COGEMA LOGISTICS

Conceptual Designs for Transportation of Used Fuel to a Centralised Facility

Report of a Study carried out for Ontario Power Generation, New Brunswick Power, Hydro-Québec and Atomic Energy of Canada Limited

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Réf.	**500276-B-005**	**Rév.**	**00**	Approved by	**J.-L. MONDANEL**		

CONTENTS

APPENDIX A : FIGURES

General:

Packaging and Transportation casks:

Equipment / Facilities:

Vehicles :

APPENDIX B: BASIS AND INTERFACES

Table N°1: Basis for “All road”

Table N°2: Basis for “Mostly rail”

Table N°3: Basis for “Mostly water”

Table N°4: Interfaces between storage and transportation for each site where the form of storage is baskets in Silo

Table N°5: Interfaces between storage and transportation for each site where the form of storage is baskets in Canstor

Table N°6: Interfaces between storage and transportation for each site where the f form of storage is trays in wet bays

Table N°7: Interfaces between storage and transportation for each site where the form of storage is modules in wet bays

Table N°8: Interfaces between storage and transportation for each site where the form of storage is modules in DSC

APPENDIX C: Road Transport Feasibility of IFTC/BM and DSCTP

APPENDIX D: Conceptual design and description for all the UFTS components in the case of “All road” mode for each site

APPENDIX E: Conceptual design and description for all the UFTS components in the case of “Mostly rail” mode for each site

APPENDIX F: Conceptual design and description for all the UFTS components in the case of “Mostly water” mode for each site

APPENDIX G: Example of the COGEMA LOGISTICS rail-to-road terminal at Valognes

APPENDIX H: The real time tracking system of COGEMA LOGISTICS

1. CHAPTER N° 1: INTRODUCTION

1.1. BACKGROUND AND PURPOSE

The purpose of the Used Fuel Transportation System (UFTS) is to transport all the used fuel arising from current Canadian program, consisting of approximately 3.6 million bundles, from their current storage facilities to a centralised long-term management facility (see Appendix A, Figure N°1). This facility may be a Deep Geologic Repository (DGR) or a Centralised Extended Storage (CES) facility, depending on the option chosen by federal government after the review of options required by the Nuclear Fuel Waste Act (Canada 2001). If continued storage at the current sites is chosen, then no transportation system will be required.
The UFTS will be required on a timescale dependent on the earliest in-service date projected for a centralised facility (~2023 for the CES facility; ~2035 for the DGR). Where needed in the design and logistics, the details of the shipping program applicable to the 2035 in-service date were used. For the purposes of the study, it was assumed that the centralised facility would be located somewhere in Ontario.

The UFTS study is divided in 3 phases:

- Phase 1: Conceptual design studies, including preliminary studies of the feasibility of certain transportation options,
- Phase 2: Logistics studies, including a study of the feasibility of the reference shipment schedules,
- Phase 3: Cost estimates.

The present report, is a Technical and Final Report entitled « Conceptual Designs for Transportation of Used Fuel to a Centralised Facility ». This report defines the conceptual designs and the descriptions for all components of the UFTS.

The report includes three alternative transportation systems:

- “All road”,
- “Mostly rail”,
- “Mostly water”.

The systems will be based on one existing cask and one new cask:

Existing cask:

- OPG’s Dry Storage Container Transportation Package (DSCTP)

New cask:

- Irradiated Fuel Transportation Cask for Baskets or Modules (IFTC/BM).

The UFTS will meet all regulatory requirements, and is designed for safe, efficient and cost-effective transport. The system is designed to operate under an environmental management system based on the ISO 14001 standard.

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Used Fuel Dry storage Container (DSC) DSC lid –sub assembly – Drawing N° 92896 D1H 29642 0003 rev.9
Used Fuel Dry storage Container (DSC) Lifting plate detail – Drawing N° 92896 D1H 29642 0011 Rev.5

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Dry Storage Container (DSC) – Outer packaging Top impact limiter details- Drawing N° 928005-03_M102 rev.0
Dry Storage Container (DSC) – Outer package Top impact limiter details- Drawing N° 928005-03_M103 rev.0
Dry Storage Container (DSC) – Outer packaging Top impact limiter details- Drawing N° 928005-03_M104 rev.0
Dry Storage Container (DSC) – Outer package Bottom impact limiter - Drawing N° 928005-03_M105 rev.0
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1.3. DEFINITIONS

Basket means a sealed stainless steel container for holding used fuel, in use in the dry storage facilities at Point Lepreau, Gentilly 1 and 2, Douglas Point, Whiteshell and Chalk River **<2>**, **<7>**.

Cask means a robust, re-usable container used for transportation of highly active radioactive material such as used fuel, designed according to the requirements of CNSC's Packaging and Transportation of Nuclear Substances regulations. The cask provides containment, heat dissipation, radiation shielding, and protection of the contents in normal operation and in the case of a transportation accident. An internal structure, baskets, or module is used to constrain the fuel bundles within the cask.

Centralised Facility means a facility used for the extended storage or geologic emplacement of used nuclear fuel. The facility would be located at a single, central location and would accept used nuclear fuel from all reactor sites in Canada.

Current Storage Site means one of the seven sites shown in Appendix A, Figure N° 2 of the present document.

Loading means placement of used fuel in a transportation cask, and carrying out all draining, flushing, backfilling, sealing, bolting etc. activities needed to ensure continuation of containment, shielding and protection of used fuel.

Module means the OPG storage/transportation module used for handling and storage of used fuel at the Pickering (AIFB and dry storage facility), Bruce (dry storage facility), and Darlington sites **<1>**.

Preparation for shipment means cask decontamination, monitoring, attaching impact limiters if used, labelling and documenting,. Placing the cask on or in the transport vehicle, securing tiedowns, inspection and placarding and all other activities needed prior to release of the vehicle from the nuclear site.

Transportation package means a package designed for transportation of radioactive materials and meeting the requirements of the Canadian nuclear Safety Commission's Packaging and Transport of Nuclear Substances Regulations. The transportation package for used fuel is usually referred to a cask.

Transportation system in this document means a system for retrieving used fuel from the current storage facilities, and transporting it to a centralised site. It includes all facilities, handling equipment, test equipment, casks, vehicles, tie-down systems, maintenance provision, management provisions, emergency response provisions, communications, security, safe guards, contingency provisions, ancillary facilities, and all other items required for safe and effective functioning.

2. CHAPTER N° 2: PRELIMINARY STUDIES

2.1. EVALUATION OF OPTIONS FOR TRANSPORTATION OF USED FUEL CURRENTLY STORED IN SPENT FUEL BASKETS.

Options for transportation of used fuel currently stored in Spent Fuel Baskets as part of the Used Fuel Transportation System (UFTS) were evaluated. Fuel baskets are currently transported on site in a vertical orientation. Studies by AECL on the transportability of the baskets in the case of off-site transport are not yet complete. For the purposes of the present study, the used fuel currently stored in baskets is assumed to be transported to the centralised facility in the baskets, in a vertical orientation, within a transportation cask. The Dry Storage Cask Transportation Package, the Irradiated Fuel Transportation Cask and potential existing and new conceptual cask designs are evaluated for transportation of the baskets.

2.1.1 CONCLUSIONS

Various options for transport of used CANDU fuel currently stored in baskets have been evaluated. Based on the discussions above, the following table summarises the various options for transporting the used fuel bundles. Advantages and disadvantages for each transport scenario are also shown in the table hereafter. Transport by an used existing Transport Cask design is not listed in this table because there is no suitable existing cask.

Because the DSCTP is seal welded closed, intended for single use only, and because the DSCTP will incur excessive road transport restrictions due to its weight, the DSCTP is considered impractical for transport of the Spent Fuel Baskets.

The existing Irradiated Fuel Transportation Cask (IFTC), which is relatively light, incurring considerably less transport restrictions, and which is intended for repeated use, does not easily accommodate the Spent Fuel Bask geometry and configuration requirements.

No existing COGEMA LOGISTICS Transport cask can be readily used to transport Spent Fuel Baskets primarily because of their geometry and transport orientation.

2.1.2 RECOMMENDATIONS

Because of the arguments tabulated above, it is recommended that a modified IFTC with a slighter larger cavity size that could accommodate two (or possible three) of the larger baskets in the vertical orientation be designed and licensed. Increasing the cavity size of the IFTC represents only a small modification to the cask design, and therefore, should be easier to license than a completely new cask. Also, since the IFTC is currently licensed to transport Standard Fuel Storage Modules, the modified IFTC could be used to transport both baskets and modules, which would reduce operations and expenses. Inexpensive and lightweight aluminium inserts could be used to account for the differences in geometry between the large and small baskets and the modules.

FUEL BUNDLE PACKAGING	**TRANSPORT CASK**	**ADVANTAGES for transportation of baskets**	**DISADVANTAGES for transportation of baskets**
Fuel in Spent Fuel Baskets with fuel vertical	DSCTP	• Is currently licensed for rail or sea transport in Canada.	• Transport Cask must be rotated 90° on axis. • Only licensed for rail or sea transport. • Package weight incurs transport restrictions [**<10> - <20>**] • Difficult to load with baskets. • Can only hold two baskets. • Has seal-welded closure, intended for single use.
	IFTC	• Is currently licensed for transport in Canada. • The package is relatively lightweight and therefore incurs less highway restrictions. • With minor redesign, two large baskets could be accommodated.	• Transport Cask must be shipped horizontally, which has not been analysed or licensed. • Difficult to load with baskets. • Can only hold one basket.
	A new Cask design	• Perfectly suited to ship baskets. • Could be designed to ship both baskets and modules.	• Design, Analysis and licensing required.

2.2. FEASIBILITY STUDY FOR THE TRANSPORTATION OF THE DRY STORAGE CONTAINERS

The feasibility of transportation of Ontario Power Generation's (OPG) Dry Storage Containers (DSC) as part of the Used Fuel Transportation System (UFTS) was examined. Since work has already been done to design and license the DSCs for transport under the Dry Storage Container Transport Package (DSCTP) license, the DSCTP, instead of a new package design for protection of the DSC during transportation, was evaluated in this study. Requirements for transport, effects of DSC ageing, as well as requirements for preparing the DSCs for transport were evaluated. Advantages and disadvantages of using the DSCs as part of the UFTS are tabulated and **it is concluded that the DSCTP should be used to transport all fuel bundles stored in DSCs at the time of transport, and the remaining fuel bundles in wet storage should be transported in a lighter package such as the IFTC.**

2.2.1 CONCLUSIONS

Even though the DSCTP is currently only licensed for transport by rail or by water, only a small amount of additional analysis and licensing work would be required in order to transport the DSCTP by road.

The main disadvantage of using the DSCTP as part of the all-road UFTS is that the DSCTP is exceedingly heavy (100.31 Mg). Typical road-weight casks usually weigh less than 40 Mg (like OPG's IFTC), while the DSCTP exceeds 100 Mg. Heavy Transport Casks like the DSCTP are typically transported by rail or by water whenever possible. Based on the requirements contained in **<10>** to **<20>**, utilisation of the DSCTP for transportation would incur many transport restrictions. Vehicle type, mode, route, and season of transport are all restricted for a package of this weight.

At the time of transport, a total of 2,212,178 used fuel bundles will be stored in DSCs, and 1,062,253 bundles will still be in wet storage **<9>**. Therefore, roughly 5,761 DSCs will be loaded and in place in the Dry Storage Facilities at the various sites **<9>**.

The following table compiles advantages and disadvantages for each aspect of transportation of the DSC to a centralised facility.

	ADVANTAGES	DISADVANTAGES
Fabrication	• Does not require construction of additional Casks.	• Equipment to attach impact limiters and rotate package will be required. • A Number of sets of the Outer Packaging must be constructed.
Operations	• Does not require unloading of the fuel bundles from the seal-welded DSCs. • Roughly 2/3 of bundles will already be stored in DSCs at time of transport.	• Package must be rotated and placed into Outer Packaging.
Logistics	• Is already licensed for transport by rail or by water under the DSCTP SAR. • DSCTP can be licensed for road transport "easily".	Package weight incurs excessive road transport restrictions [**<10> - <20>**]

2.2.2 RECOMMENDATIONS

Because roughly 2/3 of all used fuel bundles produced at sites where DSCs are used for dry storage will already be stored in DSCs at the time of transport **<9>**, it would be most efficient to use these DSCs for transport of these bundles. The DSCs are currently licensed for rail and water transport under the DSCTP SAR and can be easily re-licensed for road transport. The additional work required to unload 5,761 seal welded DSCs and repackage the four modules inside each in another Transport Cask makes transport of these bundles in another package highly inefficient.

However, the 1,062,253 bundles that will still be in wet storage at the time of transport, can be loaded into any Transport Cask desired. The IFTC is currently licensed, and could readily be used to transport the fuel bundles in wet storage. Most used fuel bundles that will be in wet storage, will be stored in Standard Fuel Storage Modules, two of which can readily be loaded into a single IFTC for transport. The IFTC is a considerably lighter cask which does not incur the excessive road transport restrictions that are imposed on the DSCTP, and the IFTC is designed for repeat usage with a bolted closure which makes it operationally more efficient than the DSCTP.

If a new cask is to be designed to transport the Spent Fuel baskets then the new transport cask design may also accommodate the remaining modules left in wet storage at the time of transport. A new cask could be designed to accommodate both Spent Fuel Baskets and Standard Fuel Storage Modules, which would reduce operation time and effort, by enabling the use of common ancillary equipment and procedures.

If the Used Fuel Transportation System utilises the DSCTP, then there are also advantages to transporting the remaining fuel in wet storage in a heavy Transportation Cask like the DSCTP. Handling equipment, procedures, and necessary highway transport permits would already be in place for the DSCTP that could also be used for another heavy Transportation Cask. A larger cask has the obvious advantage of having the capacity to accommodate more used fuel. However, if rail or water transport is used, multiple smaller packages like the IFTC (which is already licensed) can be used in a single shipment essentially cancelling out the capacity advantage of a larger cask.

2.3. TRANSPORT MODE ASSESSMENT

The feasibility of transportation of used fuel from each current storage site to a centralised facility by:

- the road mode of transportation,
- the rail mode of transportation, and
- the water mode of transportation.

was investigated.

The transport of Canadian used fuel to a centralised repository – either the Deep Geologic Repository or a Centralised Extended Storage facility – is clearly feasible. The focus of forward-going analyses should therefore be on maximising the effectiveness of the used fuel transport system.

