Recommendation*:* As outlined above under the general review for water transport, a potential transport solution would involve waterborne consolidation of used fuel from several current storage sites and transfer at a water transfer site located either on Lake Huron or on Lake Superior.

In the event that a repository or extended storage facility is sited in southern Ontario, it would be technically feasible to construct the water transfer station on or near Bruce. In this case, the recommended mode of transport for Bruce used fuel would be rail (rail transport to the final repository). See Appendix E, Section 3.

In the event that a repository or extended storage facility is sited in northern Ontario, used fuel originating at Bruce could also be consolidated on a vessel for subsequent shipment to the Lake Superior water transfer station. It is assumed that rail transport would similarly be available from the transfer station to the repository site. In this case, the recommended mode of transport for Bruce used fuel would be water/rail.

The water transfer station for both the southern and northern Ontario options would include the same components:

- A dock;
- A rail siding extending to the dock;
- A small switchyard to facilitate rail car placement;
- Rail from the transfer station to the main line and/or to the repository facility.

If transport from Bruce were made by water/rail (under the northern Ontario option), the hypothesised routing would involve water transport from the site, through Lake Huron, into Lake Superior to the marine transfer station. The loaded casks would then be transported by rail to the repository

If transport from Bruce were made by rail alone (under the southern Ontario option), the hypothesised routing would involve transport from the site to the main rail line. See Appendix E, Section 3

3.3.2. Nuclear facility loading

Receive and prepare the used fuel and packages for loading, prepare packages for loading into transportation packages, pre-shipment tests, and prepare transportation package for transfer to a vessel.

See phases 3, 4, 5 of paragraph 3.3.9 of the present document.

3.3.3. Transporter (vehicle)

3.3.3.1. Trolley with tractor

In order to transfer:

- The baskets from the silo to the packaging (phases 2 and 3 of table paragraph 3.3.9).

3.3.3.2. Bogie pulley drive system

In order to transfer:

- The IFTC/BM in the hot cell (phase 3 of table paragraph 3.3.9),
- The IFTC/BM to the pre-shipment packaging area (phase 4 of table paragraph 3.3.9),
- The IFTC/BM to the shipment area (phases 5 and 6 of table paragraph 3.3.9).

3.3.3.3. Vessel for the water transportation (phase 6 of table paragraph 3.3.9)

See section 3.7.1 of Chapter 3.

3.3.3.4. Frame of the Transportation cask for the water transportation

Similar to the rail transportation but adapted to the regulation concerning the accelerations.

3.3.3.5. Specific equipment for the water transportation

- GPS antenna (tracking) on the vessel

- Radiation protection kit:
  - Direct reading dosimeter,
  - Film dosimeters,
  - Gamma doses rate meter,
  - Neutron doses rate meter,
  - Counting rate meter,
  - Blank" Measurements performed" forms,
  - Roll of filter papers for smear test,
  - Pairs of overshoes,
  - Vinyl gloves,
  - Disposable breathing mask,
  - Disposable camera with flash

3.3.3.6. Trailer for the road transportation (phase 8 of table paragraph 3.3.9)

- Modified 48 foot flatted trailer with integrated tie-down
- Trailer equipped with hydraulic suspension to cushion the load
- Trailer equipped with four axles
- One loaded cask per trailer
- 2 drivers and no escort

3.3.3.7. Tractor for the road transportation (phase 8 of table paragraph 3.3.9)

- Standard commercial tractor sufficient for the loaded weight
- The weight for the fuelled reference tractor is roughly 9,075 kg.

3.3.3.8. Weather cover for the road transportation (phase 8 of table paragraph 3.3.9)

- Rolling removable plastic weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. Two men (one on each side of the trailer) can manually open or close the weather cover which can rolls on a rail fixed on the frame of the Transportation cask.
- Holes and a ventilation shaft on the top of the cover are calculated to create an adequate draught around the Transportation cask during the transport. The weather cover is composed with two parts: one with a fixed metallic panel at the rear side, one with a fixed metallic panel at the front side. The weather cover can be taken off from the trailer with a specific frame fixed at the rear side of the frame for the Transportation cask.

3.3.3.9. Frame of the Transportation cask for the road transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the axles. This frame is fitted to the vehicle with twistlock devices plus a metal fitting designed for the appropriate accelerations. The numbers of attachments for the frame means it is still better to remove the cask from the frame, rather than taking than cask and the frame as unit during intermodal transfers.
The weather cover can rolls on a rail fixed on the frame of the Transportation cask. A drip pan is installed under the frame in order to collect the drain of water coming from the condensation of the Transportation cask. A manual valve with a padlock is installed at the lower level of the drip pan in order to collect the water.

3.3.3.10. Specific equipment for the road transportation

- GPS antenna (tracking) on the tractor
- Turning light (“Girophare”) on the tractor
- Tools box adapted to the Transportation cask

3.3.4. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for IFTC/BM: shared facility at the centralised site as developed in paragraph 3.2 of Chapter 3.

- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

3.3.5. Casks

Conceptual design for the Transportation package and tie-down systems for UFTS:

- Tie-down: Similar to the Tie down of the IFTC for the water and rail transportation (Appendix A, Figure N°15, **<3>**) adapted to the regulations concerning the accelerations.

- IFTC/BM: See Chapter 2, section 2.4.7.1.3, Figure n° 6 of Appendix A, Appendix C.

3.3.6. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Leakage and purging equipment:
  One complete equipment with vacuum pumps and gauges (see phase 4 of table paragraph 3.3.9)

- Gantry Crane :
  One for loading installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 3.3.9) and for install the impact limiter (phase 4)
  One for loading the Transportation cask on the vessel (see phase 6 of table paragraph 3.3.9)
  One for loading the Transportation cask from the vessel to the trailer (see phase 8 of table paragraph 3.3.9).

The two last gantry crane can be only one if the vessel has its own crane.

- Lifting beam:
  One for the Transfer flask (see phase 3 of table paragraph 3.3.9)
  One for the impact limiter of the packaging (see phase 4 of table paragraph 3.3.9)
  One for the Transportation cask (see phase 8 of table paragraph 3.3.9)

- Decontamination equipment (see paragraph 3.2. of Chapter 3).

3.3.7. UFTS Transportation system operation

Loading of packages onto the vessel, rail car, security, transportation, emergency response:

- Loading of packaging onto the vessel, security, transportation as described in phase 6 of table paragraph 3.3.9.

- Loading of Transportation cask from the vessel to the trailer, security, transportation as described in phase 8 of table paragraph 3.3.9.

- Emergency response plan: see paragraph 9 of Appendix F.

- Real time tracking: see paragraph 9 of Appendix F.

3.3.8. Decommissioning

Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

3.3.9. Table : Analysis of the operational phases of transport

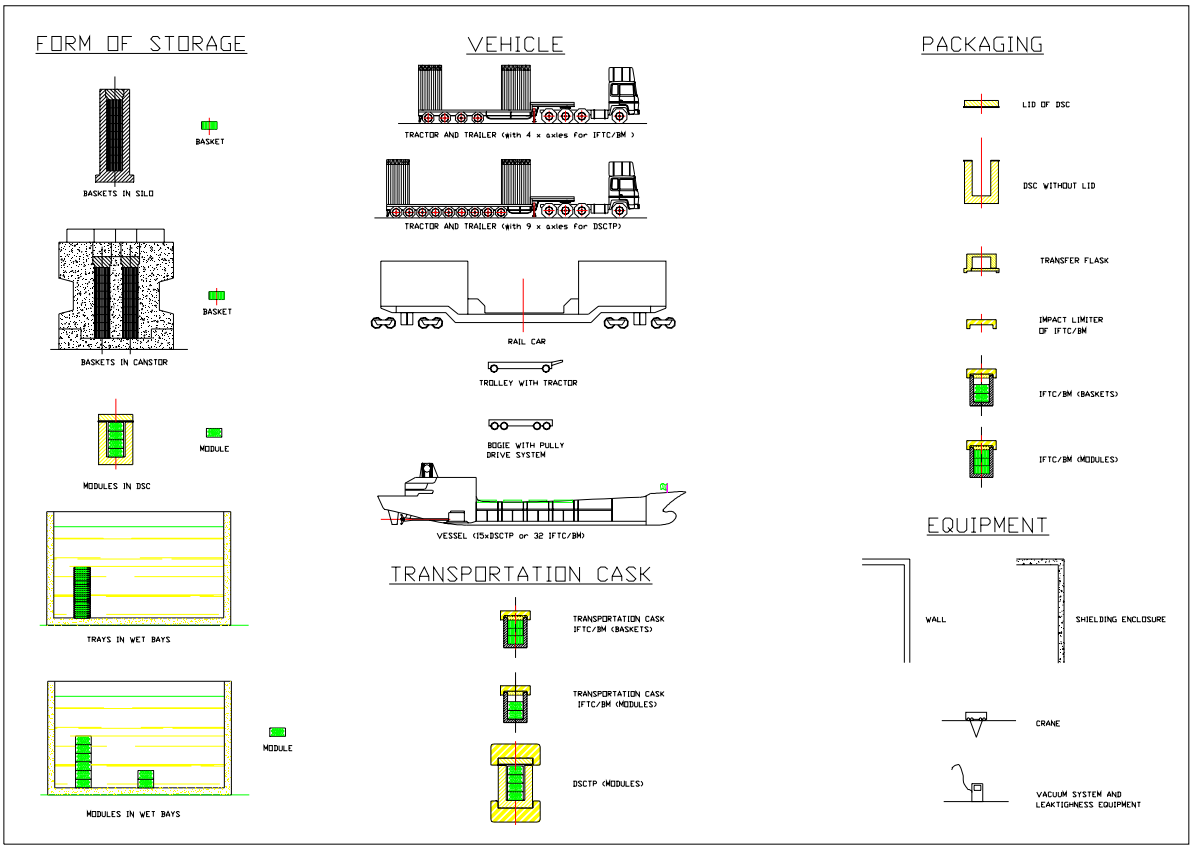
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.3.3
Phase 0	Baskets in Silo	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 2	Internal transfer of the transfer flask	Interim storage				2.0
Phase 3	Loading the baskets from the transfer flask into the packaging	UFTS	With a gantry crane , place the transfer flask on the hot cell	Transfer flask	Figure N°10: - Shielded fuel transfer cask - 26 tons with 60 bundles basket and with irradiated fuel - “Sliding” gate - Electric hoist for lifting or lowering a basket into the IFTC/BM - Chain - Basket lifting grapple - Shielding	3.0
				Gantry Crane	For the transfer flash	
				Lifting Beam for Transfer flask		
			With the hoist N°1, open the lid of the packaging in a hot cell.	Packaging	IFTC/BM : See chapter 2., section 2.4.7.1.3 of D#5 Appendix A, Figure N° 6	
			Load the baskets into the packaging			
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves,	4.0
			Filling the cavity with helium	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves, compressed air line	
			Leaktightness check	Leaktightness equipement		
			Depressurising the cavity	Vacuum circuit		
			Installing the impact limiter			
Phase 5	Internal transfer of the packaging	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Approach of the Bogie	Bogie	Bogie with pulley drive system	5.0
			Radiological control of the Bogie	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Loading of the full Transportation cask on the Bogie			5.0
			Radiological control of the Transportation cask and the Bogie	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Internal transfer	Tie down		5.1

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.3.3
Phase 6	Loading the Transportation cask on a vessel	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	6.0
			Loading the Transportation cask on the hold of the vessel	Gantry Crane (on the vessel)	With 1 hoist (of 60 tons for the IFTC/BM	6.0
				Lifting Beam for packaging	To carry of the IFTC/BM (similar to the IFTC, **<3>**)	6.0
				Vessel	Section 3.7.1 of Chapter 3 Appendix A, Figure N°18?	6.0
			Installing the impact limiter			6.1
			Packaging tie-down on the hold	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**)	6.1
			Check the condition of the Transportation cask , hold			6.1
			Fit the transport seals			6.1
			Close the upper deck			6.1
			Radiological control of the hold an the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	6.1
Phase 7	Water transportation	UFTS	Water transportation of the Transportation cask from the site to the water rail terminal		Protection equipment and materiel necessary to prevent radiation hazards : radiation protection kit	7.0
				Real time tracking	Appendix H	
Phase 8	Transfer of the Transportation cask from the vessel to a trailer	UFTS	Radiological control of the hold, the Transportation cask and the trailer		"Smear test", Radiameter	8.0
			Open the weather covers of the trailer	Weather covers		
			Loading the packaging from the vessel to the trailer	Gantry Crane (on the vessel)	With hoist (of 60 tons for the IFTC/BM)	
				Lifting Beam for Transporta-tion cask	To carry of the IFTC/BM (similar to the IFTC, **<3>**)	
				Real Time Tracking	Appendix H	
				Trailer (Appendix A, Figures N°13, 14)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic suspension to cushion the load - Trailer equipped with four axles - One loaded cask per trailer	
				Tractor (Appendix A, Figure N°14)	- Standard commercial tractor sufficient for the loaded weight - The weight for the fuelled reference tractor is roughly 9,075 kg.	
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the IFTC for the trailer (Appendix A, Figure N°15 , **<3>**)	
			Check the condition of the packaging, trailer			

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.3.3
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the hold , the trailer and of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	
Phase 9	Road transportation	UFTS	Road transportation of the Transportation cask from the water road terminal to the Centralised Facility			9.0
				Real time Tracking	Appendix H	
Phase 10	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			10.0
Phase 11	Internal transfer of the packaging	DGR/CES				


PHASE 0
BASKETS IN SILO
PHASE 1
UNLOADING OF THE BASKETS FROM SILO INTO THE TRANFER FLASK
PHASE 2
INTERNAL TRANSFER OF THE TRANSFER FLASK
Step.0
Step.1.0
Step.1.1
Step.1.2
Step.1.3
Step.2.0
PHASE 3
LOADING THE BASKETS FROM TRANSFER FLASK INTO THE PACKAGING
PHASE 4
PRE-SHIPMENT PACKAGING PREPARATION
HOIST N°1
Step.3.0
Step.3.1
Step.3.2
Step.4.0
PHASE 5
INTERNAL TRANSFER OF THE TRANSPORTATION CASK
PHASE 6
LOADING THE TRANSPORTATION CASK ON A VESSEL
STEP.5.0
STEP.6.0
PHASE 7
WATER TRANSPORTATION
PHASE 8
WATER / ROAD TRANSFER OF THE PACKAGING CASK
STEP.7.0
STEP.8.0
STEP.8.1
PHASE 9
ROAD TRANSPORTATION
PHASE 10
UNLOADING OF THE TRANSPORTATION CASK
PHASE 11
INTERNAL TRANSFER OF THE PACKAGING
STEP.9.0
STEP.10.0
STEP.11.0
500276-01a
DOUGLAS POINT-BASKETS IN SILO
MOSTLY WATER
Fig N°.33

Key:


FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (15xDSCTP or 32 IFTC/BM)
TRANSPORTATION CASK
TRANSPORTATION CASK IFTC/BM (BASKETS)
TRANSPORTATION CASK IFTC/BM (MODULES)
DSCTP (MODULES)
PACKAGING
LID OF DSC
DSC WITHOUT LID
TRANSFER FLASK
IMPACT LIMITER OF IFTC/BM
IFTC/BM (BASKETS)
IFTC/BM (MODULES)
EQUIPMENT
WALL
SHIELDING ENCLOSURE
CRANE
VACUUM SYSTEM AND LEAKTIGHNESS EQUIPMENT

4. PICKERING

4.1. Modules in DSC (See Appendix B, Table N°8)

From PUFDSF to the Centralised Facility
Quantity of bundles to be transported from 2035 to 2064: see appendix B, Table N° 3.

4.1.1. Mode and route development

Feasibility of transporting used fuel from the different current storage site to the centralised facility.
Viability of shipping by road and the identification of a preferred shipping route.

***Water*:** The direct proximity of the facility to Lake Ontario provides for feasible water transport [**<52>**, **<53>**, **<54>** and **<59>**]. A dock facility would need to be constructed and sounding of depths and associated dredging of the berth area would likely be necessary. While cranes could be added to the site, use of a geared vessel would eliminate such need.

***Recommendation*:** As outlined above under the general review for water transport, a potential transport solution would involve waterborne consolidation of used fuel from several current storage sites and transfer at a water transfer site located on Lake Ontario, Lake Huron or Lake Superior.

Under this scenario, it would be technically feasible to consolidate used fuel originating at Pickering aboard the vessel for waterborne transport to the water transfer site. In the event that a repository is sited in southern Ontario, this approach has the merit of avoiding road or rail transport through or near the Metropolitan Toronto area.

Alternatively, rail consolidation offers the most efficient means of removing used fuel from Pickering Accordingly, the recommended solution for Pickering fuel would involve either water/rail or rail transport.

The hypothesised routing would involve water transport from the facility, through Lake Ontario (this assumes that the transfer station is located on Lake Huron), Lake Erie and into Lake Huron. Under the northern Ontario repository option, the vessel would continue into Lake Superior.

4.1.2. Nuclear facility loading

Receive and prepare the used fuel and packages for loading, prepare packages for loading into transportation packages, pre-shipment tests, and prepare transportation package for transfer to a vessel.

See phases 1, 2 and 3 of paragraph 4.1.9 of the present document.

4.1.3. Transporter (vehicle)

4.1.3.1. Vessel (phases 4, 5 of table paragraph 4.1.9)

See section 3.7.1 of Chapter 3.

4.1.3.2. Specific equipment for the vessel transportation

- GPS antenna (tracking) on the vessel (Appendix H)

- Radiation protection kit:
  - Direct reading dosimeter,
  - Film dosimeters,
  - Gamma doses rate meter,
  - Neutron doses rate meter,
  - Counting rate meter,
  - Blank ”Measurements performed” forms,
  - Roll of filter papers for smear test,
  - Pairs of overshoes,
  - Vinyl gloves,
  - Disposable breathing mask,
  - Disposable camera with flash

4.1.3.3. Frame of the Transportation cask for the water transportation

Similar to the rail transportation but adapted to the regulation concerning the accelerations.

4.1.3.4. Trailer for the road transportation (phases 6, 7 of table paragraph 4.1.9)

- Modified 48 foot flatted trailer with integrated tie-down
- Trailer equipped with hydraulic suspension to cushion the load
- Trailer equipped with nine axles
- One loaded cask per trailer
- 2 drivers and an escort (see section 3.5.1 Chapter 3)

4.1.3.5. Tractor for the road transportation (phases 6, 7 of table paragraph 4.1.9)

- Standard commercial tractor sufficient for the loaded weight
- The weight for the fuelled reference tractor is roughly 11 t.

4.1.3.6. Weather cover for the road transportation (phases 6, 7 of table paragraph 4.1.9)

- Rolling removable plastic weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. Two men (one on each side of the trailer) can manually open or close the weather cover which can rolls on a rail fixed on the frame of the Transportation cask.

- Holes and a ventilation shaft on the top of the cover are calculated to create an adequate draught around the Transportation cask during the transport. The weather cover is composed with two parts: one with a fixed metallic panel at the rear side, one with a fixed metallic panel at the front side. The weather cover can be taken off from the trailer with a specific frame fixed at the rear side of the frame for the Transportation cask.

4.1.3.7. Frame of the Transportation cask for the road transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the axles This frame is fitted to the vehicle with twistlock devices plus a metal fitting designed for the appropriate accelerations. The numbers of attachments for the frame means it is still better to remove the cask from the frame, rather than taking than cask and the frame as unit during intermodal transfers.
The weather cover can rolls on a rail fixed on the frame of the Transportation cask. A drip pan is installed under the frame in order to collect the drain of water coming from the condensation of the Transportation cask. A manual valve with a padlock is installed at the lower level of the drip pan in order to collect the water.

4.1.3.8. Specific equipment for the road transportation

- GPS antenna (tracking) on the tractor
- Turning light ("Girophare") on the tractor
- Tools box adapted to the Transportation cask

4.1.4. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for DSCTP: shared facility at the centralised site as developed in paragraph 3.2 of Chapter 3.

- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

4.1.5. Casks

Conceptual design for the Transportation package and tie-down systems for UFTS:

- Tie-down: for DSCTP on trailer similar as described in **<8>**, Appendix A, Figure N° 17.

- Tie-down: for DSCTP on vessel as described in **<8>**, Appendix A, Figure N° 17 (to be adapted to the regulation concerning the accelerations).

- DSCTP: See Chapter 2, section 2.4.7.1.3 of D#5, Appendix A, Figure N° 8, Appendix C.

4.1.6. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Gantry Crane:
  One for the pre-shipment of the packaging (see phases 2, 3 of table paragraph 4.1.9)
  One for loading the Transportation cask on the vessel (see phase 4 of table paragraph 4.1.9).
  One for loading the Transportation cask from the vessel to the trailer (see phase 6 of table paragraph 4.1.9).

The two last gantry crane can be only one if the vessel has its own crane.

- Lifting beam:
  One for the packaging (see phase 2 of table paragraph 4.1.9)
  One for the impact limiter of the packaging (see phase 2 of table paragraph 4.1.9)
  One for the Transportation cask (see phases 4, 6 of table paragraph 4.1.9)

- Decontamination equipment (see paragraph 3.2 of Chapter 3).