Given the geography, existing infrastructure and location of current storage sites, each of the studied modes - road, rail and water – has benefits and disadvantages when compared against specific locales.

In the present report, three alternative transportation systems are developed. The systems take account of site-specific aspects of transportation infrastructure.

2.4. DESIGN BASIS AND ASSUMPTIONS FOR THE USED FUEL TRANSPORTATION SYSTEM

2.4.1 Current Storage Sites

The reactor sites where used fuel is currently stored in Canada are (see Appendix A, Figure N° 2 of the present document):

- Whiteshell Laboratories
- Bruce
- Pickering
- Darlington
- Chalk River Laboratories
- Gentilly
- Point Lepreau

2.4.2 Reactors

For the Current Storage Site of (see Appendix B, Tables N° 1 to 3 of the present document):

- Whiteshell Laboratories the fuel is from the Douglas Point reactor (experimental fuel stored at Whiteshell is not included in the scope of the present study),
- Bruce the reactors are Bruce A, Bruce B and Douglas Point,
- Pickering the reactors are Pickering A and Pickering B,
- Darlington the reactor is Darlington,
- Chalk River Laboratories the fuel is from the Nuclear Power Demonstration reactor (experimental fuel stored at Chalk River is not included in the scope of the present study),
- Gentilly the reactors are Gentilly 1 and Gentilly 2,
- Point Lepreau the reactor is Point Lepreau.

All these reactors are CANDU type (Appendix A, Figure N° 3), designed by Atomic Energy Canada Limited (AECL). The Used Fuel belongs to different waste owners.

2.4.3 Waste Owners

The waste of the reactors of Pickering A and B, Bruce A and B, Darlington belongs to **Ontario Power Generation (OPG)**.
The waste of the reactors of Gentilly 2 belongs to **Hydro Québec**.
The waste of the reactors of Douglas Point, Nuclear Power Demonstration, Gentilly 1, Chalk River and Whiteshell belongs to **Atomic Energy of Canada Limited (AECL)**.
The waste of the reactor of Point Lepreau belongs to **New Brunswick Power (NBP)**

This is illustrated in Appendix B, Tables N° 1 to 3 of the present document issued of **<1>**.

2.4.4 FORMS OF STORAGE

Five forms of storage are existing:

- Baskets in Silos,
- Baskets in CANSTORS,
- Trays in wet bays,
- Modules in wet bays,
- Modules in DSCs.

Modules in wet bays and trays in wet bays are wet storage.
Modules in DSCs, baskets in silo, canisters and baskets in CANSTOR vaults are dry storage.

The forms of storage per site/reactor/facility are given in Appendix B, Tables N° 1 to 3 of the present document.

2.4.5 FACILITIES OF REACTORS AT THE TIME OF TRANSPORTATION

Facilities are given on Appendix B, Tables N° 1 to 3 of the present document:

The waste of **Pickering A and B** will be stored at:
Pickering A and B Facility for Modules in wet bays,
Pickering Used Fuel Dry Storage Facility for Modules in DSCs.

The waste of **Bruce and Douglas Point** will be stored at:
Bruce B Facility for Trays in wet bays,
Western Used Fuel Dry Storage Facility for Modules in DSCs,
Douglas Point Facility for Baskets in Silo canisters.

The waste of **Darlington** will be stored at:
Darlington Facility for Modules in wet bays,
Darlington Used Fuel Dry Storage Facility for Modules in DSCs.

The waste of **Gentilly 1 and 2** will be stored at:
Gentilly 1 Facility for Baskets in Silo canisters,
Gentilly 2 Facility for Baskets in CANSTOR vaults.

The waste of **Point Lepreau** will be stored at:
Point Lepreau Facility for Baskets in Silo canisters.

The waste of **Chalk River** will be stored at:
Nuclear Power Demonstration (NPD) fuel Facility for Basket in Silo canisters.

The waste of **Whiteshell** will be stored at:
Douglas Point Fuel Facility for Baskets in Silo canisters.

2.4.6 TRANSPORTATION CASKS

The systems will be based on one existing cask and one new cask:

Existing cask:

- OPG's Dry Storage Container Transportation Package (DSCTP – see Chapter 2, section 2.4.7.2.3)

New cask:

- Irradiated Fuel Transportation Cask for Baskets or Modules (IFTC/BM - See Chapter 2, section 2.4.7.1.3)

2.4.7 MODES

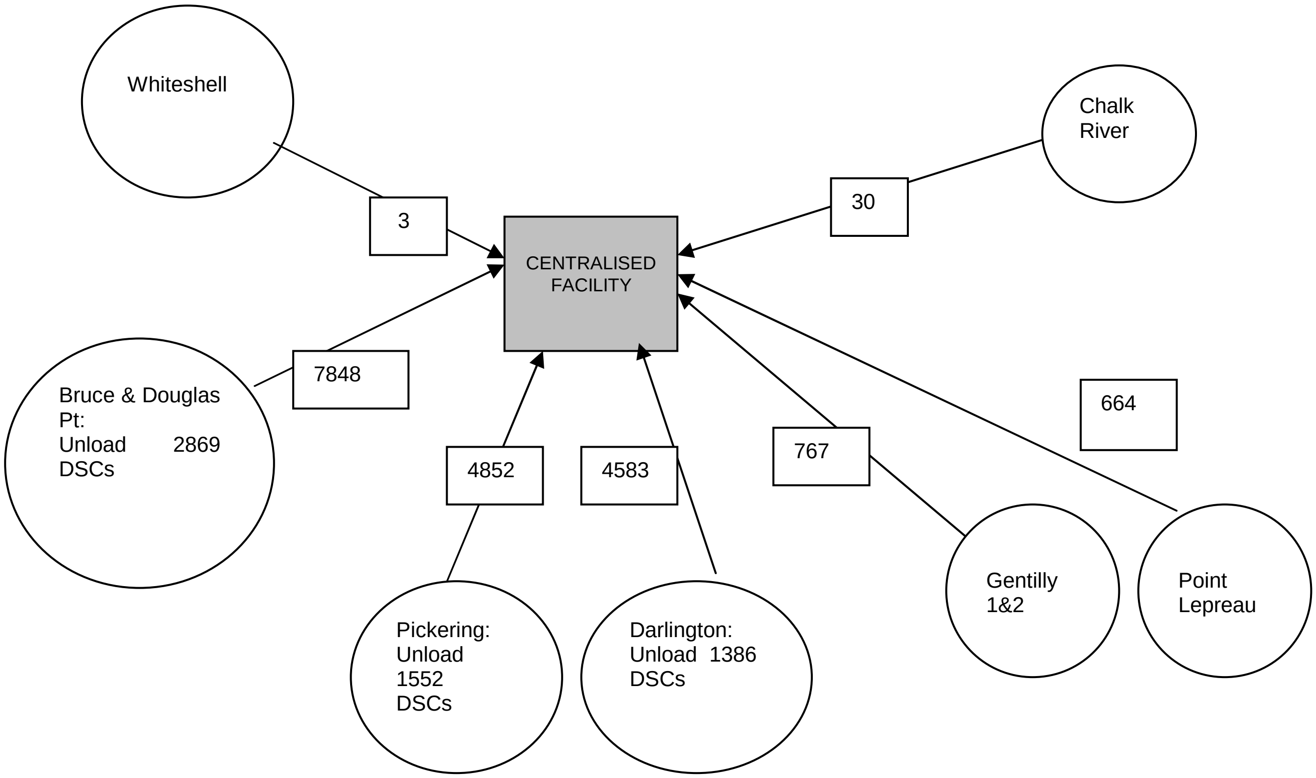
Three alternative transportation systems will be studied:

- "All road",
- "Mostly rail",
- "Mostly water".

2.4.7.1 All road

2.4.7.1.1 Features:

- Most flexible with respect to location of centralised site
- The only « one –mode » system
- All fuel loaded in IFTC/BMs
- 12 trucks arrive at centralised site each week (on average)
- Total 18 747 shipments over program
- Unload DSCs at current storage sites
- Upgrade on-site roadways



Key:

—— Road number, e.g. [7848] show total number of shipments:

Road – 1 x 192 bundle IFTC/BMs (modules) for Bruce, Pickering and Darlington
1 x 120 bundle IFTC/BMs (baskets) for Whiteshell
1 x 162 bundle IFTC/BMs (baskets) for Chalk River and Bruce (Douglas Point)
1 x 114 bundle IFTC/BMs (baskets) for Gentilly 1
1 x 180 bundle IFTC/BMs (baskets) for Gentilly 2 and Point Lepreau
The number of shipments is calculated in Table N°1 Appendix B, of the present document.

2.4.7.1.2 Interfaces for each site

Whiteshell (Appendix B, Table N° 4)

Form of storage: Baskets in Silo
Reactor: the fuel is from the Douglas Point reactor (experimental fuel stored at Whiteshell is not included in the scope of the present study),
Facility: Douglas Point Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos, ready to be loaded into the transportation cask.

Bruce

a) Form of storage: Trays in wet bays (Appendix B, Table N° 6)
Reactors: Bruce B
Facility: Bruce B Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: the used fuel will be in transportation modules in the existing bay.

b) Form of storage: Modules in DSCs (Appendix B, Table N° 8)
Reactors: Bruce A and Bruce B
Facility: WUFDSF
Transportation cask: IFTC/BM
Interface between storage and transportation: The used fuel will be in transportation modules in a hot cell at the facility ready for loading into the transportation cask.

c) Form of storage: Baskets in Silo (Appendix B, Table N° 4)
Reactor: Douglas Point
Facility: Douglas Point Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

Pickering

a) Form of storage: Modules in wet bays (Appendix B, Table N° 7)
Reactors: Pickering A and Pickering B
Facility: Pickering A and Pickering B Facilities
Transportation cask: IFTC/BM
Interface between storage and transportation: the used fuel will be in transportation modules in the Primary bay (for Pickering B Facility) or in the Auxiliary bay (for Pickering A Facility).

b) Form of storage: Modules in DSCs (Appendix B, Table N° 8)
Reactors: Pickering A and Pickering B
Facility: PUFDSF
Transportation cask: IFTC/BM
Interface between storage and transportation: the used fuel will be in transportation modules in a hot cell at the facility ready for loading into the transportation cask.

Darlington

a) Form of storage: Modules in wet bays (Appendix B, Table N° 7)
Reactors: Darlington
Facility: Darlington Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: the used fuel will be in transportation modules in the existing bays. There are two bays at Darlington, one at each end of the station.

b) Form of storage: Modules in DSCs (Appendix B, Table N° 8)
Reactors: Darlington
Facility: DUFDSF
Transportation cask: IFTC/BM
Interface between storage and transportation: the used fuel will be in transportation modules in a hot cell at the facility ready for loading into the transportation cask.

Chalk River (Appendix B, Table N° 4)

Form of storage: Baskets in Silo
Reactors: Nuclear Power Demonstration (NPD)
Facility: NPD Fuel
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

Gentilly

a) Form of storage: Baskets in Silo (Appendix B, Table N° 4)
Reactor: Gentilly 1
Facility: Gentilly 1 Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

b) Form of storage: Baskets in CANSTOR (Appendix B, Table N° 5)
Reactors: Gentilly 2
Facility: Gentilly 2 Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load Canstors ready to be loaded into the transportation cask.

Point Lepreau (Appendix B, Table N° 4)

Form of storage: Baskets in Silo
Reactor: Point Lepreau
Facility: Point Lepreau Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

2.4.7.1.3 Transportation casks

The transportation cask used is the Irradiated Fuel Transportation Cask for Baskets and Modules (IFTC/BM).

Description of IFTC/BM

The IFTC/BM design is based on the existing, licensed, OPG IFTC, shown in Figure N° 4 of Appendix A. Since only one IFTC has been constructed, an economical option would be to obtain a licence for a modified IFTC design having a slightly wider cavity that could accommodate both the Spent Fuel Baskets in the vertical orientation and the fuel modules. **This cask could have the following name: Irradiated Fuel Transportation Cask for Baskets and Modules (IFTC/BM**). This could be accomplished by designing a cask with a cavity large enough for both the baskets and modules and using inserts to account for their geometrical differences, as shown in Figures N° 5 and N° 6 of Appendix A. The inserts could be constructed from aluminium, which is light and inexpensive. The larger cavity could be achieved by reducing the thickness of two of the IFTC walls by roughly 10%. The effects of the change on shielding, heat dissipation, mass and structural performance would all need to be assessed during detailed design and licensing. Since both baskets and modules carry the same CANDU fuel, and are constructed from the same material, analysis and licensing for transportation of both would require only a little additional work relative to the work required to license a cask for transport of the baskets alone. A transport cask capable of handling both baskets and modules would also be more operationally efficient during transport and unloading at the centralised facility, since only a single type of transport frame, vehicle, and handling equipment is needed.

The IFTC/BM could transport 3 baskets or 2 standard Modules (see Appendix A, Figures N° 5 and 6). The number of bundles would be similar in either case, and so the existing analyses for the IFTC indicate that a similar design could be shown to meet regulatory requirements.