4.1.7. UFTS Transportation system operation

Loading of Transportation cask onto the vessel, trailer, security, transportation, emergency response:

- Loading of Transportation cask onto the vessel, security, transportation as described in phase 4 of table paragraph 4.1.9.
- Loading of Transportation cask onto the trailer, security, transportation as described in phase 6 of table paragraph 4.1.9.
- Emergency response plan: see paragraph 9 of Appendix F.
- Real time tracking: see paragraph 9 of Appendix F.

4.1.8. Decommissioning

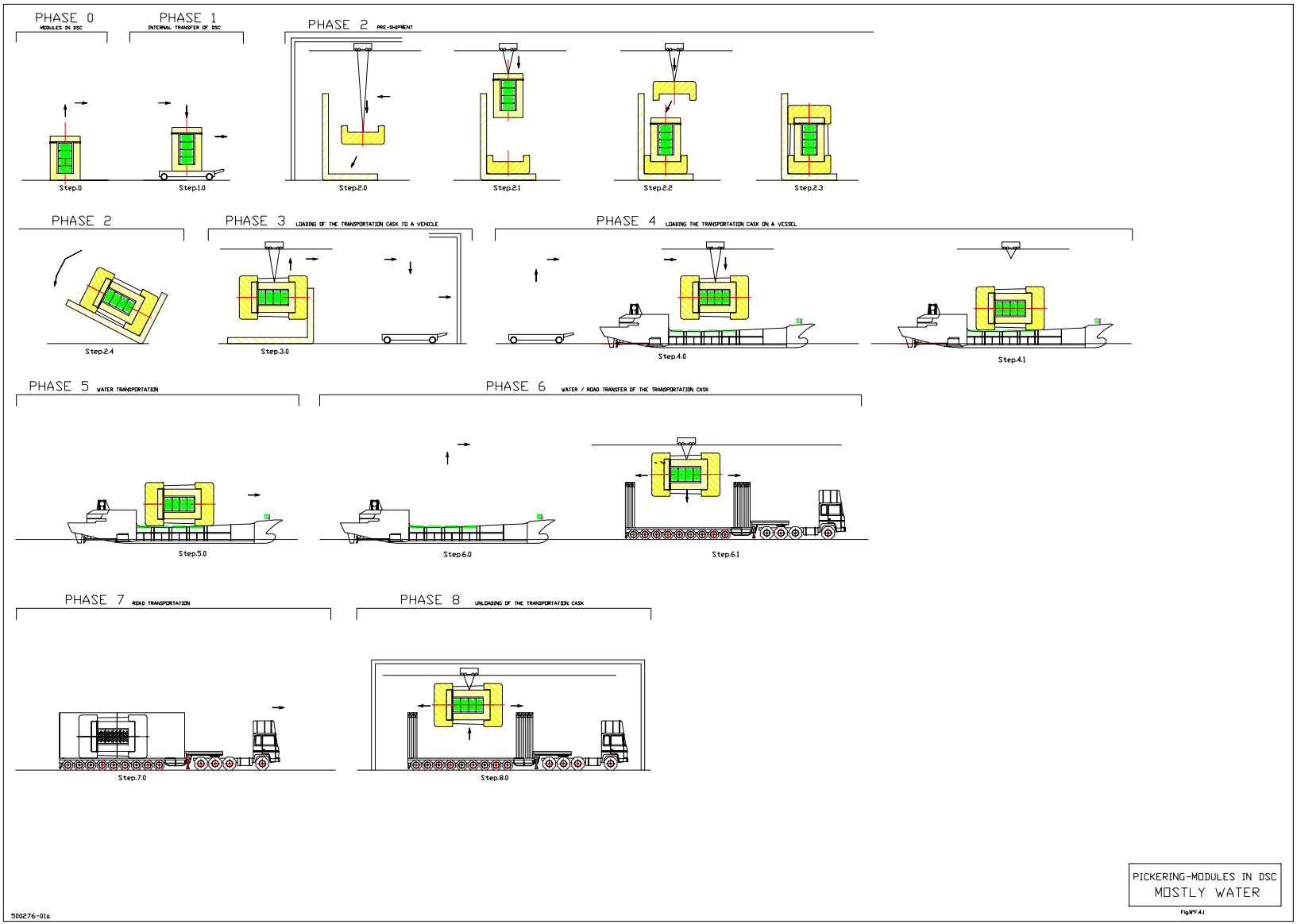
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

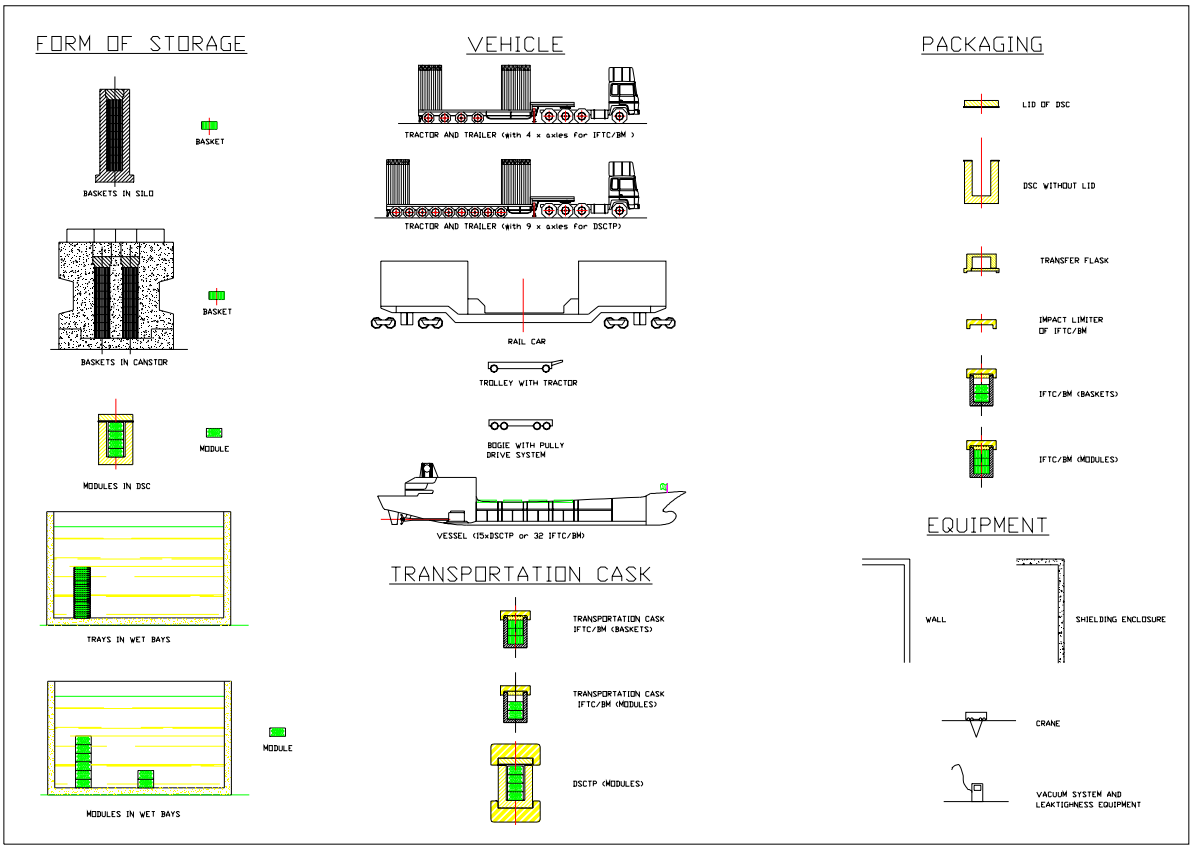
4.1.9. Table: Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.4.1
Phase 0	Modules in DSC	Interim storage	Initial phase			0
Phase 1	Internal transfer of the DSC	Interim storage			DSC, Appendix A, Figure N°7	1.0
Phase 2	Pre-shipment packaging preparation **<8>**	UFTS	Radiological control of the packaging	Non contamination, Dose Rate	"Smear test", Radiameter	2.0
				Transportation cask	DSCTP, Appendix A, Figure N° 8	
				Weather cover		
			Load impact limiter onto rotation frame	Gantry crane	With 1 hoist (of 120 tons for the DSCTP)	2.0
				Rotation frame		
				Lifting Beam impact limiter		
			Place DSC in bottom impact limiter	Lifting Beam for packaging		2.1
			Place Top impact limiter			2.2
			Attach wire rape assemblies			2.3
			Rotate frame	Rotation equipment to rotate the frame		2.4
Phase 3	Loading the Transportation cask on a vehicle and internal transfer	UFTS		Trolley	Trolley with tractor	3.0
Phase 4	Loading the Transportation cask on a vessel	UFTS	Radiological control of the hold and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	4.0
			Lift package in horizontal position	Gantry Crane (on the vessel)	With 1 hoist (of 120 tons for the DSCTP)	4.0
			Lower package onto the hold of the vessel and tie-downs	Vessel	Section 3.7.1 of Chapter 3 Appendix A, Figure N°18	4.0
			Package loaded onto the hold of the vessel and tie-downs secured			4.1
			Check the condition of the packaging, hold			4.1
			Close the upper deck			4. 1
			Fit the transport seals			4.1
			Radiological control of the hold and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	4.1
Phase 5	Water transportation	UFTS	Water transportation of the Transportation cask from the site to the water rail terminal		Protection equipment and materiel necessary to prevent radiation hazards : radiation protection kit	5.0
				Real Time Tacking	Appendix H	5.0

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.4.1
Phase 6	Transfer of the Transportation cask from the vessel to a trailer	UFTS	Radiological control of the hold, the Transportation cask and the trailer		"Smear test", Radiameter	6.0, 6.1
			Open the weather covers of the trailer	Weather covers		
			Loading the packaging from the vessel to the trailer	Gantry Crane (on the vessel)	With 1 hoist (of 120 tons for the DSCTP)	
				Lifting Beam for Transpor-tation cask	**<8>**	
				Trailer (Appendix A, Figure N°12,)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic suspension to cushion the load - Trailer equipped with nine axles - One loaded cask per trailer	
				Tractor (Appendix A, Figure N°14)	- Standard commercial tractor sufficient for the loaded weight - The weight for the fuelled reference tractor is roughly 11 t.	
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the DSCTP for the rail (Appendix A, Figure N°17 , **<8>**)	
			Check the condition of the packaging, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the hold , the trailer and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 7	Road transportation	UFTS	Road transportation of the Transportation cask from the water road terminal to the Centralised Facility			7.0
				Real time Tracking	Appendix H	
Phase 8	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			8.0
Phase 9	Internal transfer of the packaging	DGR/CES				


PHASE 0
MODULES IN DSC
PHASE 1
INTERNAL TRANSFER OF DSC
PHASE 2
PRE-SHIPMENT
Step.0
Step.1.0
Step.2.0
Step.2.1
Step.2.2
Step.2.3
PHASE 2
PHASE 3
LOADING OF THE TRANSPORTATION CASK TO A VEHICLE
PHASE 4
LOADING THE TRANSPORTATION CASK ON A VESSEL
Step.2.4
Step.3.0
Step.4.0
Step.4.1
PHASE 5
WATER TRANSPORTATION
PHASE 6
WATER / ROAD TRANSFER OF THE TRANSPORTATION CASK
Step.5.0
Step.6.0
Step.6.1
PHASE 7
ROAD TRANSPORTATION
PHASE 8
UNLOADING OF THE TRANSPORTATION CASK
Step.7.0
Step.8.0
PICKERING-MODULES IN DSC
MOSTLY WATER
500276-01a

Key:


FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (15xDSCTP or 32 IFTC/BM)
TRANSPORTATION CASK
TRANSPORTATION CASK IFTC/BM (BASKETS)
TRANSPORTATION CASK IFTC/BM (MODULES)
DSCTP (MODULES)
PACKAGING
LID OF DSC
DSC WITHOUT LID
TRANSFER FLASK
IMPACT LIMITER OF IFTC/BM
IFTC/BM (BASKETS)
IFTC/BM (MODULES)
EQUIPMENT
WALL
SHIELDING ENCLOSURE
CRANE
VACUUM SYSTEM AND LEAKTIGHNESS EQUIPMENT

4.2. Modules In wet bays (See Appendix B, Table N° 7)

From Pickering A to the Centralised Facility
Quantity of bundles *to be transported* from 2035 to 2064: see Appendix B, Table N° 3.

4.2.1. Mode and route development

Feasibility of transporting used fuel from the different current storage site to the centralised facility.
Viability of shipping by road and the identification of a preferred shipping route.

Water: The direct proximity of the facility to Lake Ontario provides for feasible water transport [**<52>**, **<53>**, **<54>** and **<59>**]. A dock facility would need to be constructed and sounding of depths and associated dredging of the berth area would likely be necessary. While cranes could be added to the site, use of a geared vessel would eliminate such need.

Recommendation*:* As outlined above under the general review for water transport, a potential transport solution would involve waterborne consolidation of used fuel from several current storage sites and transfer at a water transfer site located on Lake Ontario, Lake Huron or Lake Superior.

Under this scenario, it would be technically feasible to consolidate used fuel originating at Pickering aboard the vessel for waterborne transport to the water transfer site. In the event that a repository is sited in southern Ontario, this approach has the merit of avoiding road or rail transport through or near the Metropolitan Toronto area.

Alternatively, rail consolidation offers the most efficient means of removing used fuel from Pickering Accordingly, the recommended solution for Pickering fuel would involve either water/rail or rail transport.

The hypothesised routing would involve water transport from the facility, through Lake Ontario (this assumes that the transfer station is located on Lake Huron), Lake Erie and into Lake Huron. Under the northern Ontario repository option, the vessel would continue into Lake Superior.

4.2.2. Nuclear facility loading

Receive and prepare the used fuel and packages for loading, prepare packages for loading into transportation packages, pre-shipment tests, and prepare transportation package for transfer to a vessel.

See phases 2, 3 of paragraph 4.2.9 of the present document.

4.2.3. Transporter (vehicle)

4.2.3.1. Trolley with tractor

In order to transfer:

- The full packaging from loading area of the packaging to the transportation area of the transportation cask (phases 1 to 4 of table paragraph 4.2.9).

4.2.3.2. Trailer for the road transportation (phase 6 of table paragraph 3.2.9)

- Modified 48 foot flatted trailer with integrated tie-down
- Trailer equipped with hydraulic suspension to cushion the load
- Trailer equipped with four axles
- One loaded cask per trailer
  2 drivers and no escort

4.2.3.3. Tractor for the road transportation (phase 6 of table paragraph 3.2.9)

- Standard commercial tractor sufficient for the loaded weight
- The weight for the fuelled reference tractor is roughly 9,075 kg.

4.2.3.4. Weather cover for the road transportation (phase 6 of table paragraph 3.2.9)

- Rolling removable plastic weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. Two men (one on each side of the trailer) can manually open or close the weather cover which can rolls on a rail fixed on the frame of the Transportation cask.

- Holes and a ventilation shaft on the top of the cover are calculated to create an adequate draught around the Transportation cask during the transport. The weather cover is composed with two parts: one with a fixed metallic panel at the rear side, one with a fixed metallic panel at the front side. The weather cover can be taken off from the trailer with a specific frame fixed at the rear side of the frame for the Transportation cask.

4.2.3.5. Frame of the Transportation cask for the road transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the axles. This frame is fitted to the vehicle with twistlock devices plus a metal fitting designed for the appropriate accelerations. The numbers of attachments for the frame means it is still better to remove the cask from the frame, rather than taking than cask and the frame as unit during intermodal transfers.
The weather cover can rolls on a rail fixed on the frame of the Transportation cask. A drip pan is installed under the frame in order to collect the drain of water coming from the condensation of the Transportation cask. A manual valve with a padlock is installed at the lower level of the drip pan in order to collect the water.

4.2.3.6. Specific equipment for the road transportation

- GPS antenna (tracking) on the tractor
- Turning light (“Girophare”) on the tractor
- Tools box adapted to the Transportation cask

4.2.3.7. Vessel for the water transportation (phase 4 of table paragraph 8.1.9)

See section 3.7.1 of Chapter 3.

4.2.3.8. Frame of the Transportation cask for the water transportation

Similar to the rail transportation but adapted to the regulation concerning the accelerations.

4.2.3.9. Specific equipment for the water transportation

- GPS antenna (tracking) on the vessel

- Radiation protection kit:
  - Direct reading dosimeter,
  - Film dosimeters,
  - Gamma doses rate meter,
  - Neutron doses rate meter,
  - Counting rate meter,
  - Blank ”Measurements performed” forms,
  - Roll of filter papers for smear test,
  - Pairs of overshoes,
  - Vinyl gloves,
  - Disposable breathing mask,
  - Disposable camera with flash

4.2.4. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for IFTC/BM: shared facility at the centralised site as developed in paragraph 3.2 of Chapter 3.

- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

4.2.5. Casks

Conceptual design for the Transportation package and tie-down systems for UFTS:

- Tie-down: similar to the IFTC for road **<3** >, but adapted to the accelerations for rail and vessel.

- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 5 of Appendix A, Appendix C.

4.2.6. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Leakage and purging equipment:
  One complete equipment with vacuum pumps and gauges (see phase 2 of table paragraph 4.2.9)

- Gantry Crane:
  One for the pre-shipment of the packaging (see phase 2 of table paragraph 4.2.9)
  One for loading the Transportation cask on the vessel (see phase 4 of table paragraph 4.2.9).
  One for loading the Transportation cask on the trailer (see phase 6 of table paragraph 4.2.9).

The two last gantry cranes can be only one if the vessel has its own crane.

- Lifting beam:
  One for the packaging and Transportation cask (see phases 1 to 3 of table paragraph 4.2.9)
  One for the impact limiter of the packaging (see phase 3 of table paragraph 4.2.9)
  One for the Transportation cask (see phase 4 of table paragraph 4.2.9)

- Decontamination equipment (see paragraph 3.2 of Chapter 3).

4.2.7. UFTS Transportation system operation

Loading of packages onto the trailer, security, transportation, emergency response:

- Loading of Transportation cask onto the vessel, security, transportation as described in phase 4 of table paragraph 4.2.9.

- Loading of Transportation cask onto the trailer, security, transportation as described in phase 6 of table paragraph 4.2.9.

- Emergency response plan: see paragraph 9 of Appendix F.

- Real time tracking: see paragraph 9 of Appendix F.

4.2.8. Decommissioning

Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

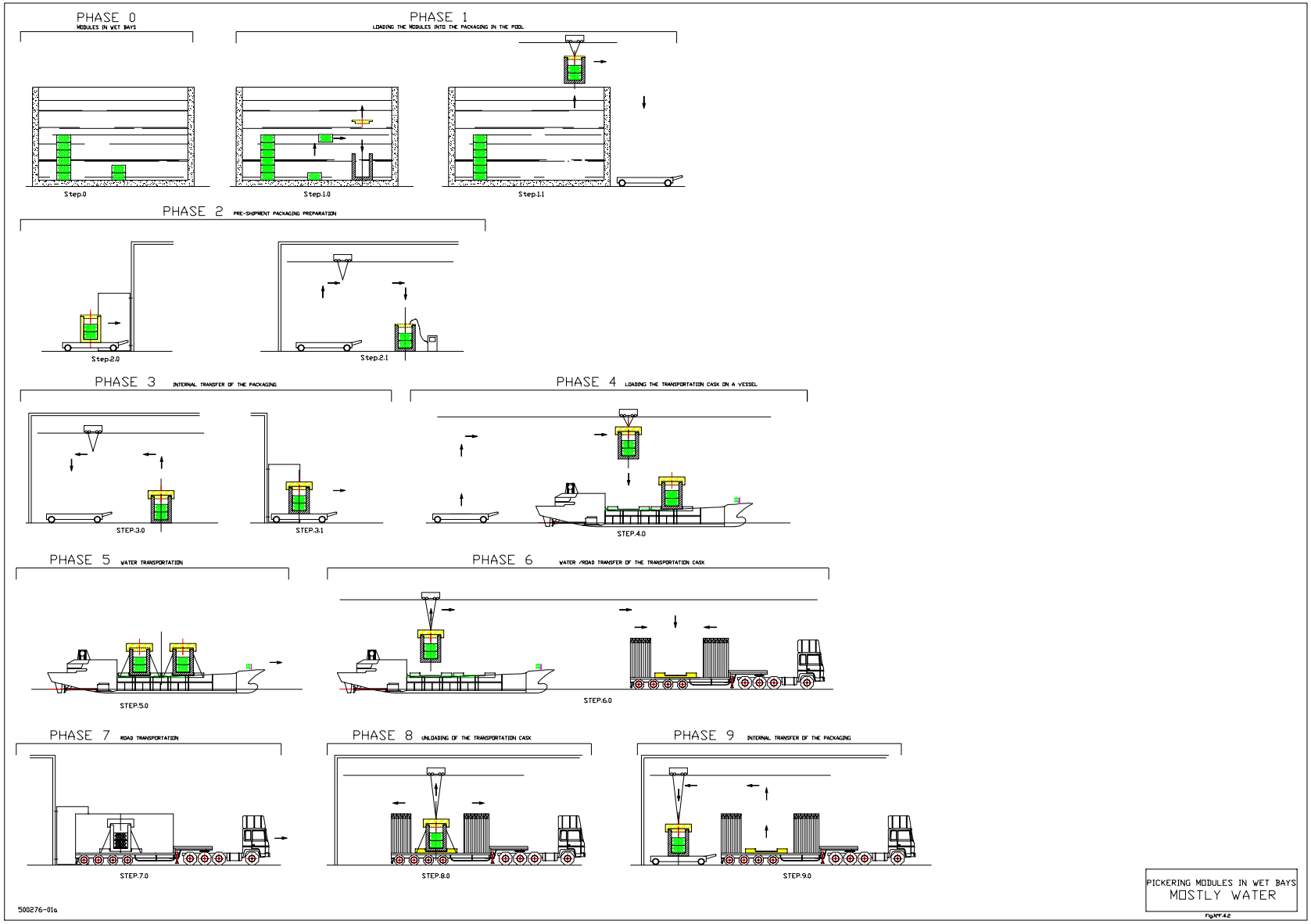
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

4.2.9. Table: Analysis of the operational phases of transport

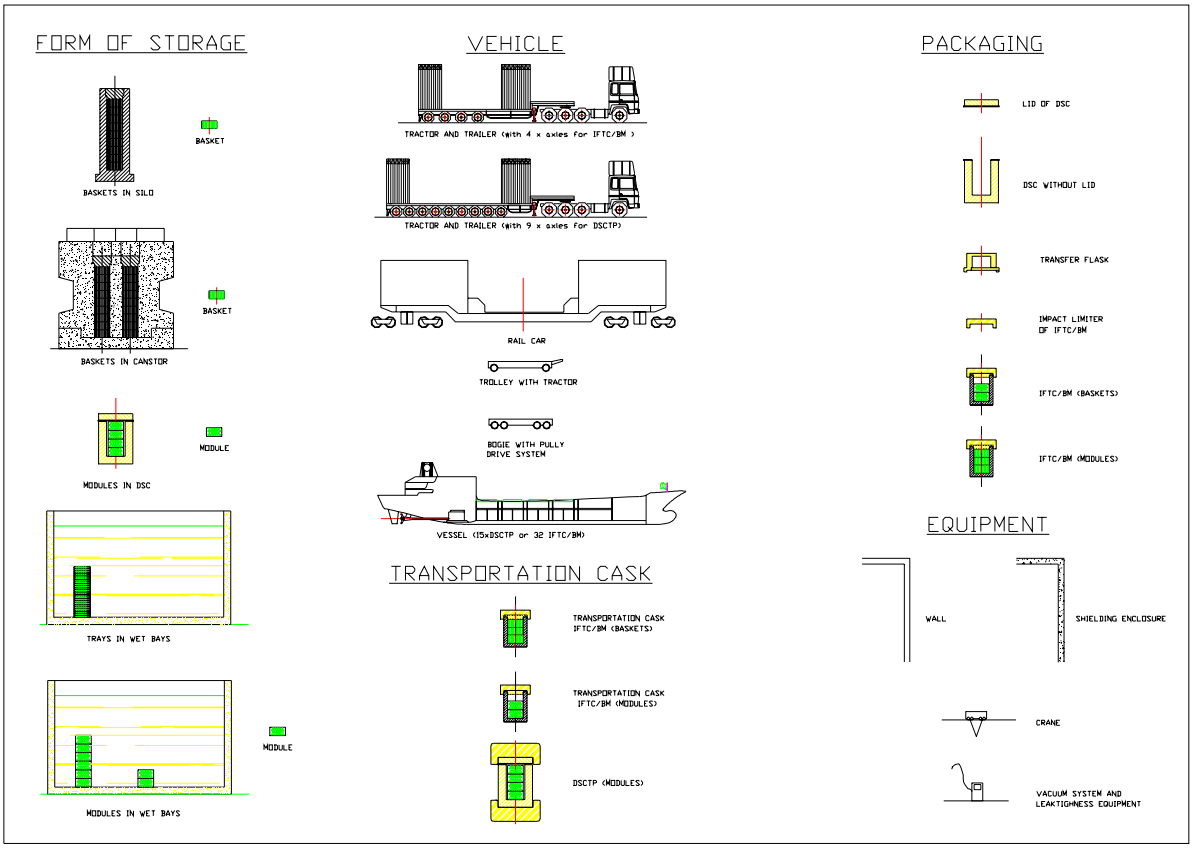
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.4.2
Phase 0	Modules in wet bays	Interim storage	Initial phase			0
Phase 1	Loading the modules into the packaging in the pool	Interim UFTS	Loading the modules into the packaging in the pool		Identical than the IFCT in the pool Decontamination of the IFTC/BM: identical as IFTC **<3>**	1.0, 1.1
				Packaging	IFTC/BM : See chapter 2., section 2.4.7.1.3 of D#5 Appendix A, Figure N° 5	
Phase 2	Pre-shipment packaging preparation	UFTS	Drainage			2.0, 2.1
			Drying the cavity	Vacuum circuit	Air/water separator, pump, vacuum gauges, valves,	
			Filling the cavity with helium	Vacuum circuit	Air/water separator, pump, vacuum gauges, valves, compressed air line	
			Leaktightness check	Leaktightness equipment		
			Depressurising the cavity	Vacuum circuit		
			Unloading of the packaging from the trolley	Gantry Crane	With 2 hoists (of 60 tons for the IFTC/BM and 10 tons for the impact limiter)	
Phase 3	Internal transfer of the packaging	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	3.0, 3.1
			Approach of the Trolley	Trolley	Trolley with tractor	
			Radiological control of the Trolley	Non contamination, Dose Rate	“Smear test”, Radiameter	
			Installing the impact limiter			
			Loading of the full Transportation cask on the Trolley			
			Radiological control of the Transportation cask and the Trolley	Non contamination, Dose Rate	“Smear test”, Radiameter	
			Internal transfer	Tie down		
Phase 4	Loading the Transportation cask on a vessel	UFTS	Radiological control of the Transportation cask and the hold	Non contamination, Dose Rate	“Smear test”, Radiameter	4.0, 4.1
			Loading the Transportation cask on the hold of the vessel	Gantry Crane (on the vessel)	With 1 hoist (of 60 tons for the IFTC/BM)	
				Lifting Beam for Transporta-tion cask	To carry of the IFTC/BM or IFTC(similar to the IFTC, **<3>**)	
				Vessel	Section 3.7.1 of Chapter 3 Appendix A, Figure N°18	
			Transportation cask tie-down on the hold	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**)	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.4.2
			Check the condition of the Transportation cask, hold			
			Fit the transport seals			
			Close the upper deck			
			Radiological control of the hold and the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 5	Water transportation	UFTS	Water transportation of the Transportation cask from the site to the water rail terminal		Protection equipment and materiel necessary to prevent radiation hazards : radiation protection kit	5.0
				Real time tracking	Appendix H	
Phase 6	Transfer of the Transportation cask from the vessel to a trailer	UFTS	Radiological control of the hold, the Transportation cask and the trailer		"Smear test", Radiameter	6.0, 6.1
			Open the weather covers of the trailer	Weather covers		
			Loading the packaging from the vessel to the trailer	Gantry Crane (on the vessel)	With hoist (of 60 tons for the IFTC/BM)	
				Lifting Beam for Transportation cask	To carry of the IFTC/BM or IFTC (similar to the IFTC, **<3>**)	
				Real Time Tracking	Appendix H	
				Trailer (Appendix A, Figures N°13, 14)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic suspension to cushion the load - Trailer equipped with four axles - One loaded cask per trailer	
				Tractor (Appendix A, Figure N°14)	- Standard commercial tractor sufficient for the loaded weight - The weight for the fuelled reference tractor is roughly 9,075 kg.	
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the IFTC for the trailer (Appendix A, Figure N°15 , **<3>**)	
			Check the condition of the packaging, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the hold , the trailer and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.4.2
Phase 7	Road transportation	UFTS	Road transportation of the Transportation cask from the water road terminal to the Centralised Facility			7.0
				Real time Tracking	Appendix H	
Phase 8	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			8.0
Phase 9	Internal transfer of the packaging	DGR/CES				


PHASE 0
MODULES IN WET BAYS
Step.0
PHASE 1
LOADING THE MODULES INTO THE PACKAGING IN THE POOL
Step.1.0
Step.1.1
PHASE 2
PRE-SHIPMENT PACKAGING PREPARATION
Step.2.0
Step.2.1
PHASE 3
INTERNAL TRANSFER OF THE PACKAGING
STEP.3.0
STEP.3.1
PHASE 4
LOADING THE TRANSPORTATION CASK ON A VESSEL
STEP.4.0
PHASE 5
WATER TRANSPORTATION
STEP.5.0
PHASE 6
WATER /ROAD TRANSFER OF THE TRANSPORTATION CASK
STEP.6.0
PHASE 7
ROAD TRANSPORTATION
STEP.7.0
PHASE 8
UNLOADING OF THE TRANSPORTATION CASK
STEP.8.0
PHASE 9
INTERNAL TRANSFER OF THE PACKAGING
STEP.9.0
500276-01a
PICKERING MODULES IN WET BAYS
MOSTLY WATER
FigNF.4.2

Key:


FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (15xDSCTP or 32 IFTC/BM)
TRANSPORTATION CASK
TRANSPORTATION CASK IFTC/BM (BASKETS)
TRANSPORTATION CASK IFTC/BM (MODULES)
DSCTP (MODULES)
PACKAGING
LID OF DSC
DSC WITHOUT LID
TRANSFER FLASK
IMPACT LIMITER OF IFTC/BM
IFTC/BM (BASKETS)
IFTC/BM (MODULES)
EQUIPMENT
WALL
SHIELDING ENCLOSURE
CRANE
VACUUM SYSTEM AND LEAKTIGHNESS EQUIPMENT

5. DARLINGTON

5.1. Modules in DSC (See Appendix B, Table N° 8)

From DUFDSF to the Centralised Facility
Quantity of bundles to be transported from 2035 to 2064: see appendix B, Table N° 3.

5.1.1. Mode and route development

Feasibility of transporting used fuel from the different current storage site to the centralised facility.
Viability of shipping by road and the identification of a preferred shipping route.

Water: The direct proximity of the facility to Lake Ontario provides for feasible water transport [**<52>**, **<53>**, **<54>** and **<59>**]. The site previously included a dock area, however this facility has not been used in more than fifteen years. While access still appears viable, the dock would require the following types of improvements in order to assure serviceability:

- Sounding of depth and likely dredging;
- Surveying of the dock itself to ensure structural soundness with a possible need for upgrading of said facility.

As with consideration of rail transport from Darlington, the dock facility does not currently possess heavy lift capability, nor does the site currently possess mobile cranes. Accordingly, lift capability would need to be added unless the vessel itself is sufficiently geared (as recommended above).

Recommendation: The Darlington site enjoys the benefits of being able to transport by all three modes: road, rail and water. Of the three options, road transport would be the least economical and of the longest duration given the volumes of used fuel present at the site. By contrast, consolidation of shipments is a more viable approach for rail or water transport.

As outlined above under the general review for water transport, a potential transport solution would involve waterborne consolidation of used fuel from several current storage sites and transfer at a water transfer site located on Lake Ontario, Lake Huron or Lake Superior.

Under this scenario, it would be technically feasible to consolidate used fuel originating at Darlington aboard the vessel for waterborne transport to the water transfer site. In the event that a repository is sited in southern Ontario, this approach has the merit of avoiding road or rail transport through or near the Metropolitan Toronto area.

Alternatively, rail consolidation offers the most efficient means of removing used fuel from Darlington. Accordingly, the recommended solution for Bruce fuel would involve either water/rail or rail transport.

The hypothesised water routing would involve water transport from the facility, through Lake Ontario (this assumes that the transfer facility is located on Lake Huron), Lake Erie and into Lake Huron. Under the northern Ontario repository option, the vessel would continue into Lake Superior.

The hypothesised rail routing would involve transport on a feeder line from the site to the main line.

5.1.2. Nuclear facility loading

Receive and prepare the used fuel and packages for loading, prepare packages for loading into transportation packages, pre-shipment tests, and prepare transportation package for transfer to a vessel.

See phases 1, 2 and 3 of paragraph 5.1.9 of the present document.

5.1.3. Transporter (vehicle)

5.1.3.1. Vessel (phases 4, 5 of table paragraph 5.1.9)

See section 3.7.1 of Chapter 3.

5.1.3.2. Specific equipment for the vessel transportation

- GPS antenna (tracking) on the vessel (Appendix H)

- Radiation protection kit:
  - Direct reading dosimeter,
  - Film dosimeters,
  - Gamma doses rate meter,
  - Neutron doses rate meter,
  - Counting rate meter,
  - Blank" Measurements performed" forms,
  - Roll of filter papers for smear test,
  - Pairs of overshoes,
  - Vinyl gloves,
  - Disposable breathing mask,
  - Disposable camera with flash

5.1.3.3. Frame of the Transportation cask for the water transportation

Similar to the rail transportation but adapted to the regulation concerning the accelerations.

5.1.3.4. 5.1.3.4 Trailer for the road transportation (phases 6, 7 of table paragraph 5.1.9)

- Modified 48 foot flatted trailer with integrated tie-down
- Trailer equipped with hydraulic suspension to cushion the load
- Trailer equipped with nine axles
- One loaded cask per trailer
- 2 drivers and an escort (see section 3.5.1 Chapter 3)

5.1.3.5. Tractor for the road transportation (phases 6, 7 of table paragraph 5.1.9)

- Standard commercial tractor sufficient for the loaded weight
- The weight for the fuelled reference tractor is roughly 11 t.

5.1.3.6. Weather cover for the road transportation (phases 6, 7 of table paragraph 5.1.9)

- Rolling removable plastic weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. Two men (one on each side of the trailer) can manually open or close the weather cover which can rolls on a rail fixed on the frame of the Transportation cask.

- Holes and a ventilation shaft on the top of the cover are calculated to create an adequate draught around the Transportation cask during the transport. The weather cover is composed with two parts: one with a fixed metallic panel at the rear side, one with a fixed metallic panel at the front side. The weather cover can be taken off from the trailer with a specific frame fixed at the rear side of the frame for the Transportation cask.

5.1.3.7. Frame of the Transportation cask for the road transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the axles This frame is fitted to the vehicle with twistlock devices plus a metal fitting designed for the appropriate accelerations. The numbers of attachments for the frame means it is still better to remove the cask from the frame, rather than taking than cask and the frame as unit during intermodal transfers.
The weather cover can rolls on a rail fixed on the frame of the Transportation cask. A drip pan is installed under the frame in order to collect the drain of water coming from the condensation of the Transportation cask. A manual valve with a padlock is installed at the lower level of the drip pan in order to collect the water.

5.1.3.8. Specific equipment for the road transportation

- GPS antenna (tracking) on the tractor
- Turning light (“Girophare”) on the tractor
- Tools box adapted to the Transportation cask

5.1.4. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for DSCTP: shared facility at the centralised site as developed in paragraph 3.2 of Chapter 3.

- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

5.1.5. Casks

Conceptual design for the Transportation package and tie-down systems for UFTS:

- Tie-down: for DSCTP on trailer similar as described in **<8>**, Appendix A, Figure N° 17.

- Tie-down: for DSCTP on vessel as described in **<8>**, Appendix A, Figure N° 17 (to be adapted to the regulation concerning the accelerations).

- DSCTP: See Chapter 2, section 2.4.7.1.3 of D#5, Appendix A, Figure N° 8, Appendix C.

5.1.6. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Gantry Crane:
  One for the pre-shipment of the packaging (see phases 2, 3 of table paragraph 5.1.9)
  One for loading the Transportation cask on the vessel (see phase 4 of table paragraph 5.1.9).
  One for loading the Transportation cask from the vessel to the trailer (see phase 6 of table paragraph 5.1.9).

The two last gantry cranes can be only one if the vessel has its own crane.

- Lifting beam:
  One for the packaging (see phase 2 of table paragraph 5.1.9)
  One for the impact limiter of the packaging (see phase 2 of table paragraph 5.1.9)
  One for the Transportation cask (see phases 4, 6 of table paragraph 5.1.9)

- Decontamination equipment (see paragraph 3.2 of Chapter 3).

5.1.7. UFTS Transportation system operation

Loading of Transportation cask onto the vessel, trailer, security, transportation, emergency response:

- Loading of Transportation cask onto the vessel, security, transportation as described in phase 4 of table paragraph 5.1.9.

- Loading of Transportation cask onto the trailer, security, transportation as described in phase 6 of table paragraph 5.1.9.

- Emergency response plan: see paragraph 9 of Appendix F.

- Real time tracking: see paragraph 9 of Appendix F.

5.1.8. Decommissioning

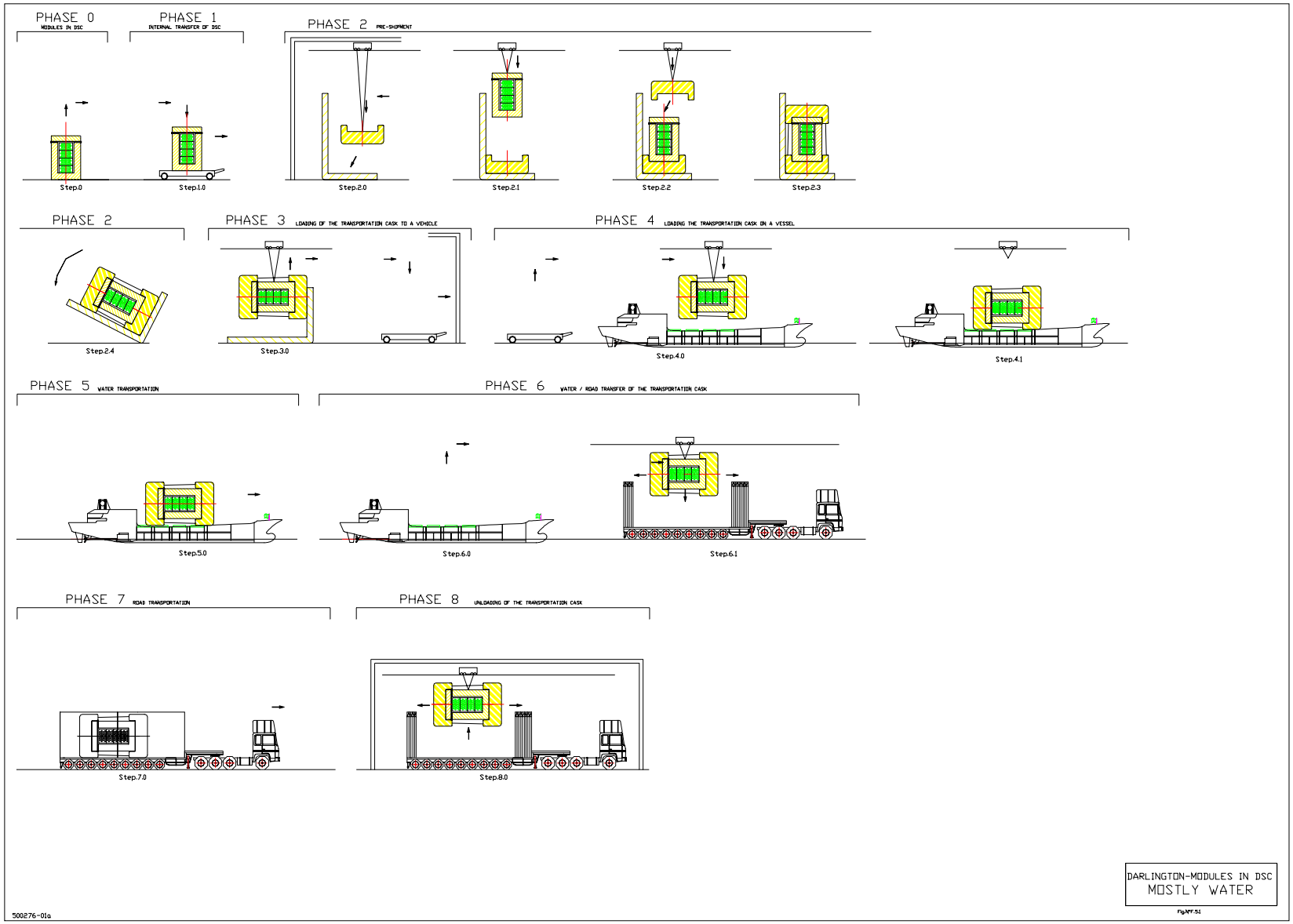
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