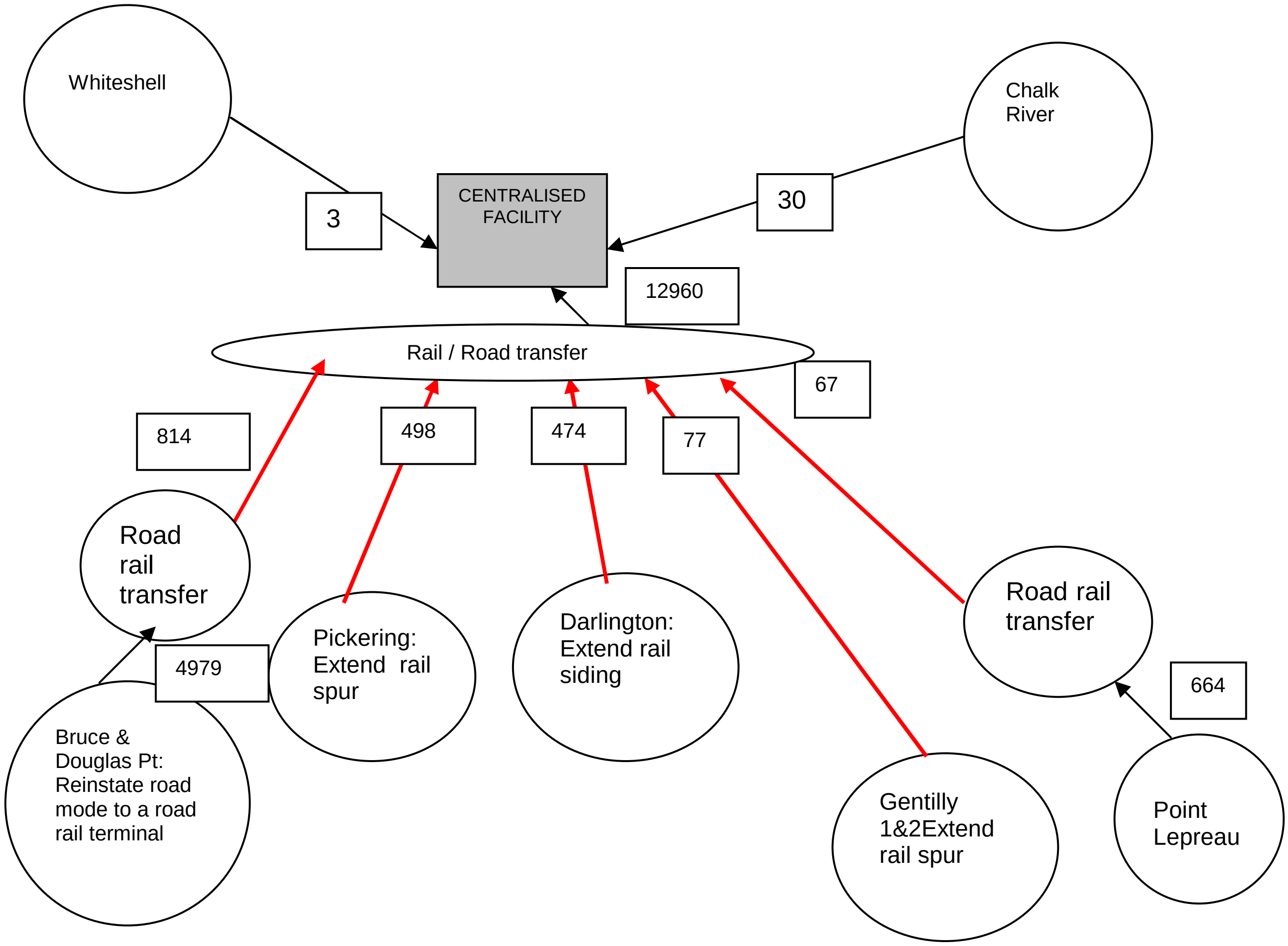
The weight of this transportation cask will be about 42.5 tons (Appendix C).

The Irradiated Fuel Transportation Cask for Baskets and Modules (IFTC/BM) can be used for all the Current Storage Sites and for all the forms of storage (Silo, CANSTOR, trays in wet bays, Modules in wet bays or DSCs).

2.4.7.2 "Mostly rail"

2.4.7.2.1 Features :

- Road links to railheads where needed. A possible alternative for the Bruce site would be to reinstate the rail line,
- Fuel loaded in IFTC/BMs (except DSCs),
- All DSCs transported,
- 8.3 trucks arrive at centralised site each week,
- Total 1930 rail shipments over program with 12960 connecting and additional road shipments,
- Assume road link to centralised site,
- Extend rail spurs into Pickering and Darlington UFDSFs and into Gentilly site,
- Up-grade on-site roadways at 2 possibly 3 sites,
- Potential cost savings from larger shipments.



Key:

Road
Rail

number, e.g. 814 show total number of shipments:

Road –
1 x 120 bundle IFTC/BMs (baskets) for Whiteshell
1 x 162 bundle IFTC/BMs (baskets) for Chalk River and Bruce (Douglas Point)
1 x 114 bundle IFTC/BMs (baskets) for Gentilly 1
1 x 180 bundle IFTC/BMs (baskets) for Gentilly 2 and Point Lepreau
1 x 384 DSCTP for Bruce, Pickering and Darlington
1 x 192 IFTC/BMs (modules) for Bruce, Pickering and Darlington

Rail – 5 x 384 bundle DSCTPs for Bruce, Pickering and Darlington or 5 x 2 x IFTC/BMs (baskets) for Point Lepreau and Gentilly 2 or 5 x 2 x 192 bundle IFTC/BMs (modules) for Bruce, Pickering and Darlington

The number of shipments is calculated in Table N° 2 Appendix B of the present document

2.4.7.2.2 Interfaces for each site

Whiteshell (Appendix B, Table N° 4)

Form of storage: Baskets in Silo
Reactor: the fuel is from the Douglas Point reactor (experimental fuel stored at Whiteshell is not included in the scope of the present study),
Facility: Douglas Point Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

Bruce

a) Form of storage: Trays in wet bays (Appendix B, Table N° 6)
Reactors: Bruce B
Facility: Bruce B Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: the used fuel will be in transportation modules in the existing bay.

b) Form of storage: Modules in DSCs (Appendix B, Table N° 8)
Reactors: Bruce A and Bruce B
Facility: WUFDSF
Transportation cask: DSCTP
Interface between storage and transportation: the used fuel will be in DSCs in the storage locations in the WUFDSF.

c) Form of storage: Baskets in Silo (Appendix B, Table N° 4)
Reactor: Douglas Point
Facility: Douglas Point Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

Pickering

a) Form of storage: Modules in wet bays (Appendix B, Table N° 7)
Reactors: Pickering A and Pickering B
Facility: Pickering A and Pickering B Facilities
Transportation cask: IFTC/BM
Interface between storage and transportation: the used fuel will be in transportation modules in the Primary bay (Pickering B Facility) or in the Auxiliary bay (Pickering A Facility).

b) Form of storage: Modules in DSCs (Appendix B, Table N° 8)
Reactors: Pickering A and Pickering B
Facility: PUFDSF
Transportation cask: DSCTP
Interface between storage and transportation: the used fuel will be in DSCs in the storage locations in the PUFDSF.

Darlington

a) Form of storage Modules in wet bays (Appendix B, Table N° 7)
Reactors: Darlington
Facility: Darlington Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: the used fuel will be in transportation modules in the existing bays.

b) Form of storage: Modules in DSCs (Appendix B, Table N° 8)
Reactors: Darlington
Facility: DUFDSF
Transportation cask: DSCTP
Interface between storage and transportation: the used fuel will be in DSCs in the storage locations in the DUFDSF.

Chalk River (Appendix B, Table N° 4)

Form of storage: Baskets in Silo
Reactors: Nuclear Power Demonstration (NPD)
Facility: NPD Fuel
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

Gentilly

a) Form of storage: Baskets in Silo (Appendix B, Table N° 4)
Reactor: Gentilly 1
Facility: Gentilly 1 Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

b) Form of storage: Baskets in CANSTOR (Appendix B, Table N° 5)
Reactors: Gentilly 2
Facility: Gentilly 2 Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load Canstors ready to be loaded into the transportation cask.

Point Lepreau

Form of storage: Baskets in Silo (Appendix B, Table N° 4)
Reactor: Point Lepreau
Facility: Point Lepreau Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

2.4.7.2.3 Transportation casks

The two transportation casks used are:

- Irradiated Fuel Transportation Cask for Baskets and Modules (IFTC/BM).
- DSCTP **<4>**, and **<5>** .

IFTC/BM (*see section 2.4.7.1.3)*

DSCTP

The DSCTP is a transport package, which is currently licensed for transport of OPG standard fuel storage modules in Canada. The package is currently only licensed for transport by rail or by water.

The DSCTP consists of the inner packaging (DSC), the outer packaging and the payload. The DSC together with the outer packaging constitutes the packaging. The DSCTP is shown in Figure N° 8 in Appendix A of this document.

The DSC, shown in Figure N° 7 of Appendix A, is currently used for dry storage of used fuel at OPG's reactor sites. It is placed in the outer packaging prior to shipment so that the complete package meets the requirements for transportation. In the transport configuration, the DSC is oriented horizontally with impact limiters attached to the front (top of the DSC) and rear (bottom of the DSC) of the package. The outer packaging is not present during the long-term storage of the DSC in the Dry Storage Facility.

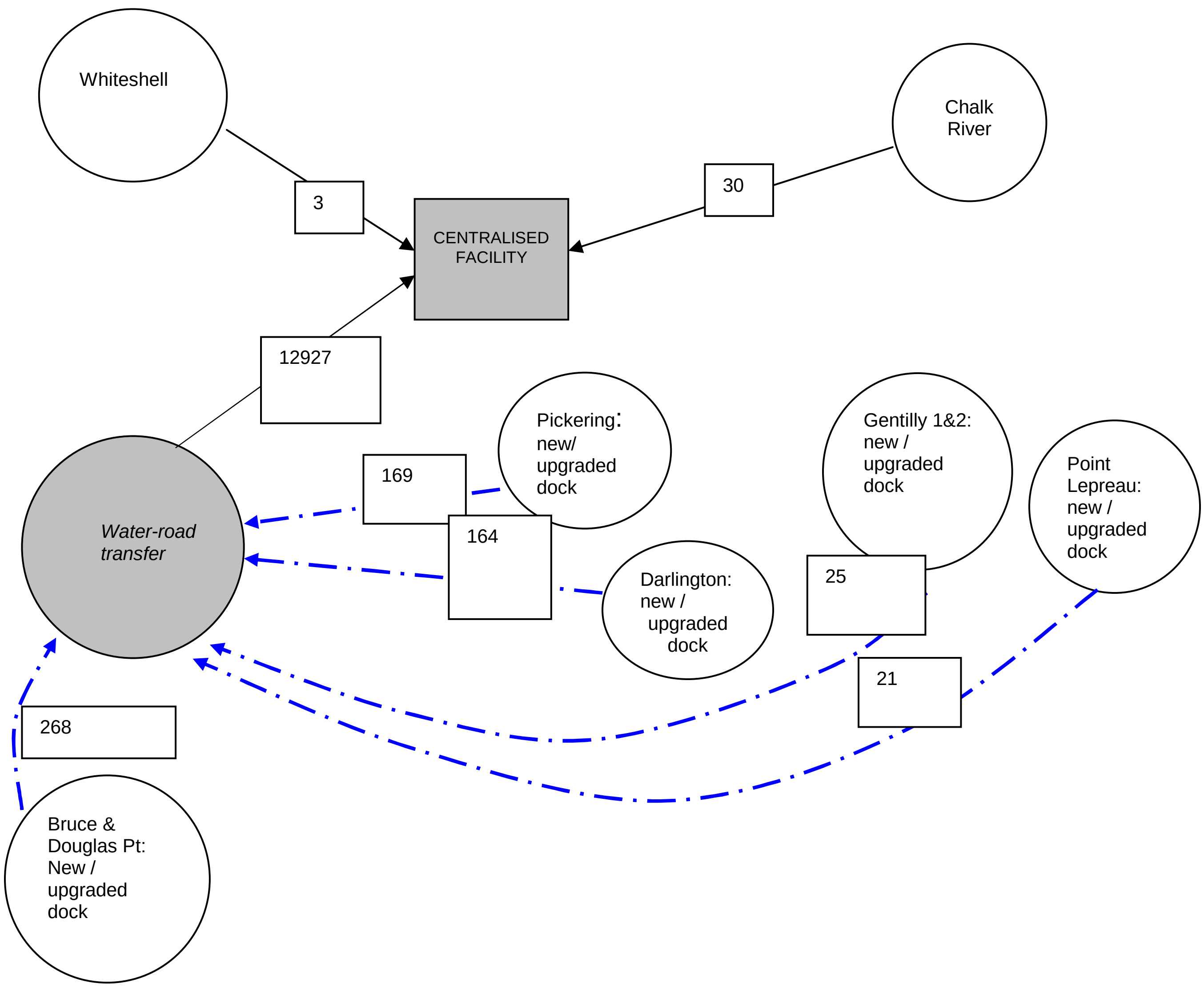
The outer packaging consists of top and bottom impact limiters, impact armoring, and attachments. The top and bottom impact limiters consist of stainless steel outer shells, 6 mm thick, filled with rigid polyurethane foam, with inner shells consisting of two plates 19 mm and 25 mm thick. The inner shells of the impact limiters are integrated with double-walled 304L stainless steel impact armoring, which extends downwards from the top impact limiter and up from the bottom impact limiter, overlapping around the circumference of the DSC. The top and bottom impact limiters are fastened to each other with wire rope assemblies.

Even though the DSCTP is currently only licensed for transport by rail or by water, it is technically feasible to transport the DSCTP by road, since all applied loads for transportation by rail are equivalent or higher than all applied loads for transportation by road. All pressure, temperature and free drop loads are the same for all modes of transport. Only transport shock and vibration loads differ between modes of transport. From **<1>**, Section 4, accelerations generated by road transport are less than accelerations for all other modes of transport. Only a small amount of additional analysis and licensing work would be required in order to license the DSCTP for transport by road.

2.4.7.3 “Mostly water”

2.4.7.3.1 Features :

- Road link to centralised site,
- New /upgraded dock at 5 or 6 sites,
- Potential cost savings from larger shipments,
- All DSCs transported ; fuel from wet bays loaded in IFTC/BM (baskets or modules),
- 8.3 trucks arrive at centralised site each week,
- Total 647 water shipments over program with 12960 connecting and additional road shipment,
- Purpose-built vessel (self-geared).



Key:

Road number, e.g. 88 show total number of shipments :

Water

Road – 1 x 120 bundle IFTC/BMs (baskets) for Whiteshell
1 x 162 bundle IFTC/BMs (baskets) for Chalk River and Bruce (Douglas Point)
– 1 x 384 bundle DSCTPs for Bruce, Pickering, Darlington,
or 1 x 192 bundle IFTC/BMs (modules) for Bruce, Pickering, Darlington or IFTC/BM (baskets) for Point Lepreau, Gentilly,

Water - 15 x 384 bundle DSCs for Bruce, Pickering, Darlington or 32 x IFTC/BMs (modules) for Bruce, Pickering, Darlington or 32 x IFTC/BMs (baskets) for Point Lepreau, Gentilly, Douglas Point.