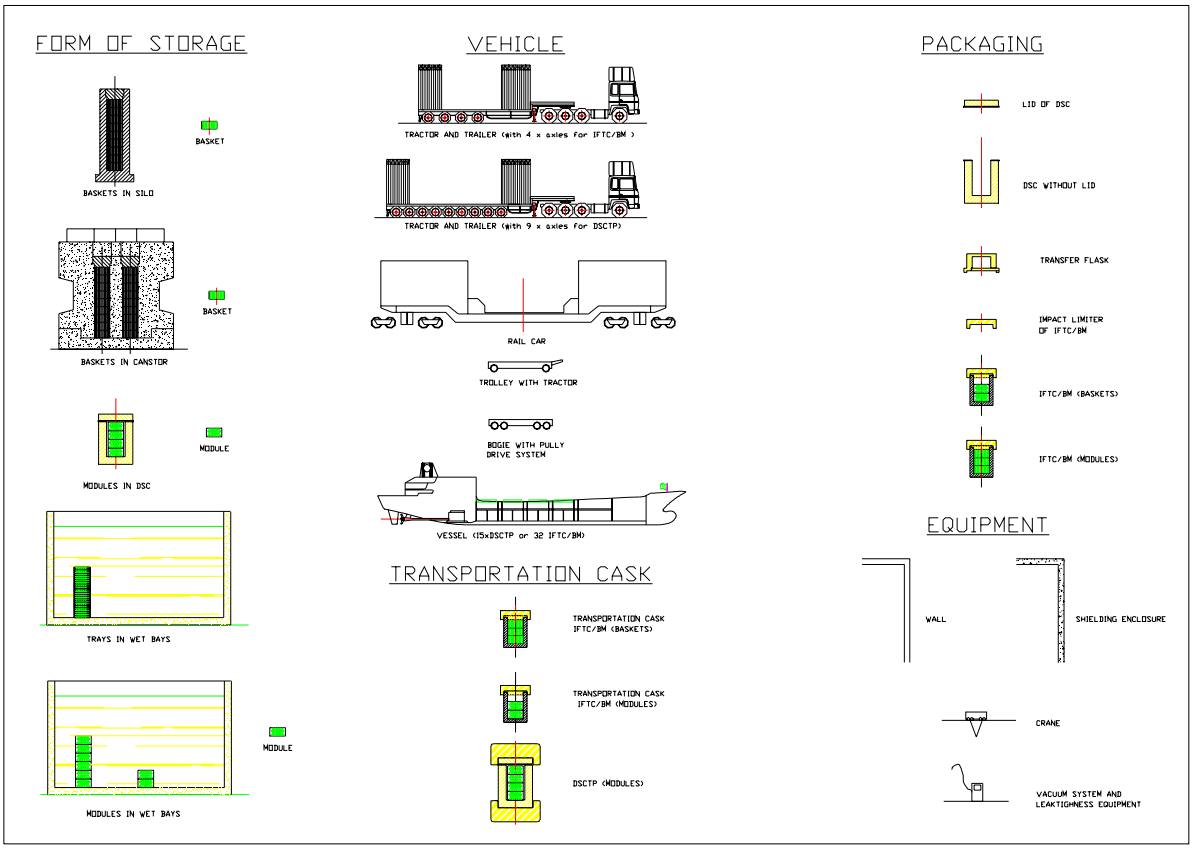
5.1.9. Table: Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° F.5.1
Phase 0	Modules in DSC	Interim storage	Initial phase			0
Phase 1	Internal transfer of the DSC	Interim storage			DSC, Appendix A, Figure N°7	1.0
Phase 2	Pre-shipment packaging preparation **<8>**	UFTS	Radiological control of the packaging	Non contamination, Dose Rate	"Smear test", Radiameter	2.0
				Transportation cask	DSCTP, Appendix A, Figure N° 8	
				Weather cover		
			Load impact limiter onto rotation frame	Gantry crane	With 1 hoist (of 120 tons for the DSCTP)	2.0
				Rotation frame		
				Lifting Beam impact limiter		
			Place DSC in bottom impact limiter	Lifting Beam for packaging		2.1
			Place Top impact limiter			2.2
			Attach wire rape assemblies			2.3
			Rotate frame	Rotation equipment to rotate the frame		2.4
Phase 3	Loading the Transportation cask on a vehicle and internal transfer	UFTS		Trolley	Trolley with tractor	3.0
Phase 4	Loading the Transportation cask on a vessel	UFTS	Radiological control of the hold and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	4.0
			Lift package in horizontal position	Gantry Crane (on the vessel)	With 1 hoist (of 120 tons for the DSCTP)	4.0
			Lower package onto the hold of the vessel and tie-downs	Vessel	Section 3.7.1 of Chapter 3 Appendix A, Figure N°18	4.0
			Package loaded onto the hold of the vessel and tie-downs secured			4.1
			Check the condition of the packaging, hold			4.1
			Close the upper deck			4. 1
			Fit the transport seals			4.1
			Radiological control of the hold and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	4.1

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° F.5.1
Phase 5	Water transportation	UFTS	Water transportation of the Transportation cask from the site to the water rail terminal		Protection equipment and materiel necessary to prevent radiation hazards : radiation protection kit	5.0
				Real Time Tacking	Appendix H	5.0
Phase 6	Transfer of the Transportation cask from the vessel to a trailer	UFTS	Radiological control of the hold, the Transportation cask and the trailer		"Smear test", Radiameter	6.0, 6.1
			Open the weather covers of the trailer	Weather covers		
			Loading the packaging from the vessel to the trailer	Gantry Crane (on the vessel)	With 1 hoist (of 120 tons for the DSCTP)	
				Lifting Beam for Transportation cask	**<8>**	
				Trailer (Appendix A, Figure N°12,)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic suspension to cushion the load - Trailer equipped with nine axles - One loaded cask per trailer	
				Tractor (Appendix A, Figure N°14)	- Standard commercial tractor sufficient for the loaded weight - The weight for the fuelled reference tractor is roughly 11 t.	
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the DSCTP for the rail (Appendix A, Figure N°17 , **<8>**)	
			Check the condition of the packaging, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the hold , the trailer and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 7	Road transportation	UFTS	Road transportation of the Transportation cask from the water road terminal to the Centralised Facility			7.0
				Real time Tracking	Appendix H	
Phase 8	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			8.0
Phase 9	Internal transfer of the packaging	DGR/CES				


PHASE 0
MODULES IN DSC
PHASE 1
INTERNAL TRANSFER OF DSC
PHASE 2
PRE-SHIPMENT
Step.0
Step.1.0
Step.2.0
Step.2.1
Step.2.2
Step.2.3
PHASE 2
PHASE 3
LOADING OF THE TRANSPORTATION CASK TO A VEHICLE
PHASE 4
LOADING THE TRANSPORTATION CASK ON A VESSEL
Step.2.4
Step.3.0
Step.4.0
Step.4.1
PHASE 5
WATER TRANSPORTATION
PHASE 6
WATER / ROAD TRANSFER OF THE TRANSPORTATION CASK
Step.5.0
Step.6.0
Step.6.1
PHASE 7
ROAD TRANSPORTATION
PHASE 8
UNLOADING OF THE TRANSPORTATION CASK
Step.7.0
Step.8.0
500276-01a
DARLINGTON-MODULES IN DSC
MOSTLY WATER

Key:


FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (15xDSCTP or 32 IFTC/BM)
TRANSPORTATION CASK
TRANSPORTATION CASK IFTC/BM (BASKETS)
TRANSPORTATION CASK IFTC/BM (MODULES)
DSCTP (MODULES)
PACKAGING
LID OF DSC
DSC WITHOUT LID
TRANSFER FLASK
IMPACT LIMITER OF IFTC/BM
IFTC/BM (BASKETS)
IFTC/BM (MODULES)
EQUIPMENT
WALL
SHIELDING ENCLOSURE
CRANE
VACUUM SYSTEM AND LEAKTIGHNESS EQUIPMENT

5.2. Modules In wet bays (See Appendix B, Table N° 7)

From Darlington to the Centralised Facility
Quantity of bundles *to be transported* from 2035 to 2064: see Appendix B, Table N° 3.

5.2.1. Mode and route development

Feasibility of transporting used fuel from the different current storage site to the centralised facility.
Viability of shipping by road and the identification of a preferred shipping route.

Water: The direct proximity of the facility to Lake Ontario provides for feasible water transport [**<52>**, **<53>**, **<54>** and **<59>**]. The site previously included a dock area, however this facility has not been used in more than fifteen years. While access still appears viable, the dock would require the following types of improvements in order to assure serviceability:

- Sounding of depth and likely dredging;
- Surveying of the dock itself to ensure structural soundness with a possible need for upgrading of said facility.

As with consideration of rail transport from Darlington, the dock facility does not currently possess heavy lift capability, nor does the site currently possess mobile cranes. Accordingly, lift capability would need to be added unless the vessel itself is sufficiently geared (as recommended above).

Recommendation: The Darlington site enjoys the benefits of being able to transport by all three modes: road, rail and water. Of the three options, road transport would be the least economical and of the longest duration given the volumes of used fuel present at the site. By contrast, consolidation of shipments is a more viable approach for rail or water transport.

As outlined above under the general review for water transport, a potential transport solution would involve waterborne consolidation of used fuel from several current storage sites and transfer at a water transfer site located on Lake Ontario, Lake Huron or Lake Superior.
Under this scenario, it would be technically feasible to consolidate used fuel originating at Darlington aboard the vessel for waterborne transport to the water transfer site. In the event that a repository is sited in southern Ontario, this approach has the merit of avoiding road or rail transport through or near the Metropolitan Toronto area.

Alternatively, rail consolidation offers the most efficient means of removing used fuel from Darlington Accordingly, the recommended solution for Bruce fuel would involve either water/rail or rail transport.

The hypothesised water routing would involve water transport from the facility, through Lake Ontario (this assumes that the transfer facility is located on Lake Huron), Lake Erie and into Lake Huron. Under the northern Ontario repository option, the vessel would continue into Lake Superior.

The hypothesised rail routing would involve transport on a feeder line from the site to the main line.

5.2.2. Nuclear facility loading

Receive and prepare the used fuel and packages for loading, prepare packages for loading into transportation packages, pre-shipment tests, and prepare transportation package for transfer to a vessel.

See phases 2, 3 of paragraph 5.2.9 of the present document.

5.2.3. Transporter (vehicle)

5.2.3.1. Trolley with tractor

In order to transfer:

- The full packaging from loading area of the packaging to the transportation area of the transportation cask (phases 1 to 4 of table paragraph 5.2.9).

5.2.3.2. Trailer for the road transportation (phase 6 of table paragraph 3.2.9)

- Modified 48 foot flatted trailer with integrated tie-down
- Trailer equipped with hydraulic suspension to cushion the load
- Trailer equipped with four axles
- One loaded cask per trailer
  2 drivers and no escort

5.2.3.3. Tractor for the road transportation (phase 6 of table paragraph 3.2.9)

- Standard commercial tractor sufficient for the loaded weight
- The weight for the fuelled reference tractor is roughly 9,075 kg.

5.2.3.4. Weather cover for the road transportation (phase 6 of table paragraph 3.2.9)

- Rolling removable plastic weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. Two men (one on each side of the trailer) can manually open or close the weather cover which can rolls on a rail fixed on the frame of the Transportation cask.

- Holes and a ventilation shaft on the top of the cover are calculated to create an adequate draught around the Transportation cask during the transport. The weather cover is composed with two parts: one with a fixed metallic panel at the rear side, one with a fixed metallic panel at the front side. The weather cover can be taken off from the trailer with a specific frame fixed at the rear side of the frame for the Transportation cask.

5.2.3.5. Frame of the Transportation cask for the road transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the axles. This frame is fitted to the vehicle with twistlock devices plus a metal fitting designed for the appropriate accelerations. The numbers of attachments for the frame means it is still better to remove the cask from the frame, rather than taking than cask and the frame as unit during intermodal transfers.
The weather cover can rolls on a rail fixed on the frame of the Transportation cask. A drip pan is installed under the frame in order to collect the drain of water coming from the condensation of the Transportation cask. A manual valve with a padlock is installed at the lower level of the drip pan in order to collect the water.

5.2.3.6. Specific equipment for the road transportation

- GPS antenna (tracking) on the tractor
- Turning light (“Girophare”) on the tractor
- Tools box adapted to the Transportation cask

5.2.3.7. Vessel for the water transportation (phase 4 of table paragraph 8.1.9)

See section 3.7.1 of Chapter 3.

5.2.3.8. Frame of the Transportation cask for the water transportation

Similar to the rail transportation but adapted to the regulation concerning the accelerations.

5.2.3.9. Specific equipment for the water transportation

- GPS antenna (tracking) on the vessel

- Radiation protection kit:
  - Direct reading dosimeter,
  - Film dosimeters,
  - Gamma doses rate meter,
  - Neutron doses rate meter,
  - Counting rate meter,
  - Blank ”Measurements performed” forms,
  - Roll of filter papers for smear test,
  - Pairs of overshoes,
  - Vinyl gloves,
  - Disposable breathing mask,
  - Disposable camera with flash

5.2.4. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for IFTC/BM: shared facility at the centralised site as developed in paragraph 3.2 of Chapter 3.

- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

5.2.5. Casks

Conceptual design for the Transportation package and tie-down systems for UFTS:

- Tie-down: similar to the IFTC for road <**3**>, but adapted to the accelerations for rail and vessel.

- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 5 of Appendix A, Appendix C.

5.2.6. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Leakage and purging equipment:
  One complete equipment with vacuum pumps and gauges (see phase 2 of table paragraph 5.2.9)

- Gantry Crane:
  One for the pre-shipment of the packaging (see phase 2 of table paragraph 5.2.9)
  One for loading the Transportation cask on the vessel (see phase 4 of table paragraph 5.2.9).
  One for loading the Transportation cask on the trailer (see phase 6 of table paragraph 5.2.9).

The two last gantry cranes can be only one if the vessel has its own crane.

- Lifting beam:
  One for the packaging and Transportation cask (see phases 1 to 3 of table paragraph 5.2.9)
  One for the impact limiter of the packaging (see phase 3 of table paragraph 5.2.9)
  One for the Transportation cask (see phase 4 of table paragraph 5.2.9)

- Decontamination equipment (see paragraph 3.2 of Chapter 3).

5.2.7. UFTS Transportation system operation

Loading of packages onto the trailer, security, transportation, emergency response:

- Loading of Transportation cask onto the vessel, security, transportation as described in phase 4 of table paragraph 5.2.9.

- Loading of Transportation cask onto the trailer, security, transportation as described in phase 6 of table paragraph 5.2.9.

- Emergency response plan: see paragraph 9 of Appendix F.

- Real time tracking: see paragraph 9 of Appendix F.

5.2.8. Decommissioning

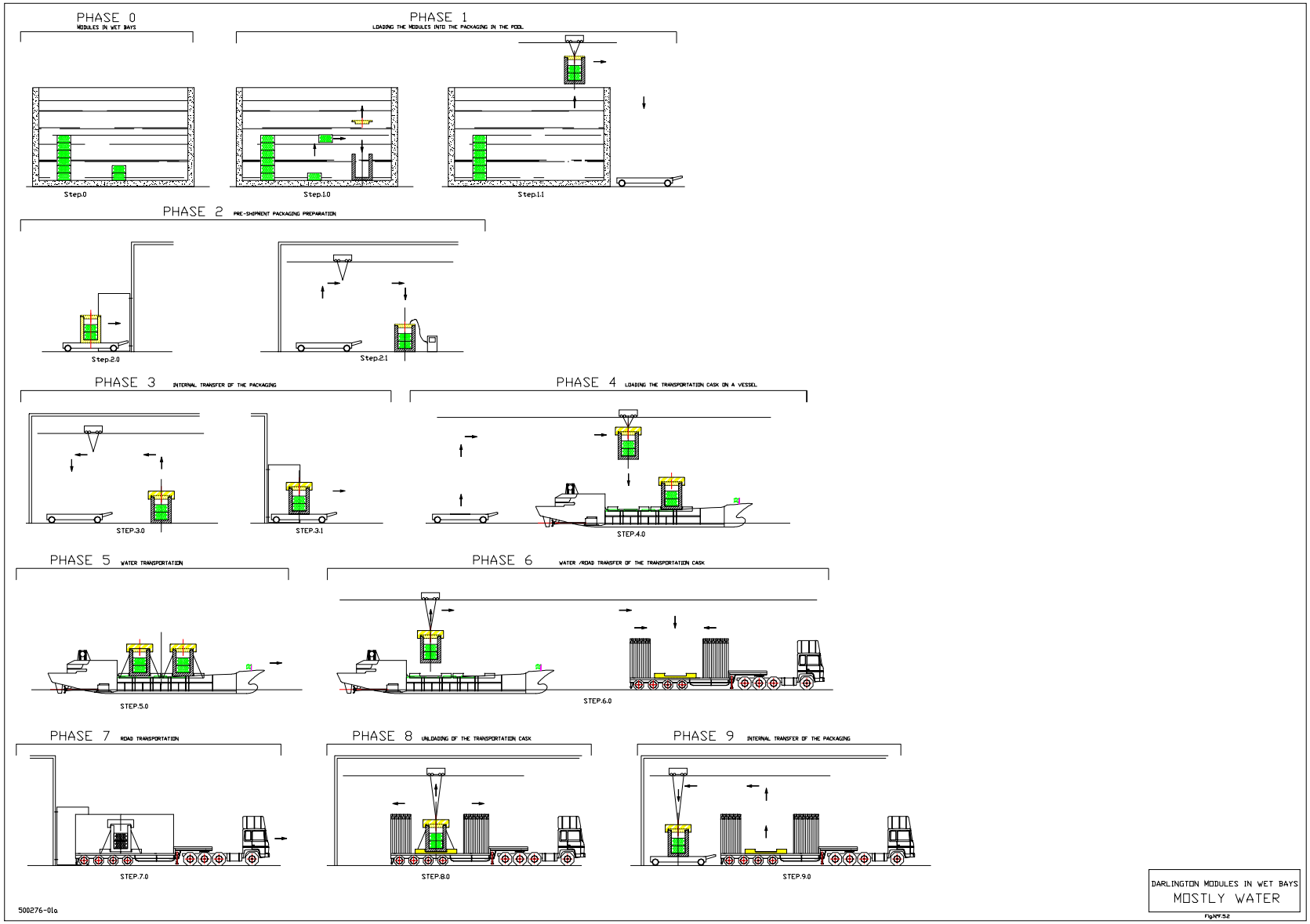
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

5.2.9. Table: Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° F.5.2
Phase 0	Modules in wet bays	Interim storage	Initial phase			0
Phase 1	Loading the modules into the packaging in the pool	Interim UFTS	Loading the modules into the packaging in the pool		Identical than the IFCT in the pool Decontamination of the IFTC/BM: identical as IFTC **<3>**	1.0, 1.1
				Packaging	IFTC/BM: See chapter 2., section 2.4.7.1.3 of D#5 Appendix A, Figure N° 5	
Phase 2	Pre-shipment packaging preparation	UFTS	Drainage			2.0, 2.1
			Drying the cavity	Vacuum circuit	Air/water separator, pump, vacuum gauges, valves,	
			Filling the cavity with helium	Vacuum circuit	Air/water separator, pump, vacuum gauges, valves, compressed air line	
			Leaktightness check	Leaktightness equipment		
			Depressurising the cavity	Vacuum circuit		
			Unloading of the packaging from the trolley	Gantry Crane	With 2 hoists (of 60 tons for the IFTC/BM and 10 tons for the impact limiter)	
Phase 3	Internal transfer of the packaging	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	3.0, 3.1
			Approach of the Trolley	Trolley	Trolley with tractor	
			Radiological control of the Trolley	Non contamination, Dose Rate	“Smear test”, Radiameter	
			Installing the impact limiter			
			Loading of the full Transportation cask on the Trolley			
			Radiological control of the Transportation cask and the Trolley	Non contamination, Dose Rate	“Smear test”, Radiameter	
			Internal transfer	Tie down		
Phase 4	Loading the Transportation cask on a vessel	UFTS	Radiological control of the Transportation cask and the hold	Non contamination, Dose Rate	“Smear test”, Radiameter	4.0, 4.1
			Loading the Transportation cask on the hold of the vessel	Gantry Crane (on the vessel)	With 1 hoist (of 60 tons for the IFTC/BM)	
				Lifting Beam for Transportation cask	To carry of the IFTC/BM or IFTC(similar to the IFTC, **<3>**)	
				Vessel	Section 3.7.1 of Chapter 3 Appendix A, Figure N°18	
			Transportation cask tie-down on the hold	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**)	
			Check the condition of the Transportation cask, hold			
			Fit the transport seals			
			Close the upper deck			

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° F.5.2
			Radiological control of the hold and the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 5	Water transportation	UFTS	Water transportation of the Transportation cask from the site to the water rail terminal		Protection equipment and materiel necessary to prevent radiation hazards : radiation protection kit	5.0
				Real time tracking	Appendix H	
Phase 6	Transfer of the Transportation cask from the vessel to a trailer	UFTS	Radiological control of the hold, the Transportation cask and the trailer		"Smear test", Radiameter	6.0, 6.1
			Open the weather covers of the trailer	Weather covers		
			Loading the packaging from the vessel to the trailer	Gantry Crane (on the vessel)	With 1 hoist (of 60 tons for the IFTC/BM)	
				Lifting Beam for Transpor-tation cask	To carry of the IFTC/BM or IFTC (similar to the IFTC, <3>)	
				Real Time Tracking	Appendix H	
				Trailer (Appendix A, Figures N°13, 14)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic suspension to cushion the load - Trailer equipped with four axles - One loaded cask per trailer	
				Tractor (Appendix A, Figure N°14)	- Standard commercial tractor sufficient for the loaded weight - The weight for the fuelled reference tractor is roughly 9,075 kg.	
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the IFTC for the trailer (Appendix A, Figure N°15 , <3>)	
			Check the condition of the packaging, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the hold , the trailer and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 7	Road transportation	UFTS	Road transportation of the Transportation cask from the water road terminal to the Centralised Facility			7.0
				Real time Tracking	Appendix H	
Phase 8	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			8.0
Phase 9	Internal transfer of the packaging	DGR/CES				