The number of shipments is calculated in Table N°3 Appendix B of the present document

2.4.7.3.2 Interfaces for each site

Whiteshell (Appendix B, Table N° 4)

Form of storage: Baskets in Silo
Reactor: the fuel is from the Douglas Point reactor (experimental fuel stored at Whiteshell is not included in the scope of the present study),
Facility: Douglas Point Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

Bruce

a) Form of storage: Trays in wet bays (Appendix B, Table N° 6)
Reactors: Bruce B
Facility: Bruce B Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: the used fuel will be in transportation modules in the existing bay.

b) Form of storage: Modules in DSCs (Appendix B, Table N° 8)
Reactors: Bruce A and Bruce B
Facility: WUFDSF
Transportation cask: DSCTP
Interface between storage and transportation: the used fuel will be in DSCs in the storage locations in the WUFDSF.

c) Form of storage: Baskets in Silo (Appendix B, Table N° 4)
Reactor: Douglas Point
Facility: Douglas Point Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

Pickering

a) Form of storage: Modules in wet bays (Appendix B, Table N° 7)
Reactors: Pickering A and Pickering B
Facility Pickering A and Pickering B Facilities
Transportation cask: IFTC/BM
Interface between storage and transportation: the used fuel will be in transportation modules in the Primary bay (Pickering B Facility) or in the Auxiliary bay (Pickering A Facility).

b) Form of storage: Modules in DSCs (Appendix B, Table N° 8)
Reactors: Pickering A and Pickering B
Facility: PUFDSF
Transportation cask: DSCTP
Interface between storage and transportation: the used fuel will be in DSCs in the storage locations in the WUFDSF.

Darlington

a) Form of storage: Modules in wet bays (Appendix B, Table N° 7)
Reactors: Darlington
Facility: Darlington Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: the used fuel will be in transportation modules in the existing bays.

b) Form of storage: Modules in DSCs (Appendix B, Table N° 8)
Reactors: Darlington
Facility: DUFDSF
Transportation cask: DSCTP
Interface between storage and transportation: the used fuel will be in DSCs in the storage locations in the DUFDSF.

Chalk River (Appendix B, Table N° 4)

Form of storage: Baskets in Silo
Reactors: Nuclear Power Demonstration (NPD)
Facility: NPD Fuel
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

Gentilly

a) Form of storage: Baskets in Silo (Appendix B, Table N° 4)
Reactor: Gentilly 1
Facility: Gentilly 1 Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

b) Form of storage: Baskets in CANSTOR (Appendix B, Table N° 5)
Reactors: Gentilly 2
Facility: Gentilly 2 Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load Canstors ready to be loaded into the transportation cask.

Point Lepreau (Appendix B, Table N°4)

Form of storage: Baskets in Silo
Reactor: Point Lepreau
Facility: Point Lepreau Facility
Transportation cask: IFTC/BM
Interface between storage and transportation: transfer flask similar to the one used to load silos ready to be loaded into the transportation cask.

2.4.7.3.3 Transportation casks

The two transportation casks used are:

- Irradiated Fuel Transportation Cask for Baskets and Modules (IFTC/BM).
- DSCTP **<4>**, and **<5>**.

IFTC/BM (*see section 2.4.7.1.3 of Chapter N° 2)*

DSCTP (*see section 2.4.7.2.3 of Chapter N° 2)*

3. CHAPTER N° 3: CONCEPTUAL DESIGN AND DESCRIPTION FOR ALL THE UFTS COMPONENTS

3.1. INTRODUCTION

In this section, we divide the study in 3 parts:
- "All road"
- "Mostly rail"
- "Mostly water"

For each Current Storage Site, we will describe the different phases needed to transport the bundles from their form of storage to the Centralised Facility, in the case of the three modes.
For each phase, we will give the concept and the description of the UFTS interfaces and components in the following order:

- Mode and route development
- Nuclear facility loading
- Transporter (vehicle)
- Transportation system maintenance facility
- Casks
- UFTS Auxiliary equipment
- UFTS Transportation system operation
- Decommissioning

Some items can have common descriptions for the Current Storage Sites and for the different modes of transportation, as for example: Maintenance facilities for casks, Maintenance facilities for Tractors and Trailers, Maintenance facilities for rail cars. These are discussed in sections 3.2 – 3.4 of this Chapter. It may be noted that it is assumed that vessels included in the UFTS description for mostly-water are assumed to be chartered, and would be maintained by the owner at a suitable facility. In the cost estimate an allowance is included in the cost of chartering to cover maintenance. In addition, the maintenance work described below could be contracted out, or could be carried out by the UFTS operator.

3.2. MAINTENANCE FACILITIES FOR CASKS (APPENDIX A, FIGURE N° 11)

3.2.1 GENERAL

Maintenance of any contaminated and/or irradiated equipment is expensive, and a large part of the cost goes to maintenance facilities: careful planning and sizing is essential.

The main factors are the radiological levels and the mass and size of the cask. High levels of radiation will make a decontamination workshop necessary. Large casks will require much handling space. The lifetime of the cask design shall also be considered, with workshop flexibility in mind for future cask designs.

It is expected that maintenance facilities will be used also for repairs and modifications, as the casks cannot go to a non-nuclear plant. The capabilities and limits, both technical and radiological, of the facilities should be given full consideration.

3.2.2 ADMINISTRATIVE AUTHORISATIONS AND SITING

Maintenance facilities will:

- usually be submitted to approval by competent authorities, which takes time,
- generate waste in solid, liquid and gaseous forms.

They should:

- be located next to installations where they are used, in order to minimise transports and lost time,
- offer suitable access to, or include, decontamination workshops and adequate waste treatment and storage,
- when possible, be an extension of an existing plant, which makes things easier for approvals, access to already available fluids...
- be subject to an environmental impact analysis.

3.2.3 LAYOUT

Access to workshop

Access may be on rail or road trailers. The latter is generally unsuitable because of exhaust gases, oil leaks... Electrically powered lorries should be preferred. Cask storage space, preferably covered or indoors should be provided just outside.

3.2.4 HANDLING

Lifting capacity shall be calculated to accommodate the largest casks. A safety margin is recommended as designers will always come with heavier designs.

Several independent lifting, handling, rolling, hovering devices allow for handling parts of different weight and size. This will preclude waiting for availability of equipment as it is already used for work or maintenance.

Storage should exist for lifting beams and equipment, as they will be possibly contaminated and will stay inside.

3.2.5 WORKSTATIONS

The number of workstations will be calculated according to the existing and planned fleet, to the maintenance frequency, to the time necessary. The number of operators working simultaneously on the same cask is usually limited by elbow room and occupational safety considerations, such as work-at-height.

It is emphasised that workstations will be occupied by casks that are stopped pending disposition of non-conformances or inspection. As it is generally difficult, impossible or not worthwhile to close and evacuate the cask, it is advisable to have more workstations or stands than strictly necessary.

The best position (vertical, horizontal, rotating...) for the cask will be determined. Stands, stools will raise the cask for good accessibility and working condition. Access platforms, stairs will be preferred to ladders. Platforms will be flexible in order to limit openings between cask and floors.

Hot cells shall be created whenever necessary to separate maintenance outside of the cask and maintenance inside or with the cask open. All components will have to be maintained or repaired, and there must be storage and workstations for all, including internals, baskets, that may require specific shielding.

Ventilation shall be adapted to pollutant concentration, with adequate depression between rooms so that airborne contamination is sucked in. Permanent radiation monitoring equipment shall be installed.

Ample storage will be created for tools and for dismantled parts. Workstations for parts such as shock absorbers, lids and covers, trunnions... shall be installed, with proper clampdown tools to provide safe working conditions.

It may be beneficial to have machining and welding equipment within the shop, as parts will not generally be acceptable in non-nuclear facilities. It will be often preferable to replace components rather than repair, as this will minimise worker exposure, and waste in unwanted form such as airborne or small chips.

Fluids should be distributed in wall mounted / embedded networks as close to the workstation as possible, as flexible pipes and wires must be strictly limited. Inert (such as nitrogen, argon...), detrimental, flammable gases, any chemicals shall be closely controlled and their use and available quantity shall be limited. Specifically, cask must be ventilated and air quality monitored during any work inside.

3.2.6 PERSONNEL

Personnel shall be properly educated in all technical, radiological, safety areas. A worker will normally need six months before being able to work without close supervision.

The capital cost of the maintenance facility is such that it will often be necessary to work in shifts. This will require special attention as any unexpected defect found in a cask may require expert advice that will be available only in office hours.

3.2.7 SPARE PARTS

It is necessary to plan:

- which spare parts are necessary, in what quantity,
- who will procure, own, and store the parts.

3.3. MAINTENANCE FACILITIES FOR TRACTORS AND TRAILERS

3.3.1 GENERAL

Maintenance of Tractors and Trailers is expensive, and a large part of the cost goes to downtime and servicing of the vehicles.

It is expected that maintenance facilities will be used also for repairs and modifications.

3.3.2 SITING

They should:

- be located next to installations where casks are loaded on the trailer or next to the route of the transportation, in order to minimise transports and lost time
- offer suitable access
- be subject to an environmental impact analysis especially for waste liquid form (when we wash the trailers)

3.3.3 HANDLING

No specific lifting except for frame of transportation cask, weather covers.

Storage should exist for lifting beams and equipment: frame of transportation cask, weather covers.

3.3.4 WORKSTATIONS

- Maintenance equipment for Trailer: one maintenance area with some mechanical and hydraulic conventional equipment especially for suspension.
- Maintenance equipment for Tractor: one maintenance area with some mechanical and hydraulic conventional equipment especially for suspension.

3.3.5 SPARE PARTS

It is necessary to plan with the trailer and tractor owner:

- which spare parts are necessary, in what quantity
- who will procure, own, and store the parts.

3.4. MAINTENANCE FACILITIES FOR RAIL CARS

3.4.1 GENERAL

Maintenance of rail car equipment is expensive, and a large part of the cost goes to maintenance facilities: careful planning and sizing is essential.
It is expected that maintenance facilities will be used also for repairs and modifications.

3.4.2 ADMINISTRATIVE AUTHORISATIONS AND SITING

Maintenance facilities will:

- usually be submitted to approval by competent authorities (railway authorities), which takes time,
- generate waste in liquid form.

They should:

- be located next to the route of the rail transportation, or next to a railroad terminal in order to minimise transports and lost time,
- offer suitable access to adequate waste treatment and storage,
- when possible, be an extension of an existing plant, which makes things easier for approvals, access to already available fluids...
- be subject to an environmental impact analysis.

3.4.3 LAYOUT

Access to workshop: access may be on rail and road trailers.

3.4.4 HANDLING

Lifting capacity shall be calculated to accommodate the largest rail cars. A safety margin is recommended as designers will always come with heavier designs.

Example (ABRF company in France):

- 2 cranes 15 tons,
- 3 hoists in order to load the main frame of the rail car,
- 3 fork-lift tracks.

Storage should exist for lifting beams and equipment.

3.4.5 WORKSTATIONS

The number of workstations will be calculated according to the existing and planned fleet, to the maintenance frequency, to the time necessary.

Example (ABRF company in France):

Total area: 115000 m2
Covered area: 13000 m2
Length of rail: 7000 m

The number of railcars they deal with is about 45. Ten persons are in charge of the maintenance of the railcars.

Equipment:

- Washing station for the rail car when they arrive at the plant with a special system to collect and to treat the liquid :
  - Exterior washing: 2000 psi / 70 °C
  - Interior washing: 3500 psi / 70°C
  - Vapour interior washing: 180°C

- Painting area: tunnel with oven (60°C, area : 360 m2)

- Granulating area: tunnel

- Sand blasting equipment

- Special equipment to check the breaks,

- Boilermaking: press, shearing..

- Machining : 1 milling machine, 3 drilling machines, 2 lathes.

3.5. CONCEPTUAL DESIGN AND DESCRIPTION FOR ALL THE UFTS COMPONENTS IN THE CASE OF "ALL ROAD" MODE FOR EACH SITE

3.5.1 ROAD TRANSPORT – OVERVIEW

Each of the current storage facilities has road access. Even if alternative or additional modes of transport are selected for the shipping campaign, it is anticipated that at least some portions of the transport would likely involve road (at least on-site or possibly into the centralised repository or extended storage facility). Road transport is a well-proven means of transporting used fuel, as demonstrated through the number of successful road shipments made by reactor operators and governments in a broad number of countries.

A critical factor associated with road transports involves weight of the load; for the purposes of this investigation, the load is assumed to include the following components: the transport cask, any associated cask systems (such as impact limiters), securement/tie-down equipment, the trailer and the power unit.

The upper limit for the payload assumes a fully loaded **IFTC/BM at a weight of 42.5 t [see Appendix C], and, for road links in the alternative mostly-rail and mostly-water systems, a fully loaded** Dry Storage Container Transportation Package (DSCTP) with outer package at a weight of 100.31 Mg.

Weight is a significant consideration as relates to environmental conditions and regulatory processes:

- Weather conditions and temperature – especially as linked to thaw periods **[<23>**, **<24>**, **<25>**, **<26>**, **<27>**, **<29>**, **<37>**, **<42>**] – affect authorised cargo weights and the time frames in which roads are available for the shipping campaign. It is assumed that roads are available for transport, without road restriction, between 270 and 300 days per year taking into account anticipated weather conditions. (It should be noted that this time frame does not take into account anticipated truck/trailer maintenance, scheduling issues, etc.)

- Given the additional effort associated with application and review for overweight permits on the part of both the regulators and the waste owners are proposed for the "all-road" transportation system.

  It is also desirable that the length, width and height of the load are within the maximums allowed for the transport vehicle; this review therefore assumes that oversize permits are not required for road transport of used fuel. Similarly, it is assumed that authorised maximum loads for axle class of the transport vehicle are not exceeded.

Accordingly, size, weight and axle load limitations for the proposed road transport of used fuel – as well as overall road system characteristics – are assumed to be in compliance with the following regimes (this listing is provided for guidance and is not intended to represent a comprehensive assessment of regulatory requirements):

- Regulations for the Safe Transport of Radioactive Material, No. TS-R-1 (International Atomic Energy Agency) [**<32>**];
- Transportation of Dangerous Goods Regulations (Transport Canada) [**<49>**];
- Packaging and Transport of Nuclear Substances Regulations (Canadian Nuclear Safety Commission) [**<21>**];
- Provincial regulations applicable to the transport of radioactive material;
- Manitoba Transportation and Government Services Weights and Dimensions Compliance Guide (October 2000) [**<38>**];
- Manitoba Transportation and Government Services, Manitoba's Spring Road Restriction Program (March 18, 2002) [**<37>**];
- Manitoba Transportation and Government Services, Manitoba Highway Classification [**<36>**];

- Ontario Highway Traffic Act [**<41>**];

- Québec Ministère des Transports, Vehicle Load and Size Limits, The 2000 Edition (2000) [**<43>**];
- Québec Ministère des Transports, Thaw Zones and Periods [**<42>**];
- New Brunswick Department of Transportation, Notice to Transporters : Guidelines for Applying for and Obtaining Required Special Permits (July 2001) [**<40>**];
- New Brunswick Department of Transportation, Motor Vehicle Act [**<39>**];
- Guide to the Agreement on Uniform Vehicle Weights and Dimensions Limits in Atlantic Canada (October 2001) [**<22>**].

Consideration of road transport is predicated on use of dedicated trucks operating under exclusive use conditions. While this review does not include development of a detailed road transportation scheme, it is nonetheless assumed that drivers would comply with applicable national and provincial requirements for motor vehicle operation, including regulations associated with hours of work standards. Notwithstanding potential security arrangements and/or other provisions of the transportation program, it is assumed that team drivers would be utilised for road travel exceeding 575 kilometers in distance (based on a ten-hour day).

The sample road transport system envisioned for the program is predicated on the following characteristics:

- Modified 48-foot flatbed trailer with integrated tie-down;
- Trailer equipped with air ride suspension to cushion the load;
- Trailer equipped with four axles (IFTC/BM) or nine axles (DSCTP) (See Appendix C) of this document.
- One loaded cask per trailer;
- Standard commercial tractor sufficient for loaded weight: The weight for the fueled reference tractor is roughly 9,075 kg for IFTC/BM and 11 t for DSCTP.

For the purposes of this review, it is assumed that the UFTS operators purchase trailers. Availability of good quality, well-maintained trailers is desirable to ensure safe transport. Additionally, it is anticipated that tie-down and securement devices would be integrated into trailers; control over such modifications and maintenance of the transport equipment would be best assured through direct ownership.

Tractors for road transport could either be purchased or contracted for, depending upon preference of the UFTS operators. It is recommended that the UFTS operators examine current practices regarding truck ownership to determine if there is an existing basis for evaluating costs, liability and business structure.

The overweight road transport configuration (needed for DSCTP transportation on road links) was compared with that used in France for transport from the Valognes rail-road terminal. There, an 8-axle vehicle is used for 120 t cask. The Transport consists of the tractor and trailer, an escort front and rear, plus police, and travels at 40 km/h. The escorts are needed because of the weight, not for security.

3.5.2 CONCEPTUAL DESIGN AND DESCRIPTION

See Appendix D of this document.

3.6. CONCEPTUAL DESIGN AND DESCRIPTION FOR ALL THE UFTS COMPONENTS IN THE CASE OF "MOSTLY RAIL" MODE FOR EACH SITE

3.6.1 RAIL TRANSPORT – OVERVIEW

Rail lends itself well to the transport of heavy loads and could potentially provide for a fewer number of shipments of used fuel than would road, as more casks could be shipped in a single consignment. This ability to consolidate cargo is among the primary benefits associated with rail.

Rail transport is a well-proven means of transporting used fuel, as demonstrated through the number of successful rail shipments made by reactor operators and governments in a broad number of countries, especially Europe.

It is also noted that the Ontario region is well served with principal main lines that could be utilized for movement of used fuel. Use of main lines only is assumed for long-haul transport, noting, however, that feeder lines may be required between specific points.

For the purposes of the present study, the rail transportation system is predicated on the following elements:

- The train is dedicated to movement of used fuel under exclusive use conditions;
- Use of 100-ton rail flat car;
- Each flat car is loaded with one DSCTP or two IFTC/BMs;
- Each train equipped with locomotive and caboose;
- The locomotive is assumed to have sufficient power to safely and efficiently haul the load;
- Use of buffer cars is assumed, the total number of which is dependent upon total cask loadings per train, with buffer cars at a minimum to be placed between loaded rail cars and the caboose and between loaded rail cars and the locomotive;
- Flat cars are equipped with shock absorbing couplers;
- Potential use of extra car and/or caboose for security escorts and related personnel.
- Five loaded railcars per train (consistent with current European train movements.

Rail transport is deemed relatively unaffected by weather conditions; it is therefore assumed that rail transport is potentially available 365 days of the year. (It should be noted that this time frame does not take into account anticipated rail car/locomotive maintenance, scheduling issues, labor conditions, etc.) Should the rail mode be selected for further evaluation, it is recommended that contact be made with rail operators to verify assumptions and time frames.

Rail transport is also assumed to be in compliance with relevant national and provincial regulations, including at a minimum the following statues:

- Regulations for the Safe Transport of Radioactive Material, No. TS-R-1 (International Atomic Energy Agency) [**<32>**];
- Transportation of Dangerous Goods Regulations (Transport Canada) [**<49>**];
- Packaging and Transport of Nuclear Substances Regulations (Canadian Nuclear Safety Commission) [**<21>**];
- Provincial regulations applicable to the transport of radioactive material;
- Railway Safety Act (Transport Canada) [**<48>**].

For the purposes of this review, it is assumed that the Canadian UFTS operators would contract for use of rail engines as part of the rail service, but would purchase rail cars for use in the program. Availability of good quality, well-maintained rail cars is desirable to ensure safe transport. Additionally, it is anticipated that tie-down and securement devices would be integrated into rail cars; control over such modifications and maintenance of the cars would be best assured through direct ownership.

Final road link

A final road link must be created as it cannot be assumed that the centralised facility will have rail access. Because the location of the repository is not known, and because of the more extensive road network, it is assumed that the repository will be serviced as a minimum by road, but may not have rail access. The final leg of the journey is therefore assumed to take place by road. This means that a rail/road transfer has to be done at the railhead near the centralised facility.

3.6.2 CONCEPTUAL DESIGN AND DESCRIPTION

See Appendix E of this document.

3.7. CONCEPTUAL DESIGN AND DESCRIPTION FOR ALL THE UFTS COMPONENTS IN THE CASE OF "MOSTLY WATER" MODE FOR EACH SITE

3.7.1 WATER TRANSPORT OVERVIEW

Given the proximity of multiple reactor sites to usable waterways, a close review of water transport was conducted. Water transport is a well-proven means of transporting used fuel, as demonstrated through the number of successful waterborne shipments made by reactor operators and governments in a broad number of countries.

This investigation centered on the following types of conveyances:

- Barge;
- Integrated tug-barge system;
- Vessel.

Roll-on/Roll-off (or "RORO") vessels were not considered herein, as such vessels are primarily designed to carry cargo secured aboard another conveyance, such as a truck. This approach would obviate some of the benefits associated with a water-based system. Additionally, RORO vessels are typically larger and more expensive than the size vessel envisioned for the Canadian fuel removal program.

All three types of waterborne transport are feasible, however the most practical and cost-effective option involves use of a modern, geared commercial cargo vessel. This determination is based on a review of the following criteria:

- Draft: The type of vessel (see further comments below) anticipated for a waterborne shipping program would have a relatively shallow draft, making it suitable for shipments on the St. Lawrence Seaway and the Great Lakes [**<44>**].

- Cargo capacity: The type of vessel anticipated for a waterborne shipping program would be able to ship a large number of casks at one time, allowing for optimisation per cask shipment costs. While specific vessel loadings are not analysed within the scope this review, the type of vessel proposed for such a program could reasonably accommodate roughly road-weight casks (using the Ontario Power Generation Irradiated Fuel Transportation Road Cask as a sample cask) [**<6>**].

- The cargo capacity of the vessel is 15 DSCTP (see Figure N° 21 in Appendix A) and 32 IFTC/BM (see Figure N° 22 in Appendix A).

- Speed: Use of vessels would allow for a shorter waterborne shipping programs than would use of barges. The proposed sample vessel would be capable of sustained service speeds of 15 knots, although actual travel time would be dictated by waterway restrictions and other vessel traffic [**<44>**].

- Maneuverability: The sample vessel anticipated for use in the program would be equipped with maneuvering thrusters, allowing for unassisted entry and exit from dock facilities at the reactor sites and destination.

- Gearing: Use of a geared vessel would eliminate the need for loading cranes at dock facilities at the individual reactor sites and destination.

- Accessibility: Use of vessels would allow easy access to cargo during the voyage for monitoring purposes (radiation monitoring, condition monitoring, security and safeguards).

- Commercial availability of conveyance: The type of vessel proposed for a waterborne program is currently available on the maritime market; no changes in availability would be predicted between now and 2035.

- Cost factors: Based on the availability of suitable vessel types, as well as a desire to avoid complicated transport solutions, use of an ocean-going vessel would likely be more cost-effective than use of other vessel types.

The sample vessel used for the viability assessment is assumed to have the following characteristics:

- The vessel is equipped for carriage of Class 7 (radioactive) material.

- The vessel meets the requirements, as applicable, of the International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships (otherwise known as the "INF Code") [**<34>**]. This Code delineates all required physical characteristics for the vessel; accordingly, the vessel would meet the INF Code provisions related to damage stability, fire safety, temperature control of cargo spaces, structural requirements, cargo securing requirements and electrical power supply. Additionally, it is assumed that the vessel is operated in compliance with INF Code provisions applicable to radiological protection, management and training, and emergency response guidelines.

- The vessel is Great Lakes fitted [**<44>**, **<46>**].

- The vessel is ice strengthened.

- At a minimum, the vessel is operated in compliance with the following:

  - *International Maritime Dangerous Goods Code* (International Maritime Organisation) [**<34>**];
  - *Regulations for the Safe Transport of Radioactive Material, No. TS-R-1* (International Atomic Energy Agency) [**<32>**];
  - *Transportation of Dangerous Goods Regulations* (Transport Canada) [**<49**>];
  - *Packaging and Transport of Nuclear Substances Regulations* (Canadian Nuclear Safety Commission) [**<21>**];
  - Provincial regulations applicable to the transport of radioactive material;
  - *Canada Shipping Act*, including the *Canada Shipping Act Dangerous Goods Shipping Regulations* (Transport Canada) [**<46>**, **<47>**];
  - *Navigable Waters Protection Act* (Department of Justice Canada) [**<22>**];
  - *The Seaway Handbook* (The St. Lawrence Seaway Management Corporation) [**<44>**];
  - *International Safety Management Code* (International Maritime Organisation) [**<35>**];
  - *International Convention on the Safety of Life at Sea* [**<33>**].

- The vessel is classed by a well-known, reputable classification society.

- The vessel type is a multi-purpose container vessel with tweendecks. This configuration is desirable to allow for flexibility in cargo loading configurations and securement activities.

- Vessel decks are strengthened for heavy cargo.

- The sample vessel meets the following size requirements:

Length o.a:	100,60 m
Length b.p:	93,80 m
Ship Width:	8,10 m
Draft:	6,40 m
Dwt:	4,800 to 5,000 dwt

- The vessel is geared with high-speed cranes capable of lifting the loaded casks and related securement materials. It is assumed that the combined crane lift capability is roughly 120 metric tons. This would avoid the need to install heavy lift cranes at marine loading docks at current storage sites.

- The vessel is equipped with bow thrusters for extra maneuverability, emergency generators, and modern nautical and communications equipment.

- The vessel is new at the time that the shipping campaign begins.

- A vessel suitability survey conducted by an independent, qualified marine inspector is performed prior to initiation of the shipping campaign.

- The vessel retains appropriate insurances, including P & I and Hull & Machinery coverage.

For the purposes of this review, it is assumed that the Canadian UFTS operators either purchase the vessel or obtain guaranteed access to the vessel under a long-term time charter. The intent is to assure that a vessel meeting the requirements detailed above is available for the full length of the waterborne program.

A long-term charter is recommended because of the specialist nature of marine transportation and crewing. The long-term arrangement (i.e., three or more years in duration) would not only guarantee access to a suitable vessel but would likely result in a cost savings of roughly 25 to 30 percent per year, as compared with contracting for a vessel on an annual basis. Such cost savings could be significant.

Should a time-charter be pursued, it is recommended that the charter arrangements allow the UFTS operators to direct the following activities:

- Loading and unloading;
- Stowage and segregation;
- Securement;
- Routing;
- Shipment monitoring (such as satellite tracking);
- Shipment schedule;
- Radiation monitoring;
- Emergency response.

As a general concept, casks would be loaded aboard the vessel at one or more reactor sites (or designated marine facilities near reactor sites). A waterborne program assumes open waterways from mid-April to mid-December of each year [**<28>**, **<29>**, **<30>**]. Accordingly, a waterborne program is predicated on a 245-day shipping window per year.

The suitability of water transportation was reviewed on a site-by-site basis. As with the rail mode of transport, the water mode offers the opportunity to consolidate casks into a fewer number of shipments. The site-by-site assessment indicates the potential to consolidate waterborne shipments between several sites, providing the potential to derive overall program efficiencies.

As the specific repository location is not well defined, it is impossible to more precisely determine the detailed routings. Within this constraint, waterborne transport to and within Ontario is deemed feasible when utilised in conjunction with an inland road or rail transport component. Use of water transport would therefore include development of a water transfer station.

It is noted that this postulated waterborne system would include transit through the United States. While political assessments are outside the scope of this review, it should be noted that international transport is viable from a regulatory standpoint [**<50>**]. International transport of irradiated nuclear materials is currently managed on an international basis with success. Canada and the United States already operate under a well-defined and tested regulatory regime in which cross border transports of radioactive material are routinely managed. In connection with the United States' Reduced Enrichment for Research and Test Reactor (RERTR) program, cross border shipments of Canadian origin used research reactor fuel have been successfully made on several occasions.

U.S. validation of the Canadian transport casks would be required [**<50>**], however such validations are clearly feasible; existing Canadian cask designs have previously been approved in the United States without difficulty. The work associated with obtaining such validations would be limited, as it is anticipated that U.S. review and approval would likely only be required for two Canadian cask designs in conjunction with the entire program.

Under this scenario, loaded casks would need to be transferred from the vessel to another mode of transport. From a technical standpoint, transfer is clearly feasible to either road or rail. From a logistical viewpoint, however, transfer to rail would provide considerably more benefits, as the higher volume vessel shipments could be maintained through similar rail car loadings. However, because the location of the repository is not known, and because of the more extensive road network, it is assumed that the repository will be serviced as a minimum by road, but may not have rail access. The final leg of the journey is therefore assumed to take place by road.

3.7.2 CONCEPTUAL DESIGN AND DESCRIPTION

See Appendix F of this document.