PHASE 0
MODULES IN WET BAYS
PHASE 1
LOADING THE MODULES INTO THE PACKAGING IN THE POOL
Step.0
Step.1.0
Step.1.1
PHASE 2
PRE-SHIPMENT PACKAGING PREPARATION
Step.2.0
Step.2.1
PHASE 3
INTERNAL TRANSFER OF THE PACKAGING
PHASE 4
LOADING THE TRANSPORTATION CASK ON A VESSEL
STEP.3.0
STEP.3.1
STEP.4.0
PHASE 5
WATER TRANSPORTATION
PHASE 6
WATER /ROAD TRANSFER OF THE TRANSPORTATION CASK
STEP.5.0
STEP.6.0
PHASE 7
ROAD TRANSPORTATION
PHASE 8
UNLOADING OF THE TRANSPORTATION CASK
PHASE 9
INTERNAL TRANSFER OF THE PACKAGING
STEP.7.0
STEP.8.0
STEP.9.0
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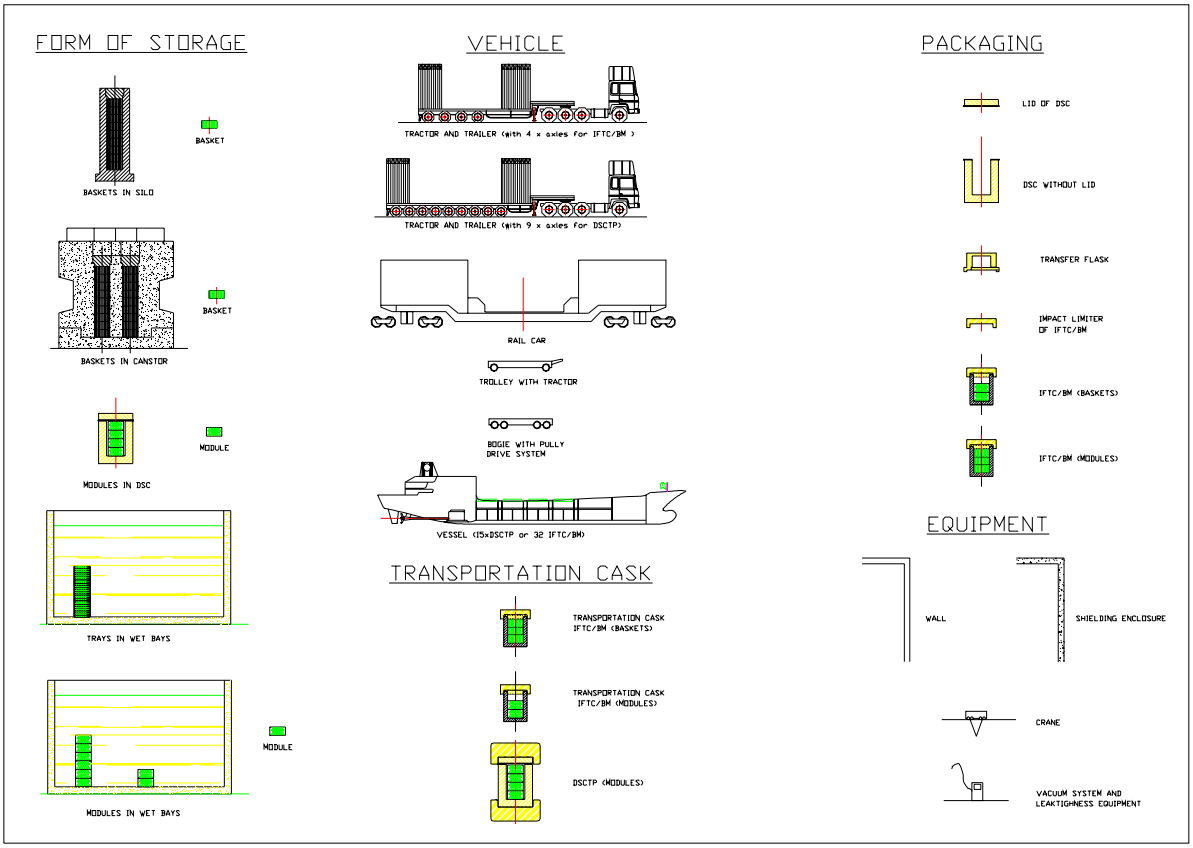
DARLINGTON MODULES IN WET BAYS
MOSTLY WATER
Fig.N°.52

Key:


FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (15xDSCTP or 32 IFTC/BM)
TRANSPORTATION CASK
TRANSPORTATION CASK IFTC/BM (BASKETS)
TRANSPORTATION CASK IFTC/BM (MODULES)
DSCTP (MODULES)
PACKAGING
LID OF DSC
DSC WITHOUT LID
TRANSFER FLASK
IMPACT LIMITER OF IFTC/BM
IFTC/BM (BASKETS)
IFTC/BM (MODULES)
EQUIPMENT
WALL
SHIELDING ENCLOSURE
CRANE
VACUUM SYSTEM AND LEAKTIGHNESS EQUIPMENT

6. POINT LEPREAU

Baskets in Silo (See Appendix B, Table N°4)
From Point Lepreau to the Centralised Facility
Quantity of bundles to be transported from 2035 to 2064: see Appendix B, Table N° 3.

6.1. Mode and route development

Feasibility of transporting used fuel from the different current storage site to the centralised facility.
Viability of shipping by road and the identification of a preferred shipping route.

Water: The Point Lepreau site is located on the water [**<52>**, **<55>**, **<54>** and **<59>**]. The facility previously contained a dock, however this structure has not been utilised since the plant began operation. In its current state, the dock is unusable and would require reconstruction. It is also notable that the road leading to the on-site dock area would need to be strengthened and re-graded to accommodate the loaded casks.

Based on an on-site review, it is anticipated that additional dredging would be required in addition infrastructure improvements. Such activity, while needing to ensure compliance with relevant environmental regulations, is deemed viable. While detailed cost estimates are not included within the scope of this review, a cursory evaluation of transport costs indicates that the overall savings associated with a water-based transport program would significantly mitigate the cost of dock construction and related activities.

Recommendation: Based on consideration of site-specific factors and related infrastructure for the Point Lepreau facility, the water mode provides a viable means of transport requiring a moderate amount of infrastructure changes. This approach, however, provides for the most expedited shipment schedule and cost-effective system while also representing a unique opportunity to further enhance program efficiencies through consolidation. The justification for a compressed shipping program is the same as that outlined above for the Gentilly sites.

For shipments from Point Lepreau, the proposed routing would take the vessel through the Bay of Fundy, around Nova Scotia in the Atlantic Ocean, and down through the St. Lawrence Seaway.

Use of the sample vessel used for this review would allow higher volume shipments, thus reducing the time required to complete the used fuel transfer from Point Lepreau. As Point Lepreau represents the single storage facility in the Province of New Brunswick, it is deemed desirable to remove used fuel from the Province in a compressed time frame as compared with removing smaller shipments over a longer period.

Additional program savings can be realised through the consolidation of used fuel originating at Point Lepreau with used fuel originating at Gentilly 1 and Gentilly 2. The routing for waterborne transport from Point Lepreau would take the vessel past the Gentilly 1 and 2 facility, allowing of consolidation of the Gentilly used fuel and thus reducing the overall per cask shipment cost. This approach assumes that the delivery schedules for the Point Lepreau, Gentilly 1 and Gentilly 2 facilities are coordinated, however it appears that this approach would allow maximized use of the vessel without awaiting for a single site – such as Point Lepreau – to complete discharge and loading of a full vessel quantity.

As described above, the used fuel would be transported to the applicable water transfer station, representing water/rail transport.

6.2. Nuclear facility loading

Receive and prepare the used fuel and packages for loading, prepare packages for loading into transportation packages, pre-shipment tests, and prepare transportation package for transfer to a vessel.

See phases 3, 4, 5 of paragraph 3.3.9 of the present document.

6.3. Transporter (vehicle)

6.3.1. Trolley with tractor

In order to transfer:

- The baskets from the silo to the packaging (phases 2 and 3 of table paragraph 6.9).

6.3.2. Bogie pulley drive system

In order to transfer:

- The IFTC/BM in the hot cell (phase 3 of table paragraph 6.9),
- The IFTC/BM to the pre-shipment packaging area (phase 4 of table paragraph 6.9),
- The IFTC/BM to the shipment area (phases 5 and 6 of table paragraph 6.9).

6.3.3. Vessel for the water transportation (phase 6 of table paragraph 6.9)

See section 3.7.1 of Chapter 3.

6.3.4. Frame of the Transportation cask for the water transportation

Similar to the rail transportation but adapted to the regulation concerning the accelerations.

6.3.5. Specific equipment for the water transportation

- GPS antenna (tracking) on the vessel

- Radiation protection kit :
  - Direct reading dosimeter,
  - Film dosimeters,
  - Gamma doses rate meter,
  - Neutron doses rate meter,
  - Counting rate meter,
  - Blank ”Measurements performed” forms,
  - Roll of filter papers for smear test,
  - Pairs of overshoes,
  - Vinyl gloves,
  - Disposable breathing mask,
  - Disposable camera with flash

6.3.6. Trailer for the road transportation (phase 8 of table paragraph 6.9)

- Modified 48 foot flatted trailer with integrated tie-down
- Trailer equipped with hydraulic suspension to cushion the load
- Trailer equipped with four axles
- One loaded cask per trailer
- 2 drivers and no escort

6.3.7. Tractor for the road transportation (phase 8 of table paragraph 6.9)

- Standard commercial tractor sufficient for the loaded weight
- The weight for the fuelled reference tractor is roughly 9,075 kg.

6.3.8. Weather cover for the road transportation (phase 8 of table paragraph 6.9)

- Rolling removable plastic weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. Two men (one on each side of the trailer) can manually open or close the weather cover which can roll on a rail fixed on the frame of the Transportation cask.

- Holes and a ventilation shaft on the top of the cover are calculated to create an adequate draught around the Transportation cask during the transport. The weather cover is composed with two parts: one with a fixed metallic panel at the rear side, one with a fixed metallic panel at the front side. The weather cover can be taken off from the trailer with a specific frame fixed at the rear side of the frame for the Transportation cask.

6.3.9. Frame of the Transportation cask for the road transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the axles. This frame is fitted to the vehicle with twistlock devices plus a metal fitting designed for the appropriate accelerations. The numbers of attachments for the frame means it is still better to remove the cask from the frame, rather than taking than cask and the frame as unit during intermodal transfers.
The weather cover can roll on a rail fixed on the frame of the Transportation cask. A drip pan is installed under the frame in order to collect the drain of water coming from the condensation of the Transportation cask. A manual valve with a padlock is installed at the lower level of the drip pan in order to collect the water.

6.3.10. Specific equipment for the road transportation

- GPS antenna (tracking) on the tractor
- Turning light (“Girophare”) on the tractor
- Tools box adapted to the Transportation cask

6.4. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for IFTC/BM: shared facility at the centralised site as developed in paragraph 3.2 of Chapter 3.

- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

6.5. Casks

Conceptual design for the Transportation package and tie-down systems for UFTS:

- Tie-down: Similar to the Tie down of the IFTC for the water and rail transportation (Appendix A, Figure N°15, **<3>**) adapted to the regulations concerning the accelerations.

- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 5 of Appendix A, Appendix C.

6.6. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Leakage and purging equipment:
  One complete equipment with vacuum pumps and gauges (see phase 4 of table paragraph 6.9)

- Gantry Crane:
  One for loading installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 6.9) and for install the impact limiter (phase 4)
  One for loading the Transportation cask on the vessel (see phase 6 of table paragraph 6.9)
  One for loading the Transportation cask from the vessel to the trailer (see phase 8 of table paragraph 6.9).

The two last gantry cranes can be only one if the vessel has its own crane.

- Lifting beam:
  One for the Transfer flask (see phase 3 of table paragraph 6.9)
  One for the impact limiter of the packaging (see phase 4 of table paragraph 6.9)
  One for the Transportation cask (see phase 8 of table paragraph 6.9)

- Decontamination equipment (see paragraph 3.2 of Chapter 3).

6.7. UFTS Transportation system operation

Loading of packages onto the vessel, rail car, security, transportation, emergency response:

- Loading of packaging onto the vessel, security, transportation as described in phase 6 of table paragraph 6.9.

- Loading of Transportation cask from the vessel to the trailer, security, transportation as described in phase 8 of table paragraph 6.9.

- Emergency response plan: see paragraph 9 of Appendix F.

- Real time tracking: see paragraph 9 of Appendix F.

6.8. Decommissioning

Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

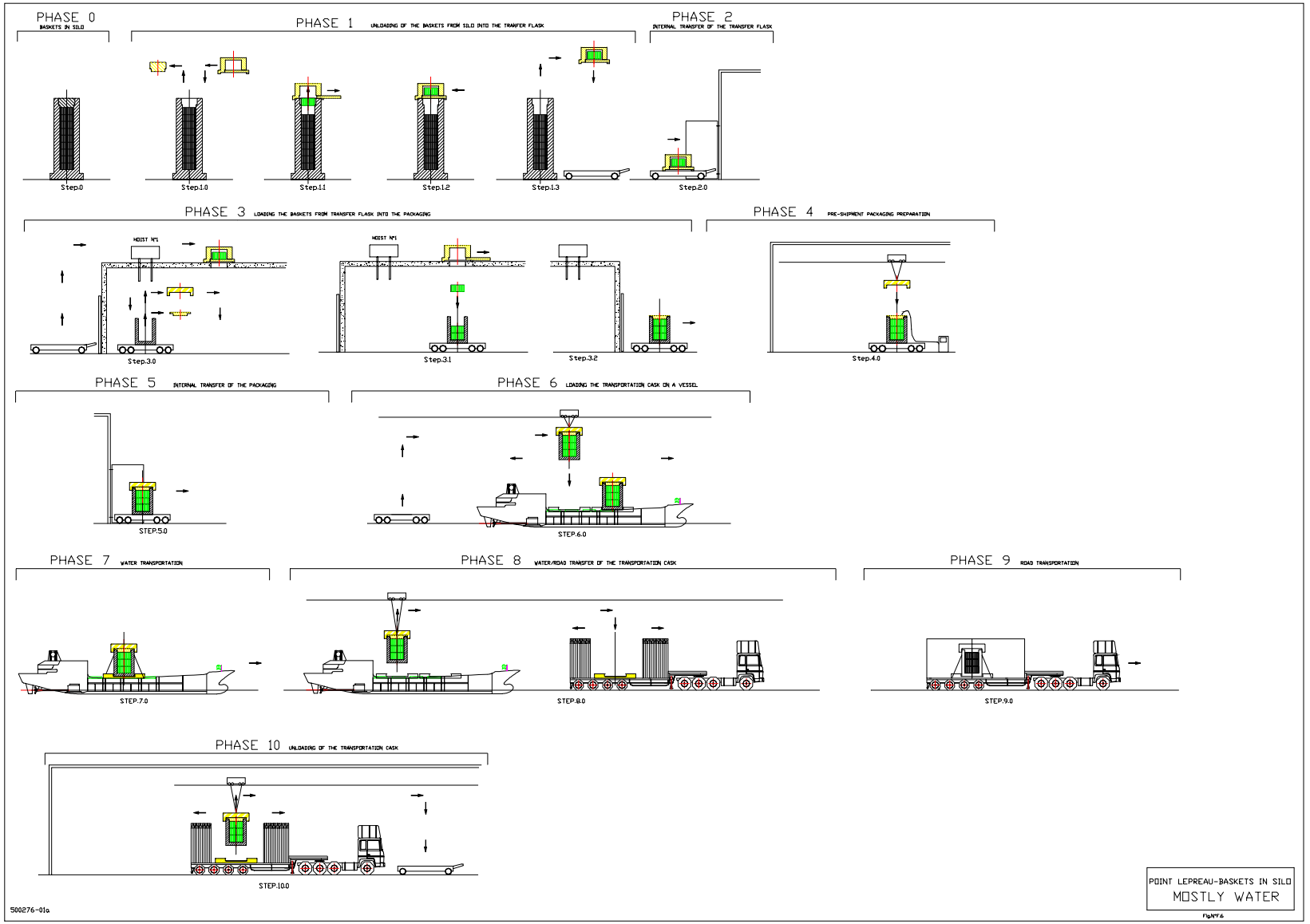
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

6.9. Table: Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° F.6
Phase 0	Baskets in Silo	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 2	Internal transfer of the transfer flask	Interim storage				2.0
Phase 3	Loading the baskets from the transfer flask into the packaging	UFTS	With a gantry crane , place the transfer flask on the hot cell	Transfer flask	Figure N°10: - Shielded fuel transfer cask - 26 tons with 60 bundles basket and with irradiated fuel - “Sliding” gate - Electric hoist for lifting or lowering a basket into the IFTC/BM - Chain - Basket lifting grapple - Shielding	3.0
				Gantry Crane	For the transfer flash	
				Lifting Beam for Transfer flask		
			With the hoist N°1, open the lid of the packaging in a hot cell.	Packaging	IFTC/BM: See chapter 2., section 2.4.7.1.3 of D#5 Appendix A, Figure N° 6	
			Load the baskets into the packaging			
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator, pump, vacuum gauges, valves,	4.0
			Filling the cavity with helium	Vacuum circuit	Air/water separator, pump, vacuum gauges, valves, compressed air line	
			Leaktightness check	Leaktightness equipement		
			Depressurising the cavity	Vacuum circuit		
			Installing the impact limiter			
Phase 5	Internal transfer of the packaging	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Approach of the Bogie	Bogie	Bogie with pulley drive system	5.0
			Radiological control of the Bogie	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Loading of the full Transportation cask on the Bogie			5.0
			Radiological control of the Transportation cask and the Bogie	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Internal transfer	Tie down		5.1

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° F.6
Phase 6	Loading the Transportation cask on a vessel	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	6.0
			Loading the Transpor-tation cask on the hold of the vessel	Gantry Crane (on the vessel)	With 1 hoist (of 60 tons for the IFTC/BM	6.0
				Lifting Beam for packaging	To carry of the IFTC/BM (similar to the IFTC, **<3>**)	6.0
				Vessel	Section 3.7.1 of Chapter 3 Appendix A, Figure N°18	6.0
			Installing the impact limiter			6.1
			Packaging tie-down on the hold	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**)	6.1
			Check the condition of the Transportation cask , hold			6.1
			Fit the transport seals			6.1
			Close the upper deck			6.1
			Radiological control of the hold an the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	6.1
Phase 7	Water transportation	UFTS	Water transportation of the Transportation cask from the site to the water rail terminal		Protection equipment and materiel necessary to prevent radiation hazards : radiation protection kit	7.0
				Real time tracking	Appendix H	
Phase 8	Transfer of the Transportation cask from the vessel to a trailer	UFTS	Radiological control of the hold, the Transportation cask and the trailer		"Smear test", Radiameter	8.0
			Open the weather covers of the trailer	Weather covers		
			Loading the packaging from the vessel to the trailer	Gantry Crane (on the vessel)	With 1 hoist (of 60 tons for the IFTC/BM)	
				Lifting Beam for Transpor-tation cask	To carry of the IFTC/BM (similar to the IFTC, **<3>**)	
				Real Time Tracking	Appendix H	
				Trailer (Appendix A, Figures N°13, 14)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic suspension to cushion the load - Trailer equipped with four axles - One loaded cask per trailer	
				Tractor (Appendix A, Figure N°14)	- Standard commercial tractor sufficient for the loaded weight - The weight for the fuelled reference tractor is roughly 9,075 kg.	
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the IFTC for the trailer (Appendix A, Figure N°15 , **<3>**)	
			Check the condition of the packaging, trailer			
			Fit the transport seals			

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° F.6
			Close the weather cover	Weather cover		
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the hold , the trailer and of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	
Phase 9	Road transportation	UFTS	Road transportation of the Transportation cask from the water road terminal to the Centralised Facility			9.0
				Real time Tracking	Appendix H	
Phase 10	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			10.0
Phase 11	Internal transfer of the packaging	DGR/CES				