4. CHAPTER N° 4: EMERGENCY RESPONSE PLAN FOR TRANSPORTATION

Conceptual emergency response provisions for the UFTS are based on those put in place by COGEMA LOGISTICS. Within the year 2000, COGEMA LOGISTICS has performed almost 2800 transports of radioactive materials. The impressive international activity of transports provided by road, railway, sea and airway has oriented COGEMA LOGISTICS towards preparing for efficient reaction in the event of any incident or accident, thus providing for limited consequences.

Moreover, according to IAEA recommendations, and in order to comply with the French regulations, our company has implemented a specific organisation since 1997 which relies on an Emergency Response Plan for Transportation (ERPT).

We are thinking that this specific organisation can be duplicated for UFTS:

The organisation is composed of technical, logistic and communication experts as well as specific equipment.
When describing the organisation, the human resources and the equipment are the ones necessary for three steps of action:

1. To give the alarm
2. To analyse the situation
3. To operate the emergency means

Emergency Teams

Command and decision Section:
Its tasks are:

- Risks Assessment
- Logistic and technical assistance to Authorities
- Decision on OPG proper technical means to be implemented
- Management of the Technical Analysis Section (see next paragraph)
- Management of the Communication Section

Technical Analysis Section
Its tasks are:

- Provision of technical expertise
- Estimation of the technical state of the packaging and of associated impacts
- Proposition of technical emergency and assistance solutions.

Mobile command team
This team is « the eyes and ears » of the command and decision section; Its tasks are:

- Implementation of command, information and expertise near the accident
- Equipped with a first intervention case (satellite communication system, radio or chemical protection equipment, camera, computers,…) this team implements processes to minimise consequences or to bring solution to the situation

Communication Section
Its tasks are:

- Preparation and elaboration of a crisis communication specially dedicated to the media
- Provision of a specific communication plan
- Information for the press and for other communication entities
- Information from the press

Emergency Means

The crisis cell is located in a specially built crisis room 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 main crisis room must be at the Centralised Facility but each Current Storage site has to have a little crisis area to communicate with the crisis room of the Centralised Facility.

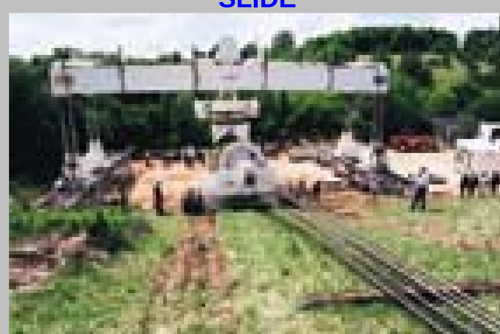
The crisis room is operated permanently during our transports using the real Time tracking system (see Chapter N° 5):

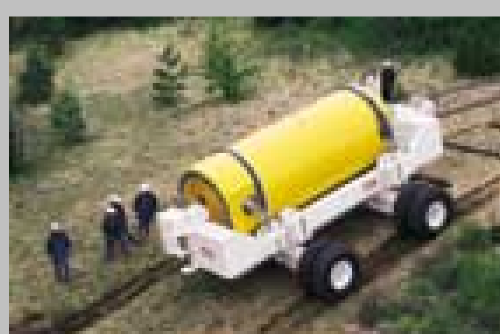
- Location of the vehicle (trucks, wagons, ship) with the GPS system
- Transmission of information with the Inmarsat system

In addition, we are thinking that the UFTS, as COGEMA LOGISTICS, should be equipped with 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.

This fully modular system can be shipped in ISO containers to any route in CANADA, and then implemented without any other infrastructure.

EMERGENCY RECOVERY SYSTEM : MODULAR CRANE AND RECOVERY SLIDE





5. CHAPTER N° 5: REAL TIME TRACKING

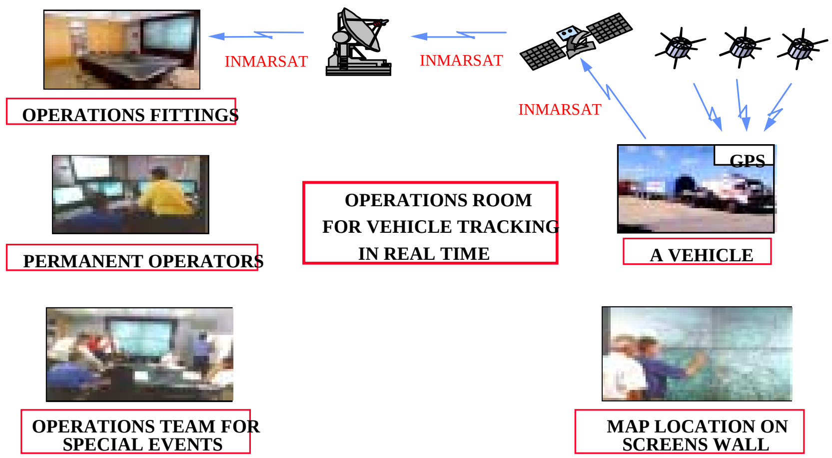
Dedicated water and ground transports for UFTS can be real time tracked from a UFTS headquarters located at the Centralised Facility. Road vehicles, railway wagons as well as dedicated vessels involved in the logistic network for the UFTS can be equipped with specific tracking systems.

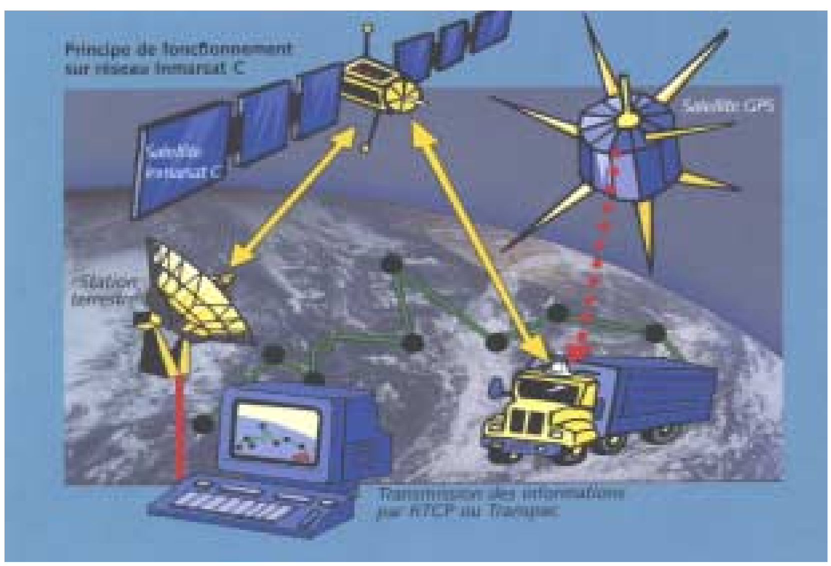
The real time tracking system based on the experience of COGEMA LOGISTICS can be an integral element of UFTS (See Appendix H):

It will be enabled to perform:

- Fast and regular information on cask location,
- Remote interrogation,
- Assurance of the good progress of the transport operation for the customer,
- Full confidentiality with regards to information transmittal.

REAL TIME TRACKING





6. CHAPTER N° 6: APPENDICES

APPENDIX A : FIGURES

APPENDIX B: BASIS AND INTERFACES

APPENDIX C: ROAD TRANSPORT FEASIBILITY OF IFTC/BM AND DSCTP

APPENDIX D: CONCEPTUAL DESIGN AND DESCRIPTION FOR ALL THE UFTS COMPONENTS IN THE CASE OF "ALL ROAD" MODE FOR EACH SITE

APPENDIX E: CONCEPTUAL DESIGN AND DESCRIPTION FOR ALL THE UFTS COMPONENTS IN THE CASE OF "MOSTLY RAIL" MODE FOR EACH SITE

APPENDIX F: CONCEPTUAL DESIGN AND DESCRIPTION FOR ALL THE UFTS COMPONENTS IN THE CASE OF "MOSTLY WATER" MODE FOR EACH SITE

APPENDIX G: EXAMPLE OF THE COGEMA LOGISTICS RAIL-TO-ROAD TERMINAL AT VALOGNES

APPENDIX H: THE REAL TIME TRACKING SYSTEM OF COGEMA LOGISTICS

Appendix A : FIGURES

General:

Packaging and Transportation casks :

Equipment / Facilities :

Vehicles :

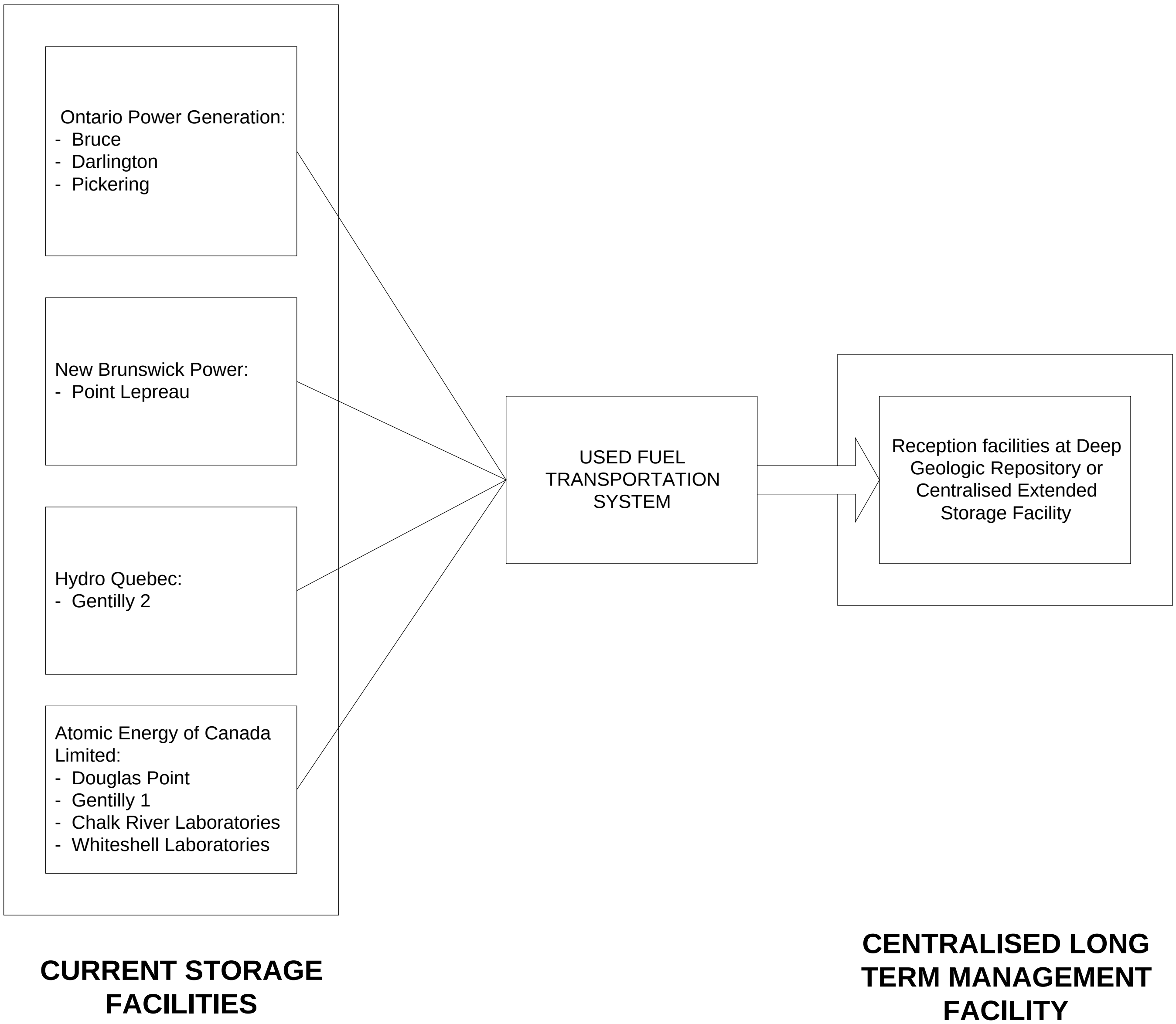


FIGURE N° 1: PURPOSE OF USED FUEL TRANSPORTATION SYSTEM

FIGURE N° 2: REACTOR SITES WHERE USED FUEL IS CURRENTLY STORED IN CANADA

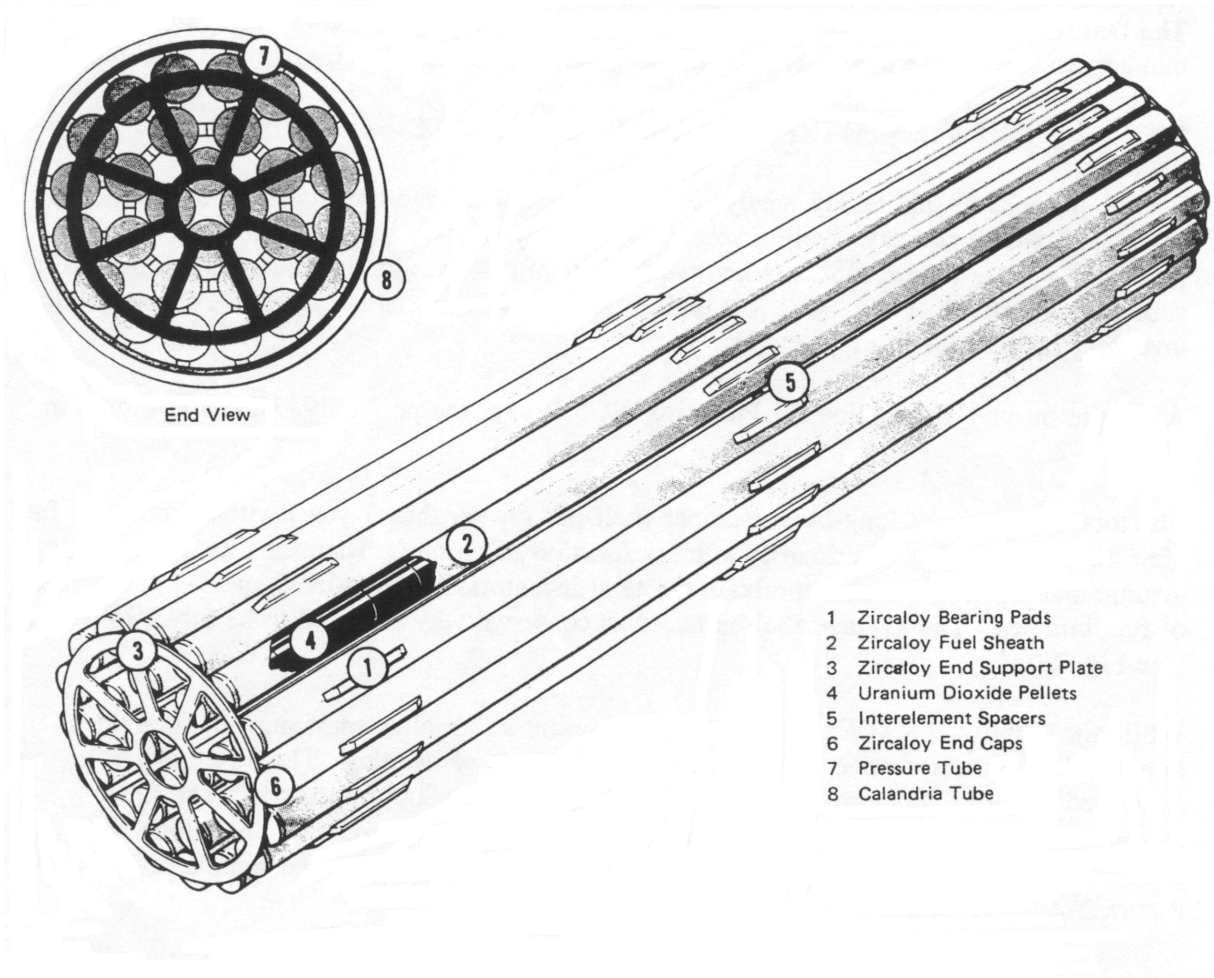


FIGURE N° 3: TYPICAL CANDU FUEL BUNDLE

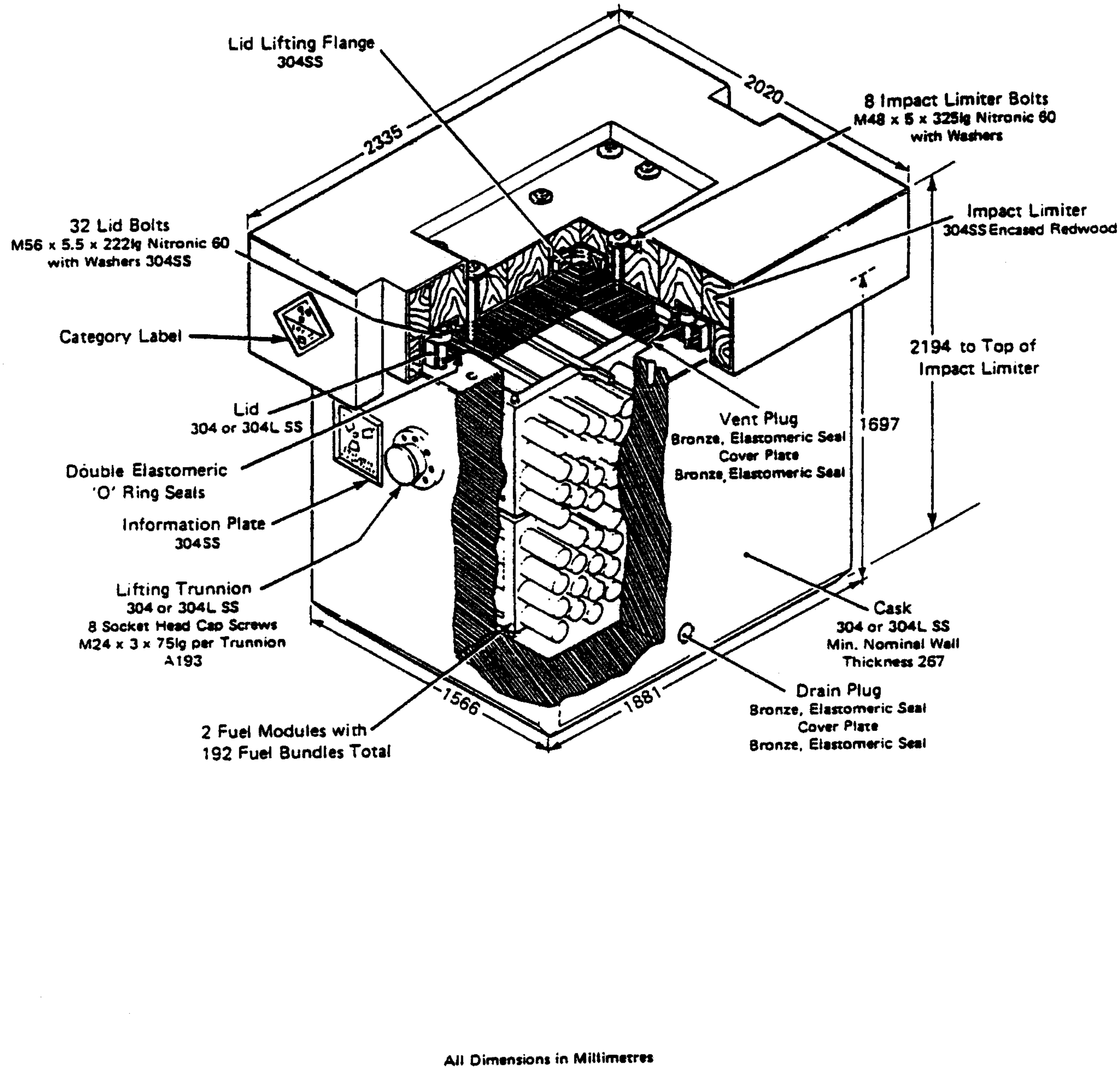


FIGURE N° 4: IFTC

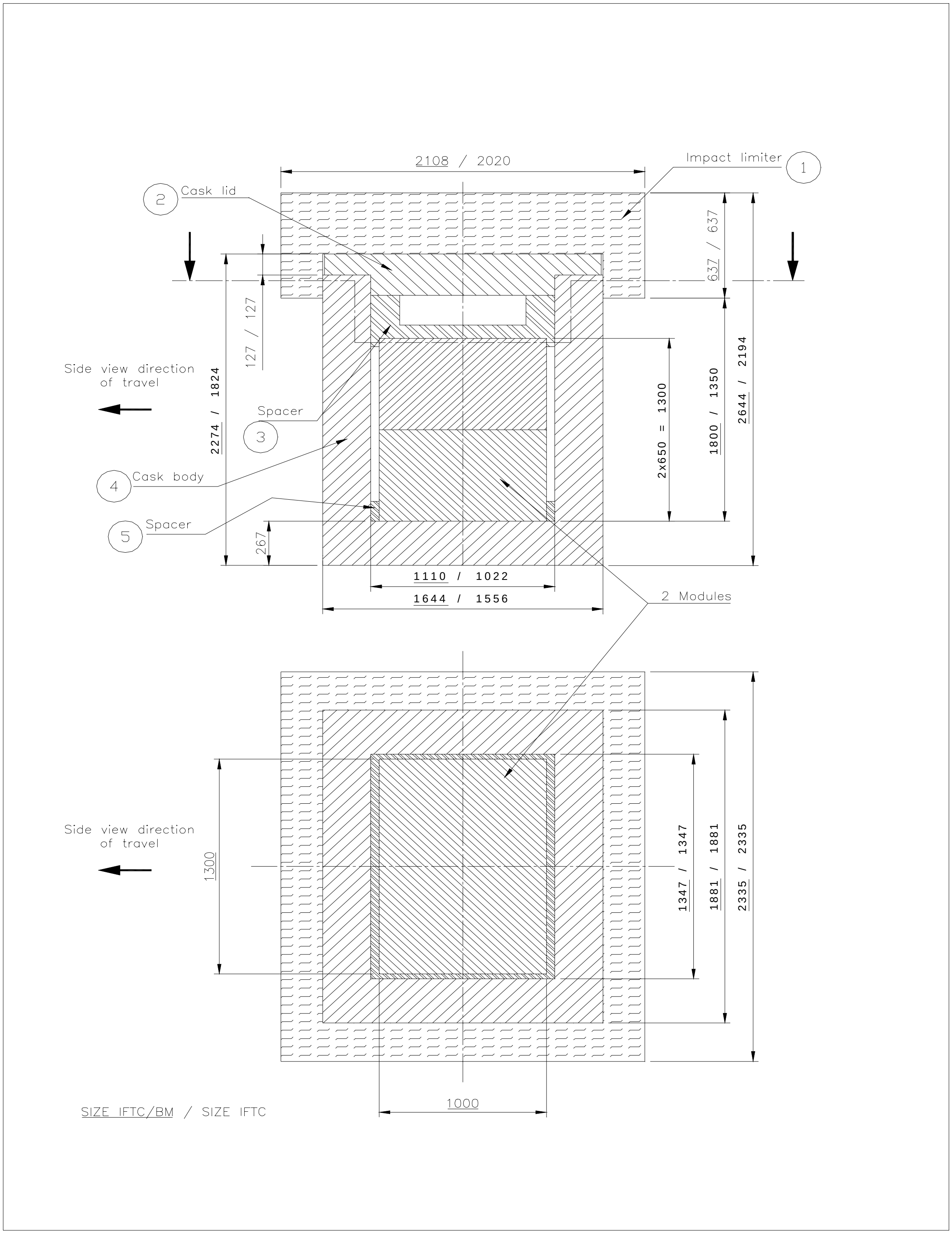


FIGURE N° 5: IFTC/BM LOADED WITH 2 MODULES

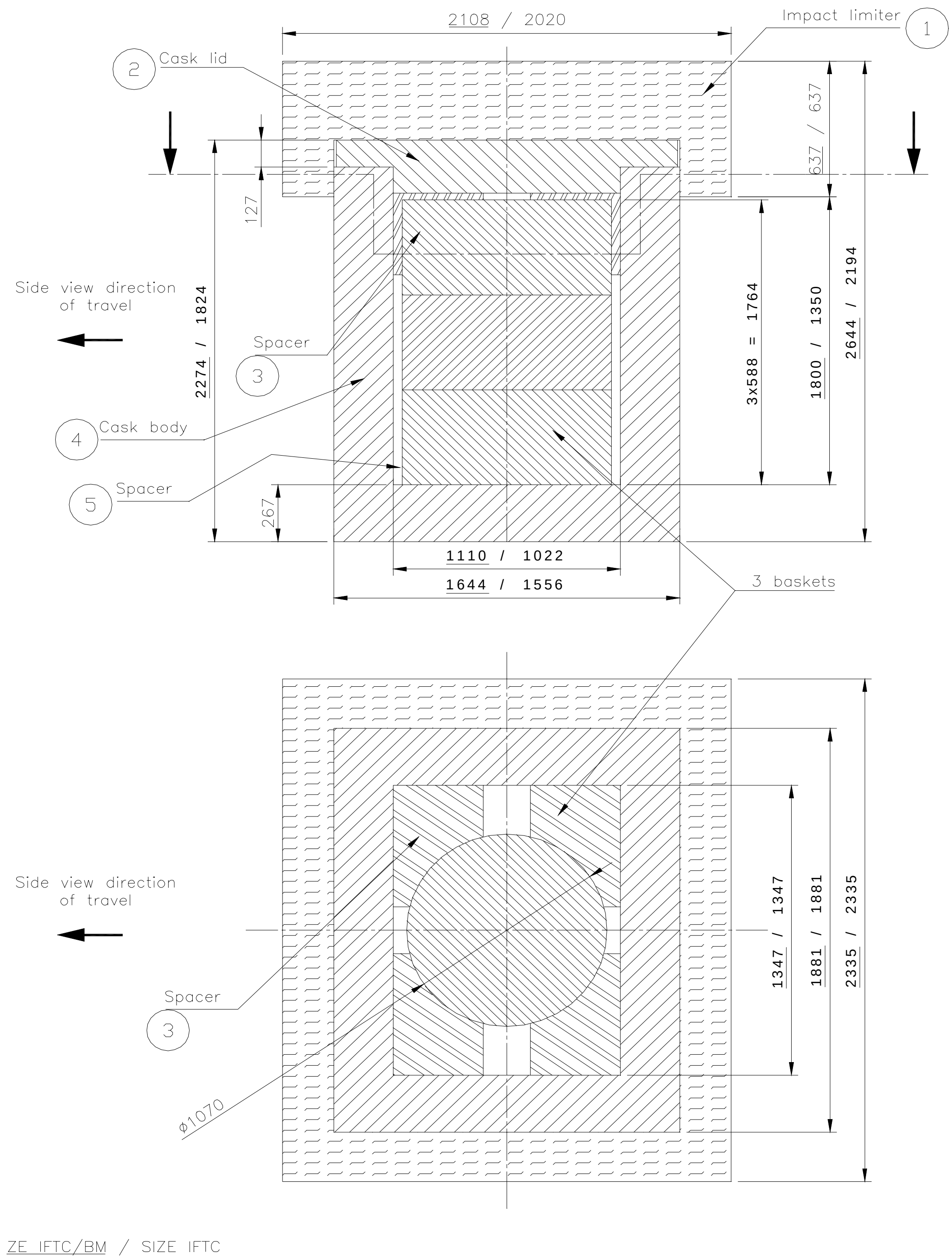


FIGURE N° 6: IFTC/BM LOADED WITH 3 BASKETS

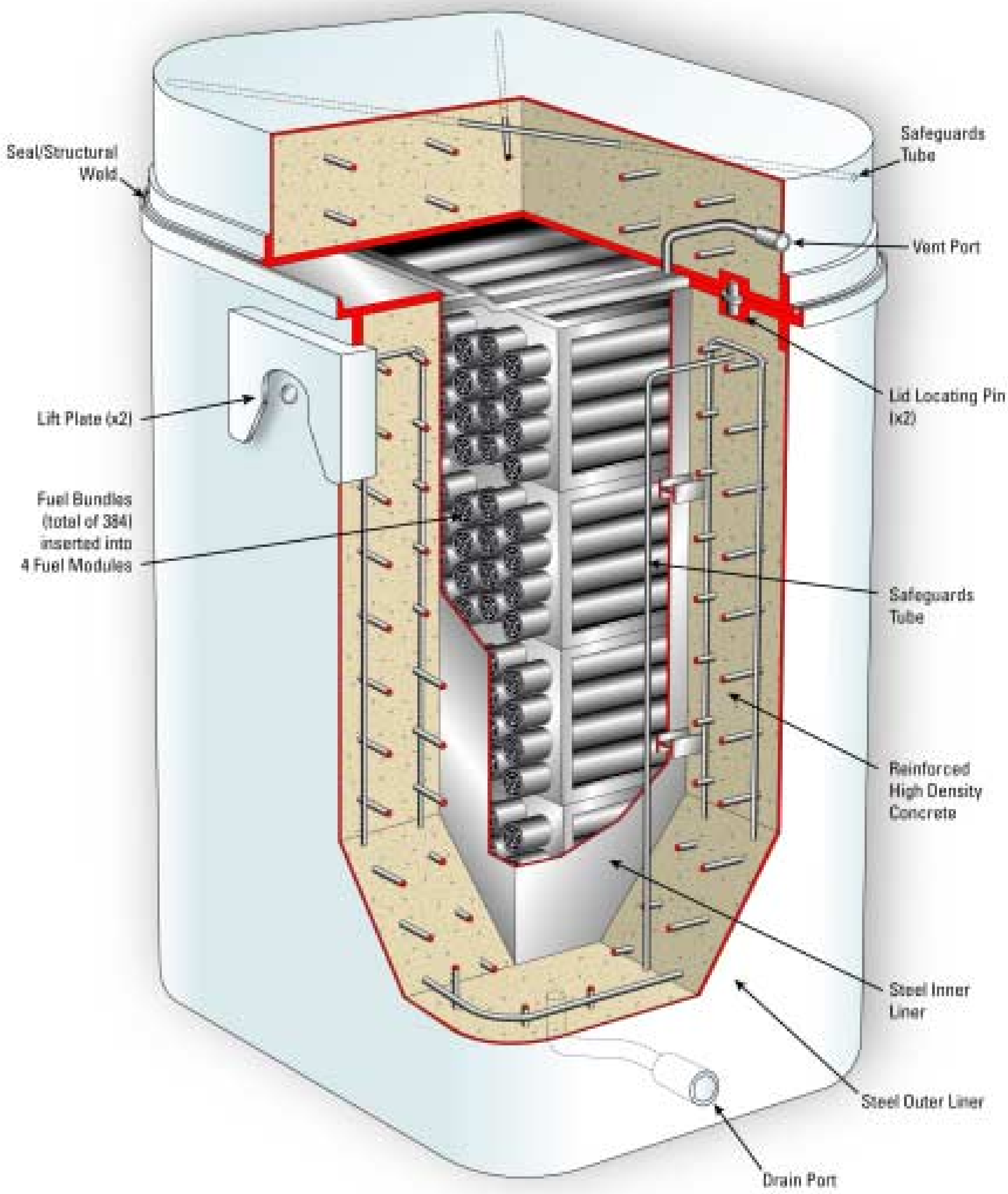