PHASE 0
BASKETS IN SILO
PHASE 1
UNLOADING OF THE BASKETS FROM SILO INTO THE TRANFER FLASK
PHASE 2
INTERNAL TRANSFER OF THE TRANSFER FLASK
Step.0
Step.1.0
Step.1.1
Step.1.2
Step.1.3
Step.2.0
PHASE 3
LOADING THE BASKETS FROM TRANSFER FLASK INTO THE PACKAGING
PHASE 4
PRE-SHIPMENT PACKAGING PREPARATION
HOIST N°1
HOIST N°1
Step.3.0
Step.3.1
Step.3.2
Step.4.0
PHASE 5
INTERNAL TRANSFER OF THE PACKAGING
PHASE 6
LOADING THE TRANSPORTATION CASK ON A VESSEL
STEP.5.0
STEP.6.0
PHASE 7
WATER TRANSPORTATION
PHASE 8
WATER/ROAD TRANSFER OF THE TRANSPORTATION CASK
PHASE 9
ROAD TRANSPORTATION
STEP.7.0
STEP.8.0
STEP.9.0
PHASE 10
UNLOADING OF THE TRANSPORTATION CASK
STEP.10.0
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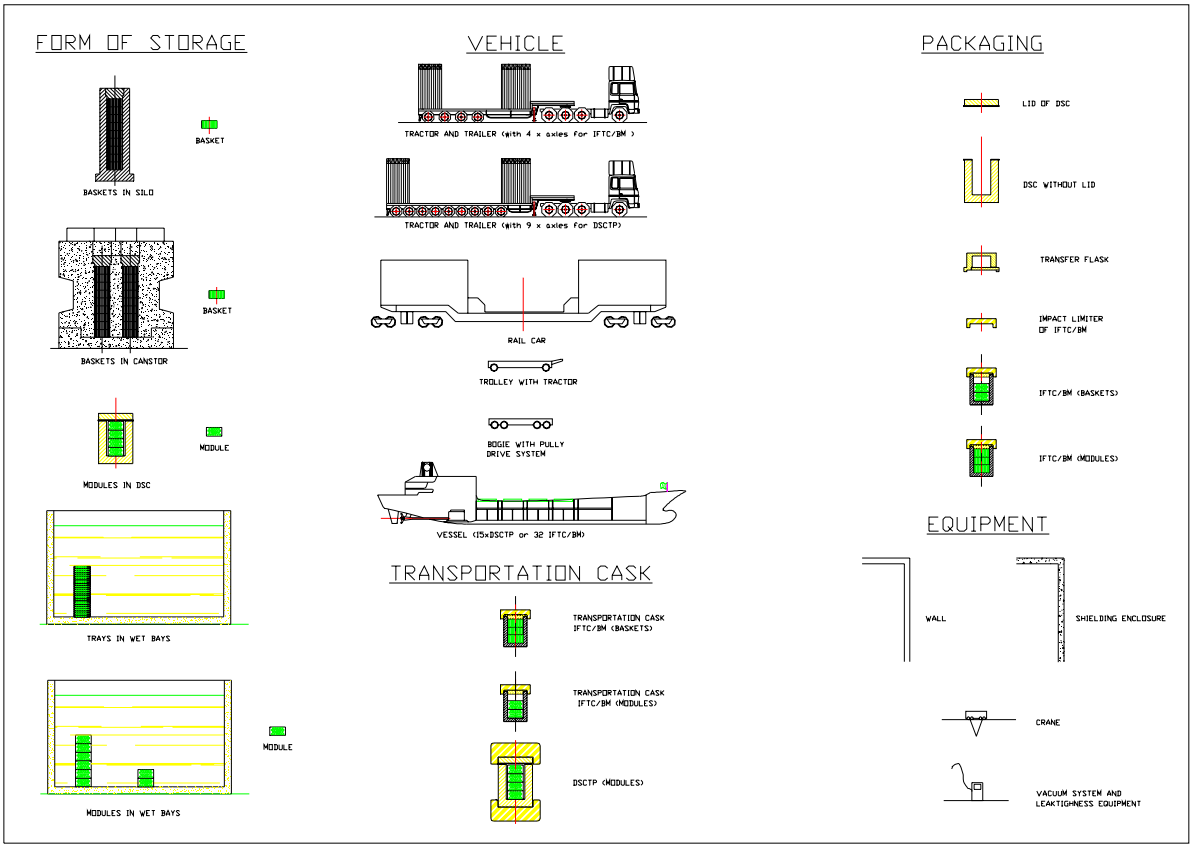
POINT LEPREAU-BASKETS IN SILO
MOSTLY WATER
FIgN°6

Key:


FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (15xDSCTP or 32 IFTC/BM)
TRANSPORTATION CASK
TRANSPORTATION CASK IFTC/BM (BASKETS)
TRANSPORTATION CASK IFTC/BM (MODULES)
DSCTP (MODULES)
PACKAGING
LID OF DSC
DSC WITHOUT LID
TRANSFER FLASK
IMPACT LIMITER OF IFTC/BM
IFTC/BM (BASKETS)
IFTC/BM (MODULES)
EQUIPMENT
WALL
SHIELDING ENCLOSURE
CRANE
VACUUM SYSTEM AND LEAKTIGHNESS EQUIPMENT

7. CHALK RIVER

Baskets in Silo (See Appendix B, Table N° 4)
From Douglas Point Facility to the Centralised Facility
Quantity of bundles to transport from 2035 to 2064: see Appendix B, Table N° 3.

7.1. Mode and route development

Feasibility of transporting used fuel from the different current storage site to the centralised facility.
Viability of shipping by road and the identification of a preferred shipping route.

Road transport is clearly feasible from Chalk River [**<52>**, **<53>**, **<56>, <27>** and **<54>**]. The public road system is generally adequate to support the lower volume shipments from this site, however some improvement may be necessary to public roadways at the time of shipment. On-site roadways would also likely require strengthening and re-grading (especially noting the grade leaving the site storage area).

Road transport would be appropriate for Chalk River used fuel being transferred to either the northern or southern Ontario repository. This transport mode is consistent with the volume of used fuel to be removed from the site.

7.2. Nuclear facility loading

Receive and prepare the used fuel and packages for loading, prepare packages for loading into transportation packages, pre-shipment tests, and prepare transportation package for transfer to a trailer.

See phases 3, 4, 5 of paragraph 7.9 of the present document.

7.3. Transporter (vehicle)

7.3.1. Trolley with tractor

In order to transfer:

- The baskets from the silo to the packaging (phases 2 and 3 of table paragraph 7.9).

7.3.2. Bogie pulley drive system

In order to transfer:

- The IFTC/BM in the hot cell (phase 3 of table paragraph 7.9),
- The IFTC/BM to the pre-shipment packaging area (phase 4 of table paragraph 7.9),
- The IFTC/BM to the shipment area (phases 5 and 6 of table paragraph 7.9).

- Modified 48 foot flatted trailer with integrated tie-down
- Trailer equipped with hydraulic or air ride suspension to cushion the load
- Trailer equipped with four axles
- One loaded cask per trailer
- 2 drivers and no escort.

7.3.3. Tractor for the road transportation (phase 6 of table paragraph 7.9)

- Standard commercial tractor sufficient for the loaded weight
- The weight for the fuelled reference tractor is roughly 9,075 kg.

7.3.4. Weather cover for the road transportation (phase 7 of table paragraph 7.9)

- Rolling removable plastic weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. Two men (one on each side of the trailer) can manually open or close the weather cover which can rolls on a rail fixed on the frame of the Transportation cask.

- Holes and a ventilation shaft on the top of the cover are calculated to create an adequate draught around the Transportation cask during the transport. The weather cover is composed with two parts: one with a fixed metallic panel at the rear side, one with a fixed metallic panel at the front side. The weather cover can be taken off from the trailer with a specific frame fixed at the rear side of the frame for the Transportation cask.

7.3.5. Frame of the Transportation cask for the road transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the axles. This frame is fitted to the vehicle with twistlock devices plus a metal fitting designed for the appropriate accelerations. The numbers of attachments for the frame means it is still better to remove the cask from the frame, rather than taking than cask and the frame as unit during intermodal transfers.
The weather cover can rolls on a rail fixed on the frame of the Transportation cask. A drip pan is installed under the frame in order to collect the drain of water coming from the condensation of the Transportation cask. A manual valve with a padlock is installed at the lower level of the drip pan in order to collect the water.

7.3.6. Specific equipment

- GPS antenna (tracking) on the tractor
- Turning light (“Girophare”) on the tractor
- Tools box adapted to the Transportation cask

7.4. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for IFTC/BM: shared facility at the centralised site as developed in paragraph 3.2 of Chapter 3.

- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

7.5. Casks

Conceptual design for the Transportation package and tie-down systems for UFTS:

- Tie-down: similar to the IFTC, Appendix A, Figure N° 15 **<3>**.
- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 5 of Appendix A, Appendix C.

7.6. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Leakage and purging equipment:
  One complete equipment with vacuum pumps and gauges (see phase 4 of table paragraph 7.9)

- Gantry Crane:
  One for loading the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 7.9) and for installing the impact limiter (phase 4)
  One for loading the transporter cask on the trailer (see phase 6 of table paragraph 7.9)

- Lifting beam:
  One for the Transfer flask (see phase 3 of table paragraph 7.9)
  One for the transporter cask (see phase 6 of table paragraph 7.9)
  One for the impact limiter of the packaging (see phase 4 of table paragraph 7.9)

- Decontamination equipment (see paragraph 3.2 of Chapter 3).

7.7. UFTS Transportation system operation

Loading of packages onto the trailer, security, transportation, emergency response:

- Loading of packages onto the trailer, security, transportation as described in phase 6 of table paragraph 7.9

- Emergency response plan: see paragraph 9 of Appendix F.

- Real time tracking: see paragraph 9 of Appendix F.

7.8. Decommissioning

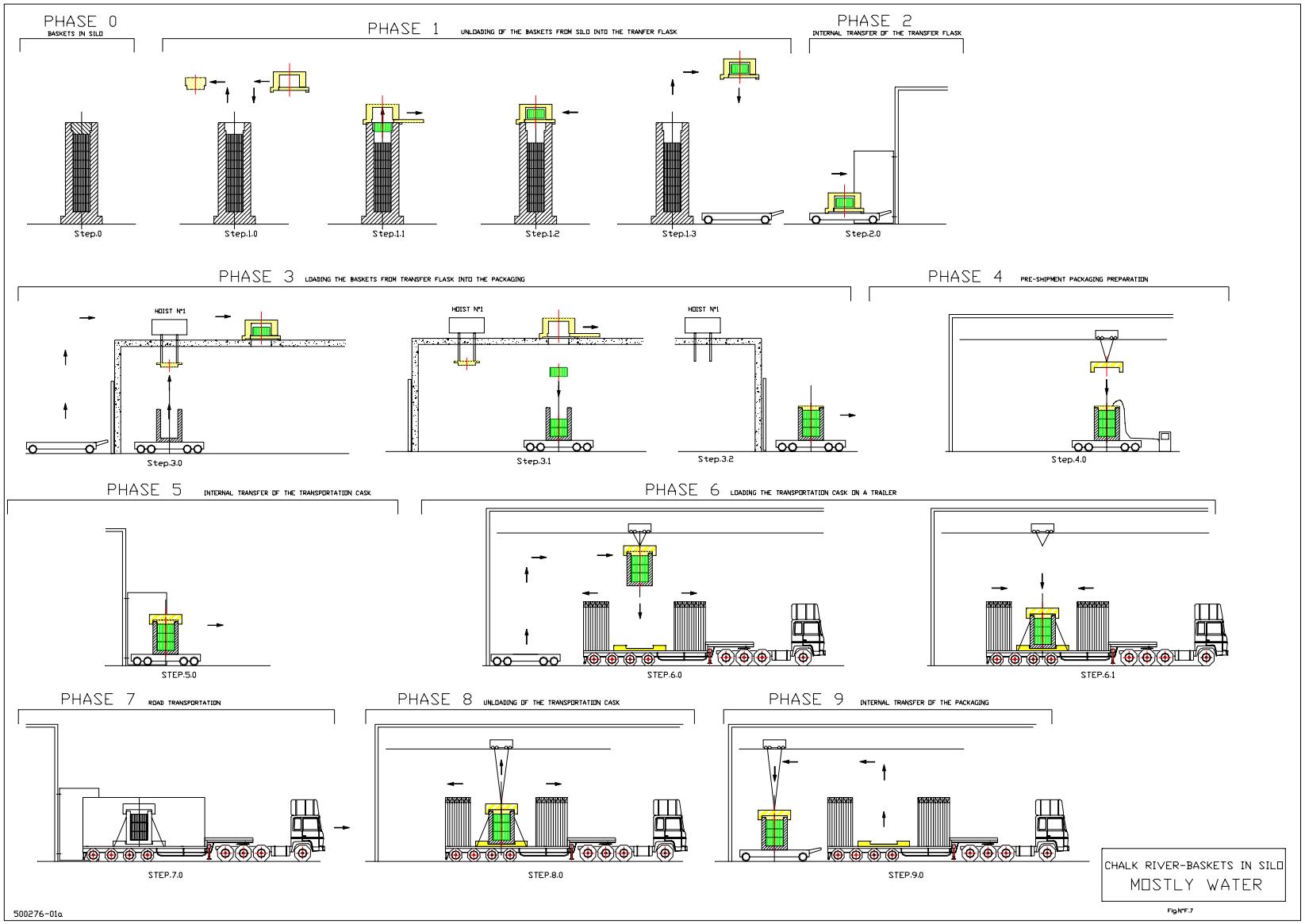
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

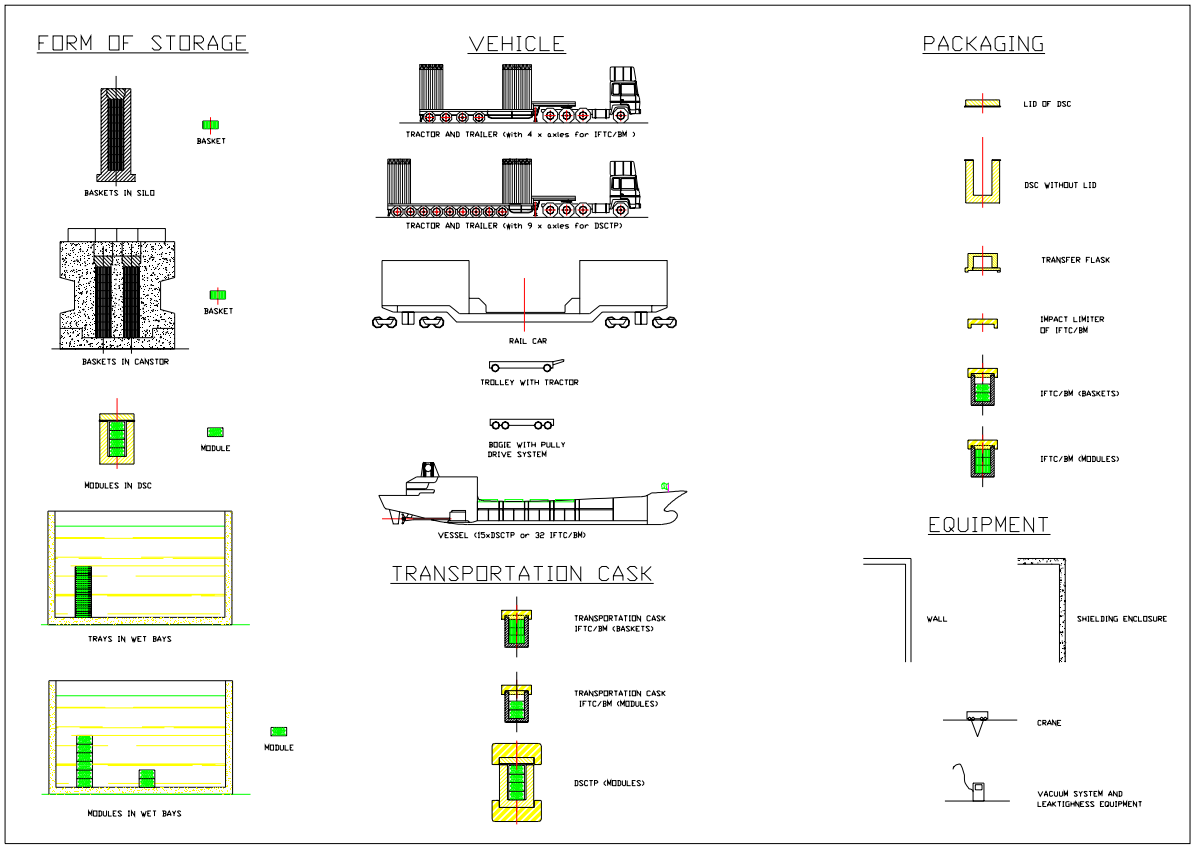
7.9. Table: Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.7
Phase 0	Baskets in Silo	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 2	Internal transfer of the transfer flask	Interim storage				2.0
Phase 3	Loading the baskets from the transfer flask into the packaging	UFTS	With the gantry, take the impact limiter handling tool of the packaging.	Packaging	IFTC/BM: See section 2.4.7.1.3 of D#5 Appendix A, Figure N° 6,	3.0
			With the gantry, place the transfer flask on the hot cell	Transfer flask	Similar to Gentilly 2, Appendix A, Figure N°10: - Shielded fuel transfer cask - 26 tons with 60 bundles basket and with irradiated fuel - "Sliding" gate - Electric hoist for lifting or lowering a basket into the IFTC/BM - Chain - Basket lifting grapple - Shielding	3.0
				Gantry Crane	For the transfer flask	
				Lifting Beam for the Transfer flask		3.0
			Load the baskets into the packaging			
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator, pump, vacuum gauges, valves,	4.0
			Filling the cavity with helium	Vacuum circuit	Air/water separator, pump, vacuum gauges, valves, compressed air line	
			Leaktightness check	Leaktightness equipement		
			Depressurising the cavity	Vacuum circuit		
			Installing the impact limiter			
Phase 5	Internal transfer of the packaging	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	5.0
			Approach of the Bogie	Bogie	Bogie with fully drive system	5.0
			Radiological control of the Bogie	Non contamination, Dose Rate	"Smear test", Radiameter	5.0
			Loading of the full Transportation cask on the vehicle			5.0
			Radiological control of the Transportation cask and the Trolley	Non contamination, Dose Rate	"Smear test", Radiameter	5.0
			Internal transfer	Tie down		5.1

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° F.7
Phase 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask and of the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	6.0
			Open the weather cover	Weather cover		6.0
			Loading the Transpor-tation cask on a trailer	Gantry Crane	With hoist (of 60 tons for the IFTC/BM)	6.0
				Lifting Beam for packaging	To carry of the IFTC/BM (similar to the lifting beam of IFTC)	6.0
				Trailer (Appendix A, Figures N°12, 13, 14)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic or air ride suspension to cushion the load - Trailer equipped with four axles - One loaded cask per trailer	6.0
				Tractor (Appendix A, Figure N°14)	- Standard commercial tractor sufficient for the loaded weight - The weight for the fuelled reference tractor is roughly 9,075 kg.	6.0
			Installing the impact limiter			6.1
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15 , <**3**>)	6.1
			Check the condition of the packaging, trailer			6.1
			Fit the transport seals			6.1
			Close the weather cover	Weather cover		6.1
			Radiological control of the trailer and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	6.1
Phase 7	Road transportation	UFTS	Road transportation of the Transportation cask from the Facility to the Centralised Facility			7.0
				Real time tracking	Appendix H	7.0
Phase 8	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			8.0
Phase 9	Internal transfer of loaded Transportation cask	DGR/CES				
Phase 10	Unloading the baskets from the Transportation cask	DGR/CES				
Phase 11	Storage of the baskets on the Centralised Facility	DGR/CES				
Phase 12	Road transportation of the empty Transportation cask from the Centralised Facility	DGR/CES				


PHASE 0
BASKETS IN SILO
PHASE 1
UNLOADING OF THE BASKETS FROM SILO INTO THE TRANFER FLASK
PHASE 2
INTERNAL TRANSFER OF THE TRANSFER FLASK
Step.0
Step.1.0
Step.1.1
Step.1.2
Step.1.3
Step.2.0
PHASE 3
LOADING THE BASKETS FROM TRANSFER FLASK INTO THE PACKAGING
PHASE 4
PRE-SHIPMENT PACKAGING PREPARATION
HOIST N°1
HOIST N°1
HOIST N°1
Step.3.0
Step.3.1
Step.3.2
Step.4.0
PHASE 5
INTERNAL TRANSFER OF THE TRANSPORTATION CASK
PHASE 6
LOADING THE TRANSPORTATION CASK ON A TRAILER
STEP.5.0
STEP.6.0
STEP.6.1
PHASE 7
ROAD TRANSPORTATION
PHASE 8
UNLOADING OF THE TRANSPORTATION CASK
PHASE 9
INTERNAL TRANSFER OF THE PACKAGING
STEP.7.0
STEP.8.0
STEP.9.0
CHALK RIVER-BASKETS IN SILO
MOSTLY WATER
500276-01a
Fig.N°F.7

Key:


FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (15xDSCTP or 32 IFTC/BM)
TRANSPORTATION CASK
TRANSPORTATION CASK IFTC/BM (BASKETS)
TRANSPORTATION CASK IFTC/BM (MODULES)
DSCTP (MODULES)
PACKAGING
LID OF DSC
DSC WITHOUT LID
TRANSFER FLASK
IMPACT LIMITER OF IFTC/BM
IFTC/BM (BASKETS)
IFTC/BM (MODULES)
EQUIPMENT
WALL
SHIELDING ENCLOSURE
CRANE
VACUUM SYSTEM AND LEAKTIGHNESS EQUIPMENT

8. GENTILLY

8.1. Baskets in Silo (See Appendix B, Table N° 4)

From Gentilly 1 to the Centralised Facility
Quantity of bundles to be transported from 2035 to 2064: see Appendix B, Table N°3.

8.1.1. Mode and route development

Feasibility of transporting used fuel from the different current storage site to the centralised facility.
Viability of shipping by road and the identification of a preferred shipping route.

Water: The Gentilly reactors are located on the water, making the possibility of water transport a clear possibility [**<52>**, **<53>**, **<56>, <54>** and **<57>**]. Construction of a dock area would be required in order to provide a necessary loading area for the transport vessel; while detailed cost estimates are not included within the scope of this review, a cursory evaluation of transport costs indicates that the overall savings associated with a water-based transport program would significantly mitigate the cost of dock construction and related activities.

Recommendation: Based on consideration of site-specific factors and related infrastructure for the Gentilly 1 & 2 facility, the water mode provides a viable means of transport requiring a moderate amount of infrastructure changes. This approach, however, provides for the most expedited shipment schedule and cost-effective system while also representing a unique opportunity to further enhance program efficiencies through consolidation into a smaller number of shipments.

A shorter shipping program is deemed desirable for the following reasons:

- A compressed shipping schedule would expedite removal of used fuel from the current storage sites. This may be significant financially, operationally and politically for individual sites. Additionally, sites contemplating decommissioning could take advantage of nearer-term shipping schedules.

- A shorter program would likely reduce overhead and management costs associated with the program.

- A shorter program would be consistent with physical security recommendations to reduce the duration of shipments of nuclear material.

For shipments from Gentilly, the proposed routing would take the vessel through the St. Lawrence Seaway into Ontario.

Use of the sample vessel used for this review would allow higher volume shipments, thus reducing the time required to complete the used fuel transfer from Gentilly. As Gentilly represents the single storage facility in the Province of Québec, it is deemed desirable to remove used fuel from the Province in a compressed time frame as compared with removing smaller shipments over a longer period.

Additional program savings can be realized through the consolidation of used fuel originating at Gentilly 1 and Gentilly 2 with used fuel originating at Point Lepreau. The routing for waterborne transport from Point Lepreau would take the vessel past the Gentilly 1 and 2 facilities, allowing of consolidation of the Gentilly used fuel and thus reducing the overall per cask shipment cost. This approach assumes that the delivery schedules for the Point Lepreau, Gentilly 1 and Gentilly 2 facilities are coordinated, however it appears that this approach would allow maximized use of the vessel without awaiting for a single site – such as Gentilly – to complete discharge and loading of a full vessel quantity.

As described above, the used fuel would be transported to the applicable water transfer station, representing water/rail transport.

8.1.2. Nuclear facility loading

Receive and prepare the used fuel and packages for loading, prepare packages for loading into transportation packages, pre-shipment tests, and prepare transportation package for transfer to a vessel.

See phases 3, 4, 5 of paragraph 8.1.9 of the present document.

8.1.3. Transporter (vehicle)

8.1.3.1. Trolley with tractor

In order to transfer:

- The baskets from the silo to the packaging (phases 2 and 3 of table paragraph 8.1.9).

8.1.3.2. Bogie pulley drive system

In order to transfer:

- The IFTC/BM in the hot cell (phase 3 of table paragraph 8.1.9),
- The IFTC/BM to the pre-shipment packaging area (phase 4 of table paragraph 8.1.9),
- The IFTC/BM to the shipment area (phases 5 and 6 of table paragraph 8.1.9).

8.1.3.3. Vessel for the water transportation (phase 6 of table paragraph 8.1.9)

See section 3.7.1 of Chapter 3.

8.1.3.4. Frame of the Transportation cask for the water transportation

Similar to the rail transportation but adapted to the regulation concerning the accelerations.

8.1.3.5. Specific equipment for the water transportation

- GPS antenna (tracking) on the vessel

- Radiation protection kit:
  - Direct reading dosimeter,
  - Film dosimeters,
  - Gamma doses rate meter,
  - Neutron doses rate meter,
  - Counting rate meter,
  - Blank” Measurements performed” forms,
  - Roll of filter papers for smear test,
  - Pairs of overshoes,
  - Vinyl gloves,
  - Disposable breathing mask,
  - Disposable camera with flash

8.1.3.6. Trailer for the road transportation (phase 8 of table paragraph 8.1.9)

- Modified 48 foot flatted trailer with integrated tie-down
- Trailer equipped with hydraulic suspension to cushion the load
- Trailer equipped with four axles
- One loaded cask per trailer
- 2 drivers and no escort

8.1.3.7. Tractor for the road transportation (phase 8 of table paragraph 8.1.9)

- Standard commercial tractor sufficient for the loaded weight
- The weight for the fuelled reference tractor is roughly 9,075 kg.

8.1.3.8. Weather cover for the road transportation (phase 8 of table paragraph 8.1.9)

- Rolling removable plastic weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. Two men (one on each side of the trailer) can manually open or close the weather cover which can rolls on a rail fixed on the frame of the Transportation cask.

- Holes and a ventilation shaft on the top of the cover are calculated to create an adequate draught around the Transportation cask during the transport. The weather cover is composed with two parts: one with a fixed metallic panel at the rear side, one with a fixed metallic panel at the front side. The weather cover can be taken off from the trailer with a specific frame fixed at the rear side of the frame for the Transportation cask.

8.1.3.9. Frame of the Transportation cask for the road transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the axles. This frame is fitted to the vehicle with twistlock devices plus a metal fitting designed for the appropriate accelerations. The numbers of attachments for the frame means it is still better to remove the cask from the frame, rather than taking than cask and the frame as unit during intermodal transfers.
The weather cover can rolls on a rail fixed on the frame of the Transportation cask. A drip pan is installed under the frame in order to collect the drain of water coming from the condensation of the Transportation cask. A manual valve with a padlock is installed at the lower level of the drip pan in order to collect the water.

8.1.3.10. Specific equipment for the road transportation

- GPS antenna (tracking) on the tractor
- Turning light (“Girophare”) on the tractor
- Tools box adapted to the Transportation cask

8.1.4. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for IFTC/BM: shared facility at the centralised site as developed in paragraph 3.2 of Chapter 3.

- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

8.1.5. Casks

Conceptual design for the Transportation package and tie-down systems for UFTS:

- Tie-down: Similar to the Tie down of the IFTC for the water and rail transportation (Appendix A, Figure N°15, **<3>**) adapted to the regulations concerning the accelerations.

- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 6 of Appendix A, Appendix C.

8.1.6. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Leakage and purging equipment:
  One complete equipment with vacuum pumps and gauges (see phase 4 of table paragraph 8.1.9)
- Gantry Crane :
  One for loading installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 8.1.9) and for install the impact limiter (phase 4)
  One for loading the Transportation cask on the vessel (see phase 6 of table paragraph 8.1.9)
  One for loading the Transportation cask from the vessel to the trailer (see phase 8 of table paragraph 8.1.9).

The two last gantry crane can be only one if the vessel has its own crane.

- Lifting beam:
  One for the Transfer flask (see phase 3 of table paragraph 8.1.9)
  One for the impact limiter of the packaging (see phase 4 of table paragraph 8.1.9)
  One for the Transportation cask (see phase 8 of table paragraph 8.1.9)

- Decontamination equipment (see paragraph 3.2. of Chapter 3).

8.1.7. UFTS Transportation system operation

Loading of packages onto the vessel, trailer, security, transportation, emergency response:

- Loading of packaging onto the vessel, security, transportation as described in phase 6 of table paragraph 8.1.9.

- Loading of Transportation cask from the vessel to the trailer, security, transportation as described in phase 8 of table paragraph 8.1.9.

- Emergency response plan: see paragraph 9 of Appendix F.

- Real time tracking: see paragraph 9 of Appendix F.

8.1.8. Decommissioning

Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

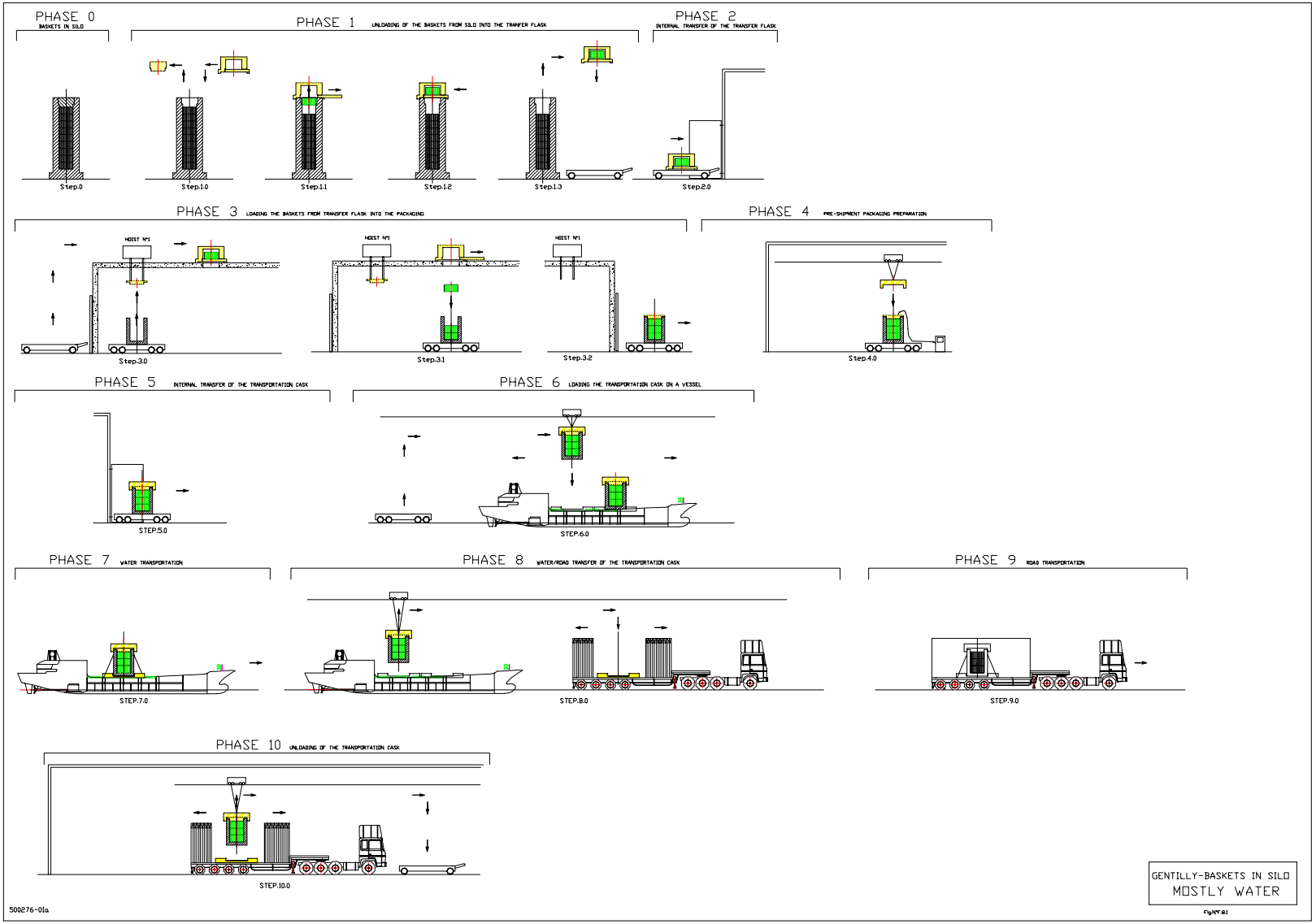
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

8.1.9. Table: Analysis of the operational phases of transport

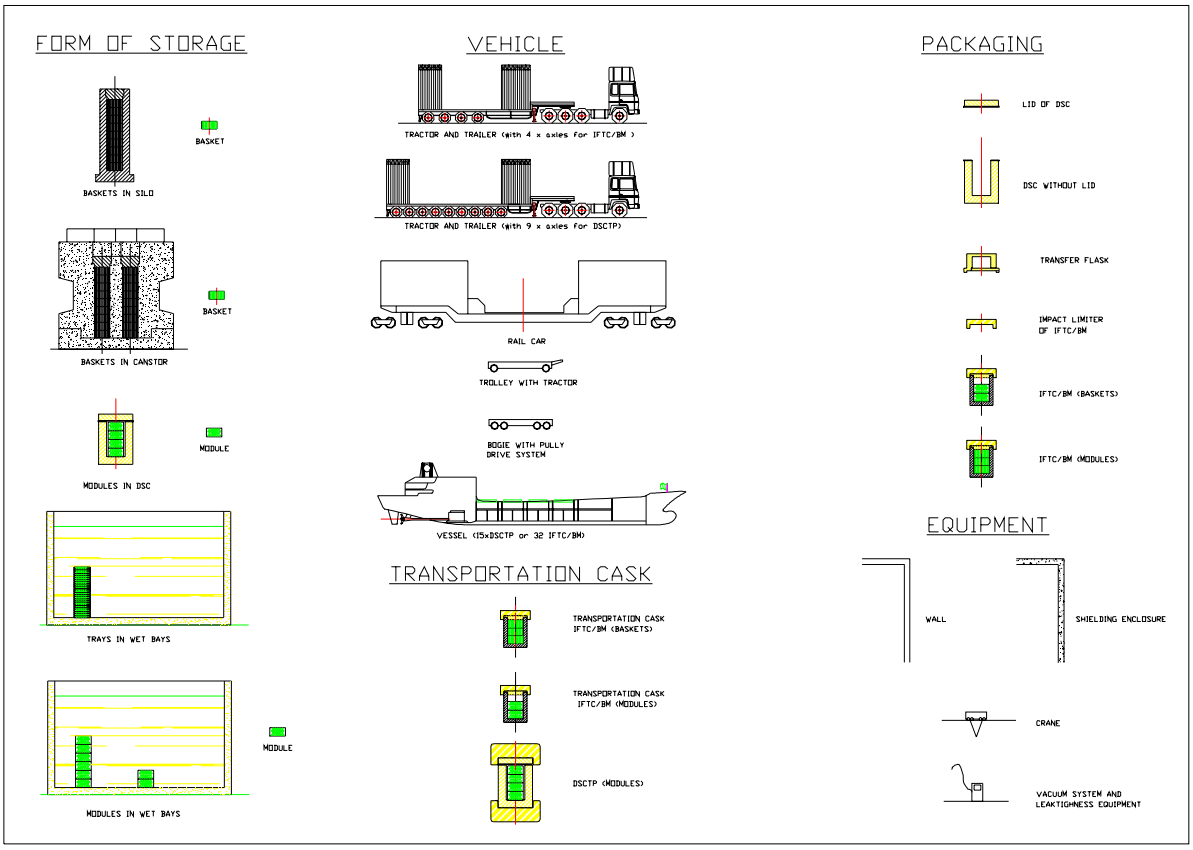
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.8.1
Phase 0	Baskets in Silo	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 2	Internal transfer of the transfer flask	Interim storage				2.0
Phase 3	Loading the baskets from the transfer flask into the packaging	UFTS	With a gantry crane , place the transfer flask on the hot cell	Transfer flask	Figure N°10: - Shielded fuel transfer cask - 26 tons with 60 bundles basket and with irradiated fuel - “Sliding” gate - Electric hoist for lifting or lowering a basket into the IFTC/BM - Chain - Basket lifting grapple - Shielding	3.0
				Gantry Crane	For the transfer flash	
				Lifting Beam for Transfer flask		
			With the hoist N°1, open the lid of the packaging in a hot cell.	Packaging	IFTC/BM: See chapter 2., section 2.4.7.1.3 of D#5 Appendix A, Figure N° 6	
			Load the baskets into the packaging			
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator, pump, vacuum gauges, valves,	4.0
			Filling the cavity with helium	Vacuum circuit	Air/water separator, pump, vacuum gauges, valves, compressed air line	
			Leaktightness check	Leaktightness equipement		
			Depressurising the cavity	Vacuum circuit		
			Installing the impact limiter			
Phase 5	Internal transfer of the packaging	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Approach of the Bogie	Bogie	Bogie with pulley drive system	5.0
			Radiological control of the Bogie	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Loading of the full Transportation cask on the Bogie			5.0
			Radiological control of the Transportation cask and the Bogie	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Internal transfer	Tie down		5.1

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.8.1
Phase 6	Loading the Transportation cask on a vessel	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	6.0
			Loading the Transportation cask on the hold of the vessel	Gantry Crane (on the vessel)	With 1 hoist (of 60 tons for the IFTC/BM	6.0
				Lifting Beam for packaging	To carry of the IFTC/BM (similar to the IFTC, **<3>**)	6.0
				Vessel	Section 3.7.1 of Chapter 3 Appendix A, Figure N°18	6.0
			Installing the impact limiter			6.1
			Packaging tie-down on the hold	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**)	6.1
			Check the condition of the Transportation cask , hold			6.1
			Fit the transport seals			6.1
			Close the upper deck			6.1
			Radiological control of the hold an the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	6.1
Phase 7	Water transportation	UFTS	Water transportation of the Transportation cask from the site to the water rail terminal		Protection equipment and materiel necessary to prevent radiation hazards : radiation protection kit	7.0
				Real time tracking	Appendix H	
Phase 8	Transfer of the Transportation cask from the vessel to a trailer	UFTS	Radiological control of the hold, the Transportation cask and the trailer		"Smear test", Radiameter	8.0
			Open the weather covers of the trailer	Weather covers		
			Loading the packaging from the vessel to the trailer	Gantry Crane (on the vessel)	With 1 hoist (of 60 tons for the IFTC/BM)	
				Lifting Beam for Transportation cask	To carry of the IFTC/BM (similar to the IFTC, **<3>**)	
				Real Time Tracking	Appendix H	
				Trailer (Appendix A, Figures N°13, 14)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic suspension to cushion the load - Trailer equipped with four axles - One loaded cask per trailer	
				Tractor (Appendix A, Figure N°14)	- Standard commercial tractor sufficient for the loaded weight - The weight for the fuelled reference tractor is roughly 9,075 kg.	
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the IFTC for the trailer (Appendix A, Figure N°15 , **<3>**)	
			Check the condition of the packaging, trailer			

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.8.1
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the hold , the trailer and of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	
Phase 9	Road transportation	UFTS	Road transportation of the Transportation cask from the water road terminal to the Centralised Facility			9.0
				Real time Tracking	Appendix H	
Phase 10	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			10.0
Phase 11	Internal transfer of the packaging	DGR/CES				


PHASE 0
BASKETS IN SILO
PHASE 1
UNLOADING OF THE BASKETS FROM SILO INTO THE TRANFER FLASK
PHASE 2
INTERNAL TRANSFER OF THE TRANSFER FLASK
Step.0
Step.1.0
Step.1.1
Step.1.2
Step.1.3
Step.2.0
PHASE 3
LOADING THE BASKETS FROM TRANSFER FLASK INTO THE PACKAGING
PHASE 4
PRE-SHIPMENT PACKAGING PREPARATION
HOIST N°1
Step.3.0
Step.3.1
Step.3.2
Step.4.0
PHASE 5
INTERNAL TRANSFER OF THE TRANSPORTATION CASK
PHASE 6
LOADING THE TRANSPORTATION CASK ON A VESSEL
STEP.5.0
STEP.6.0
PHASE 7
WATER TRANSPORTATION
PHASE 8
WATER/ROAD TRANSFER OF THE TRANSPORTATION CASK
PHASE 9
ROAD TRANSPORTATION
STEP.7.0
STEP.8.0
STEP.9.0
PHASE 10
UNLOADING OF THE TRANSPORTATION CASK
STEP.10.0
500276-01a
GENTILLY-BASKETS IN SILO
MOSTLY WATER
FIGN°.81

Key:


FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (15xDSCTP or 32 IFTC/BM)
TRANSPORTATION CASK
TRANSPORTATION CASK IFTC/BM (BASKETS)
TRANSPORTATION CASK IFTC/BM (MODULES)
DSCTP (MODULES)
PACKAGING
LID OF DSC
DSC WITHOUT LID
TRANSFER FLASK
IMPACT LIMITER OF IFTC/BM
IFTC/BM (BASKETS)
IFTC/BM (MODULES)
EQUIPMENT
WALL
SHIELDING ENCLOSURE
CRANE
VACUUM SYSTEM AND LEAKTIGHNESS EQUIPMENT

8.2. Baskets in Canstor (See Appendix B, Table N°5)

From Gentilly 2 to the Centralised Facility
Quantity of bundles to be transported from 2035 to 2064: see Appendix B, Table N°3.

8.2.1. Mode and route development

Feasibility of transporting used fuel from the different current storage site to the centralised facility.
Viability of shipping by road and the identification of a preferred shipping route.

***Water**:* The Gentilly reactors are located on the water, making the possibility of water transport a clear possibility [**<52>**, **<53>**, **<56>, <54>, <59>** and **<57>**]. Construction of a dock area would be required in order to provide a necessary loading area for the transport vessel; while detailed cost estimates are not included within the scope of this review, a cursory evaluation of transport costs indicates that the overall savings associated with a water-based transport program would significantly mitigate the cost of dock construction and related activities.

***Recommendation**:* Based on consideration of site-specific factors and related infrastructure for the Gentilly 1 & 2 facility, the water mode provides a viable means of transport requiring a moderate amount of infrastructure changes. This approach, however, provides for the most expedited shipment schedule and cost-effective system while also representing a unique opportunity to further enhance program efficiencies through consolidation into a smaller number of shipments.

A shorter shipping program is deemed desirable for the following reasons:

- A compressed shipping schedule would expedite removal of used fuel from the current storage sites. This may be significant financially, operationally and politically for individual sites. Additionally, sites contemplating decommissioning could take advantage of nearer-term shipping schedules.

- A shorter program would likely reduce overhead and management costs associated with the program.

- A shorter program would be consistent with physical security recommendations to reduce the duration of shipments of nuclear material.

For shipments from Gentilly, the proposed routing would take the vessel through the St. Lawrence Seaway into Ontario.

Use of the sample vessel used for this review would allow higher volume shipments, thus reducing the time required to complete the used fuel transfer from Gentilly. As Gentilly represents the single storage facility in the Province of Québec, it is deemed desirable to remove used fuel from the Province in a compressed time frame as compared with removing smaller shipments over a longer period.

Additional program savings can be realised through the consolidation of used fuel originating at Gentilly 1 and Gentilly 2 with used fuel originating at Point Lepreau. The routing for waterborne transport from Point Lepreau would take the vessel past the Gentilly 1 and 2 facilities, allowing of consolidation of the Gentilly used fuel and thus reducing the overall per cask shipment cost. This approach assumes that the delivery schedules for the Point Lepreau, Gentilly 1 and Gentilly 2 facilities are coordinated, however it appears that this approach would allow maximised use of the vessel without awaiting for a single site – such as Gentilly – to complete discharge and loading of a full vessel quantity.

As described above, the used fuel would be transported to the applicable water transfer station, representing water/rail transport.

8.2.2. Nuclear facility loading

Receive and prepare the used fuel and packages for loading, prepare packages for loading into transportation packages, pre-shipment tests, and prepare transportation package for transfer to a vessel.

See phases 4, 5 of paragraph 8.2.9 of the present document.

8.2.3. Transporter (vehicle)

8.2.3.1. Trolley with tractor

In order to transfer:

- The baskets from the silo to the packaging (phases 2 and 3 of table paragraph 8.2.9).

8.2.3.2. Bogie pulley drive system

In order to transfer:

- The IFTC/BM in the hot cell (phase 3 of table paragraph 8.2.9),
- The IFTC/BM to the pre-shipment packaging area (phase 4 of table paragraph 8.2.9),
- The IFTC/BM to the shipment area (phases 5 and 6 of table 8.2.9).

8.2.3.3. Vessel for the water transportation (phase 6 of table paragraph 8.2.9)

See section 3.7.1 of Chapter 3.

8.2.3.4. Frame of the Transportation cask for the water transportation

Similar to the rail transportation but adapted to the regulation concerning the accelerations.

8.2.3.5. Specific equipment for the water transportation

- GPS antenna (tracking) on the vessel
- Radiation protection kit:
  - Direct reading dosimeter,
  - Film dosimeters,
  - Gamma doses rate meter,
  - Neutron doses rate meter,
  - Counting rate meter,
  - Blank ”Measurements performed” forms,
  - Roll of filter papers for smear test,
  - Pairs of overshoes,
  - Vinyl gloves,
  - Disposable breathing mask,
  - Disposable camera with flash

8.2.3.6. Trailer for the road transportation (phase 8 of table paragraph 8.1.9)

- Modified 48 foot flatted trailer with integrated tie-down
- Trailer equipped with hydraulic suspension to cushion the load
- Trailer equipped with four axles
- One loaded cask per trailer
- 2 drivers and no escort

8.2.3.7. Tractor for the road transportation (phase 8 of table paragraph 8.1.9)

- Standard commercial tractor sufficient for the loaded weight
- The weight for the fuelled reference tractor is roughly 9,075 kg.

8.2.3.8. Weather cover for the road transportation (phase 8 of table paragraph 8.1.9)

- Rolling removable plastic weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. Two men (one on each side of the trailer) can manually open or close the weather cover which can rolls on a rail fixed on the frame of the Transportation cask.

- Holes and a ventilation shaft on the top of the cover are calculated to create an adequate draught around the Transportation cask during the transport. The weather cover is composed with two parts: one with a fixed metallic panel at the rear side, one with a fixed metallic panel at the front side. The weather cover can be taken off from the trailer with a specific frame fixed at the rear side of the frame for the Transportation cask.

8.2.3.9. Frame of the Transportation cask for the road transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the axles. This frame is fitted to the vehicle with twistlock devices plus a metal fitting designed for the appropriate accelerations. The numbers of attachments for the frame means it is still better to remove the cask from the frame, rather than taking than cask and the frame as unit during intermodal transfers.
The weather cover can rolls on a rail fixed on the frame of the Transportation cask. A drip pan is installed under the frame in order to collect the drain of water coming from the condensation of the Transportation cask. A manual valve with a padlock is installed at the lower level of the drip pan in order to collect the water.

8.2.3.10. Specific equipment for the road transportation

- GPS antenna (tracking) on the tractor
- Turning light (“Girophare”) on the tractor
- Tools box adapted to the Transportation cask

8.2.4. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for IFTC/BM: shared facility at the centralised site as developed in paragraph 3.2 of Chapter 3.

- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

8.2.5. Casks

Conceptual design for the Transportation package and tie-down systems for UFTS:

- Tie-down: Similar to the Tie down of the IFTC for the water and rail transportation (Appendix A, Figure N° 15, **<3>**)

- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 6 of Appendix A, Appendix C.

8.2.6. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Leakage and purging equipment:
  One complete equipment with vacuum pumps and gauges (see phase 4 of table paragraph 3.3.9)

- Gantry Crane :
  One for loading installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 3.3.9) and for install the impact limiter (phase 4)
  One for loading the Transportation cask on the vessel (see phase 6 of table paragraph 3.3.9)
  One for loading the Transportation cask from the vessel to the trailer (see phase 8 of table paragraph 3.3.9).

The two last gantry crane can be only one if the vessel has its own crane.

- Lifting beam:
  One for the Transfer flask (see phase 3 of table paragraph 3.3.9)
  One for the impact limiter of the packaging (see phase 4 of table paragraph 3.3.9)
  One for the Transportation cask (see phase 8 of table paragraph 3.3.9)

- Decontamination equipment (see paragraph 3.2. of Chapter 3).

8.2.7. UFTS Transportation system operation

Loading of packages onto the vessel, trailer, security, transportation, emergency response:

- Loading of packaging onto the vessel, security, transportation as described in phase 6 of table paragraph 8.2.9.

- Loading of Transportation cask from the vessel to the trailer, security, transportation as described in phase 8 of table paragraph 8.2.9.

- Emergency response plan: see paragraph 9 of Appendix F.

- Real time tracking: see paragraph 9 of Appendix F.

8.2.8. Decommissioning

Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

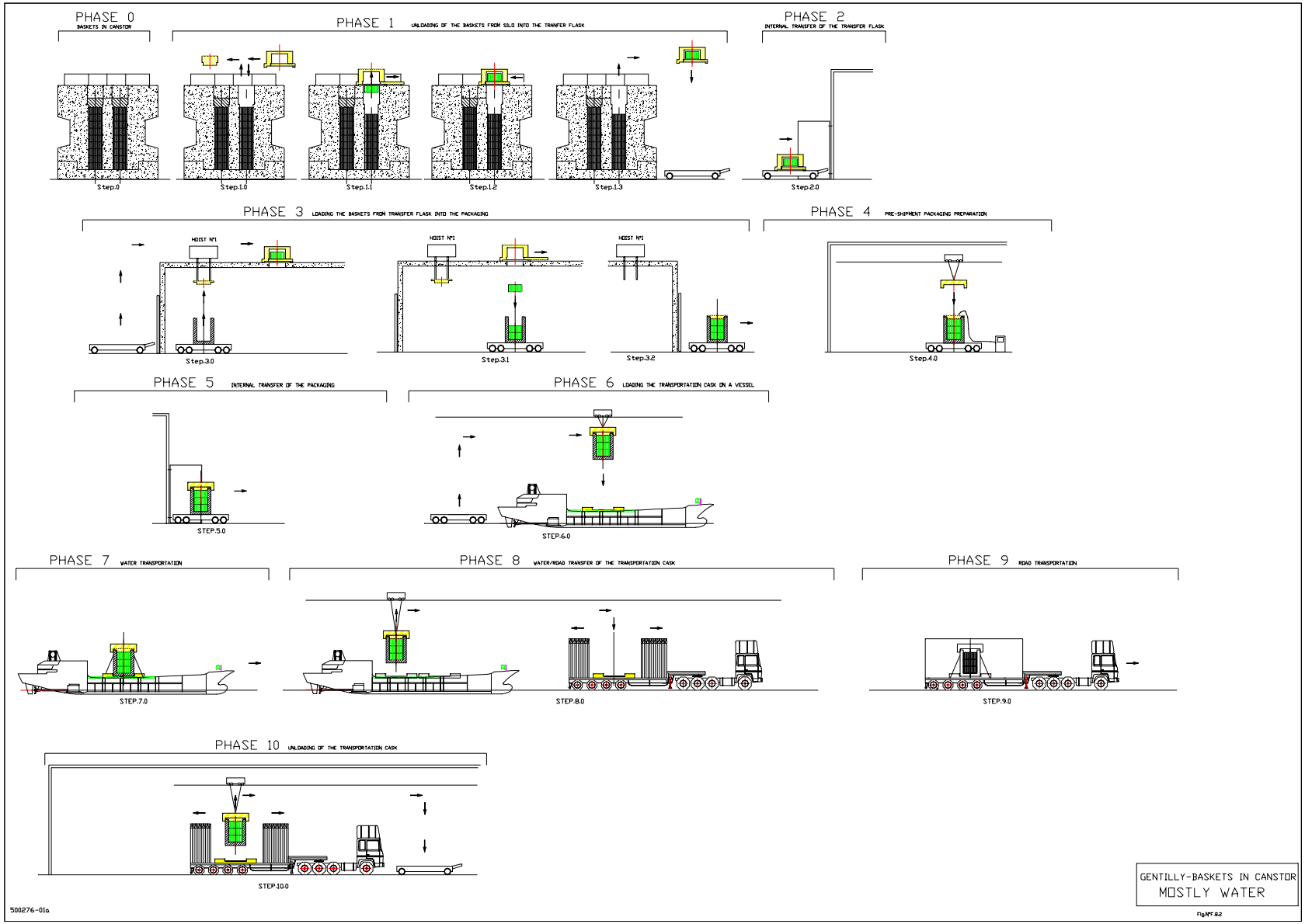
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

8.2.9. Table: Analysis of the operational phases of transport

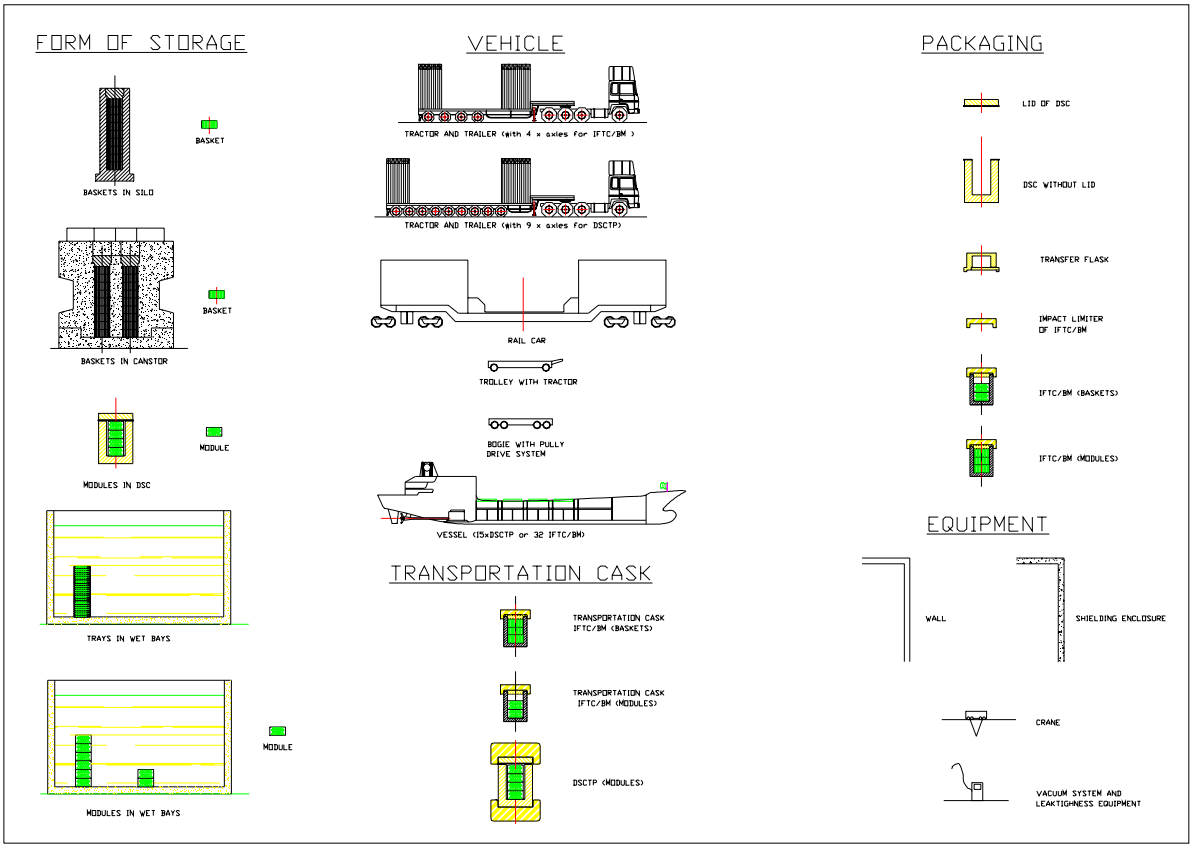
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F. 8.2
Phase 0	Baskets in Canstor	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 2	Internal transfer of the transfer flask	Interim storage				2.0
Phase 3	Loading the baskets from the transfer flask into the packaging	UFTS	With a gantry crane , place the transfer flask on the hot cell	Transfer flask	Figure N°10: - Shielded fuel transfer cask - 26 tons with 60 bundles basket and with irradiated fuel - “Sliding” gate - Electric hoist for lifting or lowering a basket into the IFTC/BM - Chain - Basket lifting grapple - Shielding	3.0
				Gantry Crane	For the transfer flash	
				Lifting Beam for Transfer flask		
			With the hoist N°1, open the lid of the packaging in a hot cell.	Packaging	IFTC/BM: See chapter 2., section 2.4.7.1.3 of D#5 Appendix A, Figure N° 6	
			Load the baskets into the packaging			
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator, pump, vacuum gauges, valves,	4.0
			Filling the cavity with helium	Vacuum circuit	Air/water separator, pump, vacuum gauges, valves, compressed air line	
			Leaktightness check	Leaktightness equipement		
			Depressurising the cavity	Vacuum circuit		
			Installing the impact limiter			
Phase 5	Internal transfer of the packaging	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Approach of the Bogie	Bogie	Bogie with pulley drive system	5.0
			Radiological control of the Bogie	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Loading of the full Transportation cask on the Bogie			5.0
			Radiological control of the Transportation cask and the Bogie	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0
			Internal transfer	Tie down		5.1

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.8.2
Phase 6	Loading the Transportation cask on a vessel	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	6.0
			Loading the Transportation cask on the hold of the vessel	Gantry Crane (on the vessel)	With 1 hoist (of 60 tons for the IFTC/BM	6.0
				Lifting Beam for packaging	To carry of the IFTC/BM (similar to the IFTC, **<3>**)	6.0
				Vessel	Section 3.7.1 of Chapter 3 Appendix A, Figure N°18	6.0
			Installing the impact limiter			6.1
			Packaging tie-down on the hold	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**)	6.1
			Check the condition of the Transportation cask , hold			6.1
			Fit the transport seals			6.1
			Close the upper deck			6.1
			Radiological control of the hold an the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	6.1
Phase 7	Water transportation	UFTS	Water transportation of the Transportation cask from the site to the water rail terminal		Protection equipment and materiel necessary to prevent radiation hazards : radiation protection kit	7.0
				Real time tracking	Appendix H	
Phase 8	Transfer of the Transportation cask from the vessel to a trailer	UFTS	Radiological control of the hold, the Transportation cask and the trailer		"Smear test", Radiameter	8.0
			Open the weather covers of the trailer	Weather covers		
			Loading the packaging from the vessel to the trailer	Gantry Crane (on the vessel)	With 1 hoist (of 60 tons for the IFTC/BM)	
				Lifting Beam for Transportation cask	To carry of the IFTC/BM (similar to the IFTC, **<3>**)	
				Real Time Tracking	Appendix H	
				Trailer (Appendix A, Figures N°13, 14)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic suspension to cushion the load - Trailer equipped with four axles - One loaded cask per trailer	
				Tractor (Appendix A, Figure N°14)	- Standard commercial tractor sufficient for the loaded weight - The weight for the fuelled reference tractor is roughly 9,075 kg.	
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the IFTC for the trailer (Appendix A, Figure N°15 , **<3>**)	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.8.2
			Check the condition of the packaging, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the hold , the trailer and of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	
Phase 9	Road transportation	UFTS	Road transportation of the Transportation cask from the water road terminal to the Centralised Facility			9.0
				Real time Tracking	Appendix H	
Phase 10	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			10.0
Phase 11	Internal transfer of the packaging	DGR/CES				


PHASE 0
BASKETS IN CANSTOR
Step.0
PHASE 1
UNLOADING OF THE BASKETS FROM SILO INTO THE TRANFER FLASK
Step.1.0
Step.1.1
Step.1.2
Step.1.3
PHASE 2
INTERNAL TRANSFER OF THE TRANSFER FLASK
Step.2.0
PHASE 3
LOADING THE BASKETS FROM TRANSFER FLASK INTO THE PACKAGING
HOIST N°1
Step.3.0
Step.3.1
Step.3.2
PHASE 4
PRE-SHIPMENT PACKAGING PREPARATION
Step.4.0
PHASE 5
INTERNAL TRANSFER OF THE PACKAGING
STEP.5.0
PHASE 6
LOADING THE TRANSPORTATION CASK ON A VESSEL
STEP.6.0
PHASE 7
WATER TRANSPORTATION
STEP.7.0
PHASE 8
WATER/ROAD TRANSFER OF THE TRANSPORTATION CASK
STEP.8.0
PHASE 9
ROAD TRANSPORTATION
STEP.9.0
PHASE 10
UNLOADING OF THE TRANSPORTATION CASK
STEP.10.0
500276-01a
GENTILLY-BASKETS IN CANSTOR
MOSTLY WATER
FIGN°.82

Key:


FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (15xDSCTP or 32 IFTC/BM)
TRANSPORTATION CASK
TRANSPORTATION CASK IFTC/BM (BASKETS)
TRANSPORTATION CASK IFTC/BM (MODULES)
DSCTP (MODULES)
PACKAGING
LID OF DSC
DSC WITHOUT LID
TRANSFER FLASK
IMPACT LIMITER OF IFTC/BM
IFTC/BM (BASKETS)
IFTC/BM (MODULES)
EQUIPMENT
WALL
SHIELDING ENCLOSURE
CRANE
VACUUM SYSTEM AND LEAKTIGHNESS EQUIPMENT

9. CENTRALISED SITE

Quantity of bundles to transport from 2035 to 2064: see Appendix A, Table N° 3

9.1. Mode and route development

In accordance with the shipment rate:

- Creation of a area to unload the Transportation cask from the trailer (scope of DGR/CSE site).

9.2. Transportation system maintenance facility

Design, procurement and construction of maintenance equipment, and the commissioning of the maintenance facility for UFTS:

- Maintenance equipment for IFTC/BM: shared facility at the centralised site as developed in paragraph 3.2 of Chapter 3.

- Maintenance equipment for Trailer: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

- Maintenance equipment for Tractor: shared facility at the centralised site (see paragraph 3.3 of Chapter 3).

9.3. UFTS Transportation system operation

- Emergency response plan:

As described in chapter 4 of D#5 an Emergency response plan for transportation, is needed.
The crisis cell will be located in a specially built crisis room at the Centralised Facility fully equipped with communication means (Vehicles tracking system, telephones, telefax, teleconference system,...) and all the necessary documentation (regulations, maps, safety files, ERPT and specific plans,…).

The crisis room is operated permanently during our transports using the real Time tracking system:

- Location of the vehicle (trucks, wagons, ship) with the GPS system
- Transmission of information with the Inmarsat system

In addition, we are thinking that OPG, as COGEMA LOGISTICS needs to own a **recovery system for heavy casks**. It may be needed if the casks are placed accidentally in a location where no classical means of recovery can be efficiently used.

- Real time tracking:
  As described in chapter 5 of D#5, dedicated sea and ground transports for UFTS can be real time tracked from an OPG headquarters to be located at the Centralised Facility. Road vehicles, railway wagons as well as dedicated vessels involved in the logistic network for UFTS can be equipped with specific tracking systems.