FIGURE Nº 7: DRY STORAGE CONTAINER

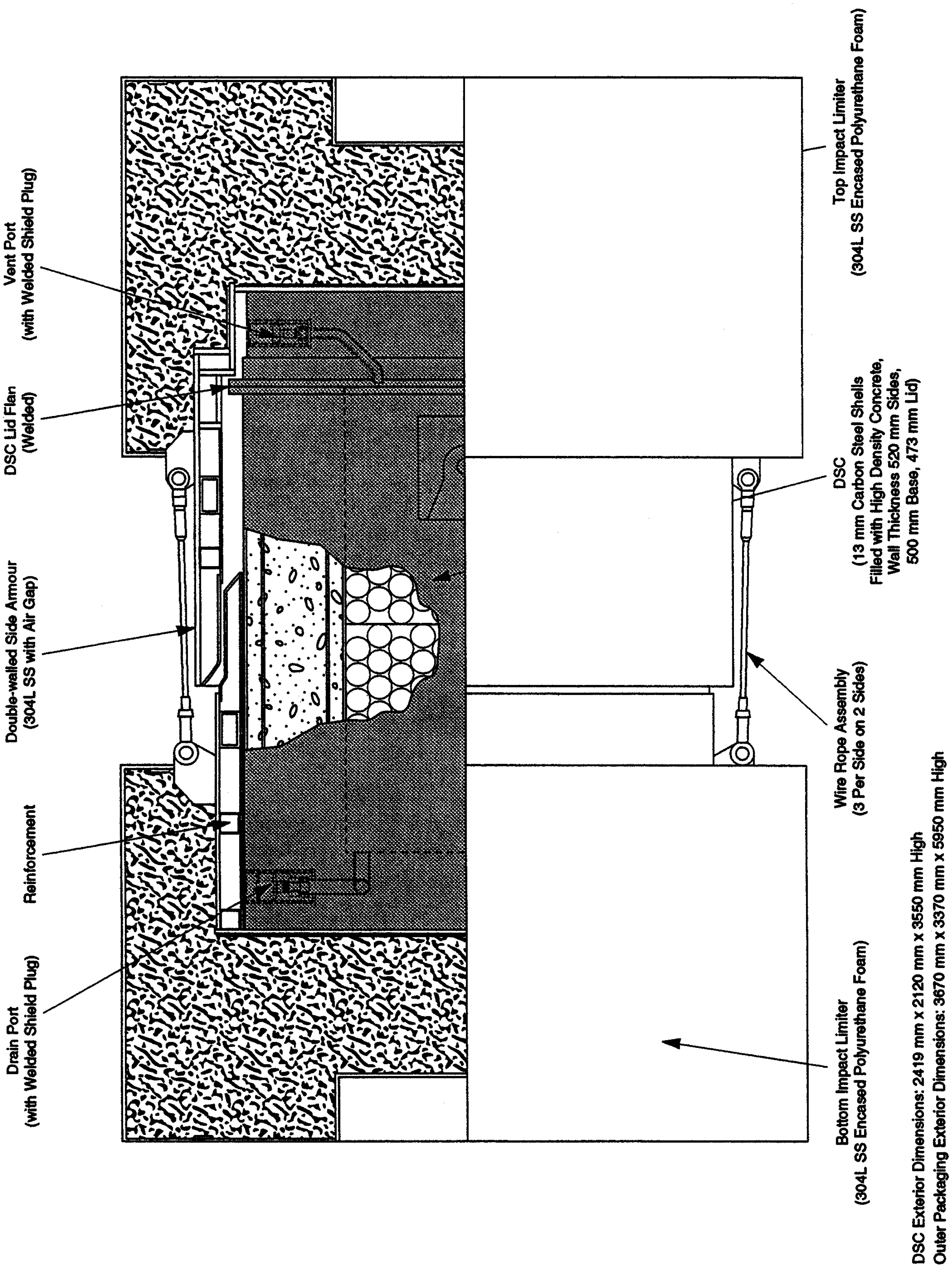


FIGURE N° 8: DRY STORAGE CONTAINER TRANSPORTATION PACKAGE

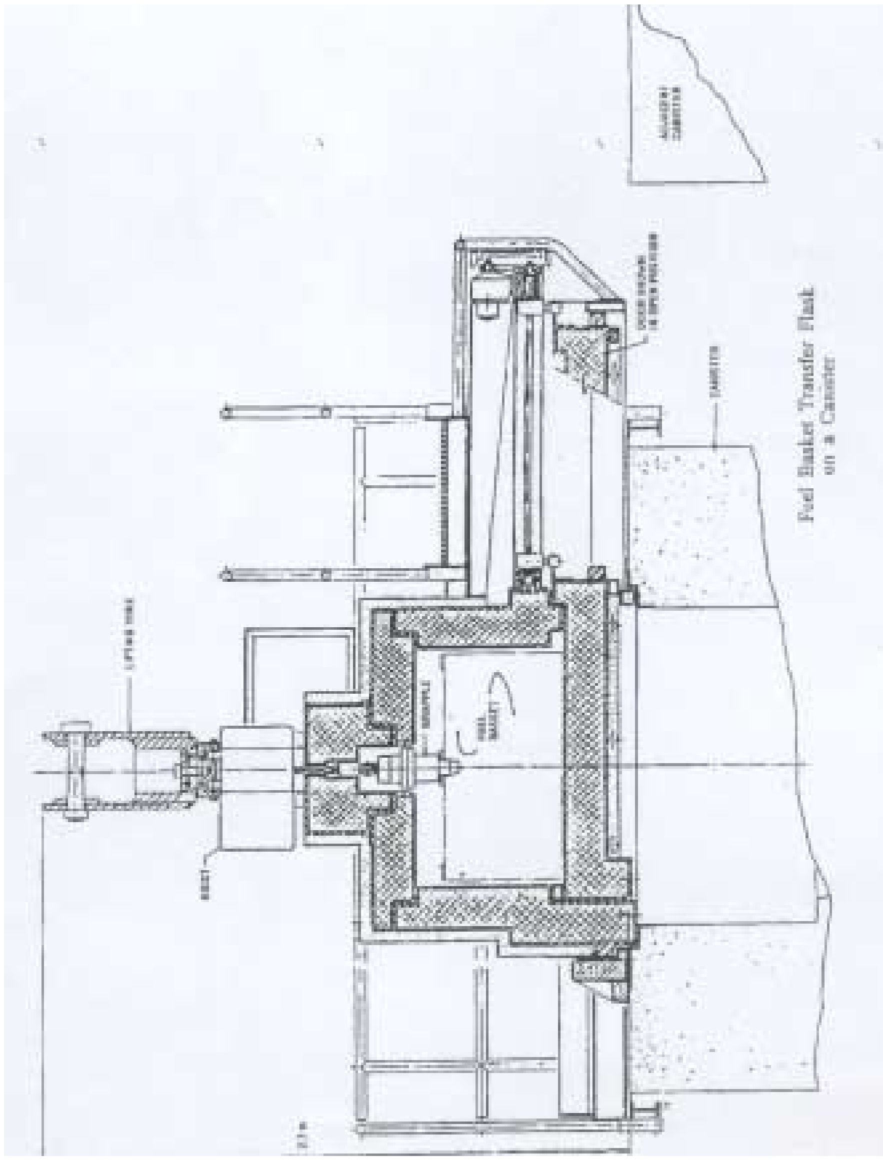


FIGURE N° 9: FUEL BASKET TRANSFER FLASK ON A IFTC/BM (SIMILAR TO FUEL BASKET TRANSFER ON A CANISTER)

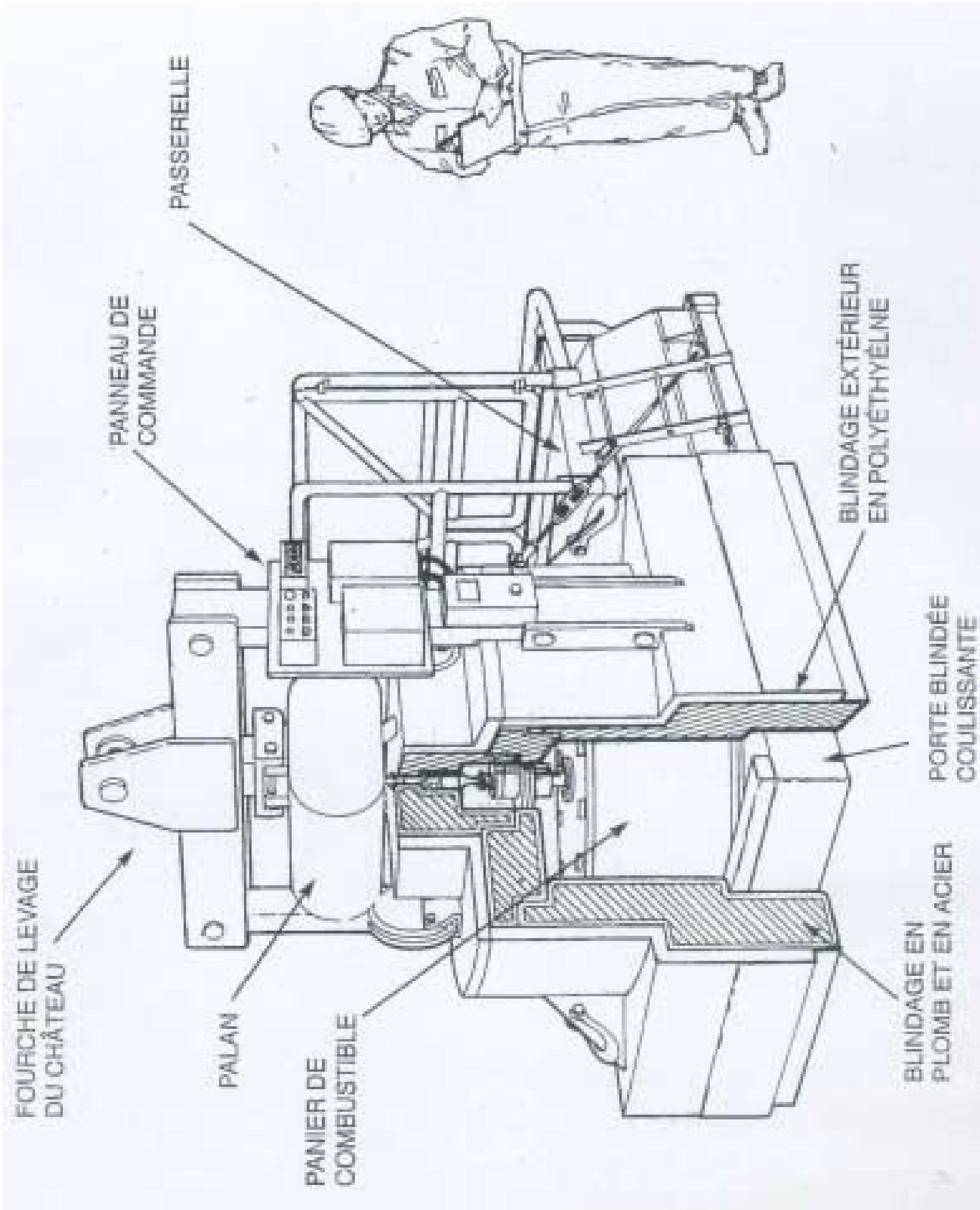


FIGURE N° 10: TRANSFER FLASK FOR BASKETS IN GENTILLY

FIGURE N° 11: EXAMPLE OF MAINTENANCE FACILITIES FOR CASKS AT LA HAGUE PLANT

FIGURE N° 12: EXAMPLE OF 9 AXLES TRAILER

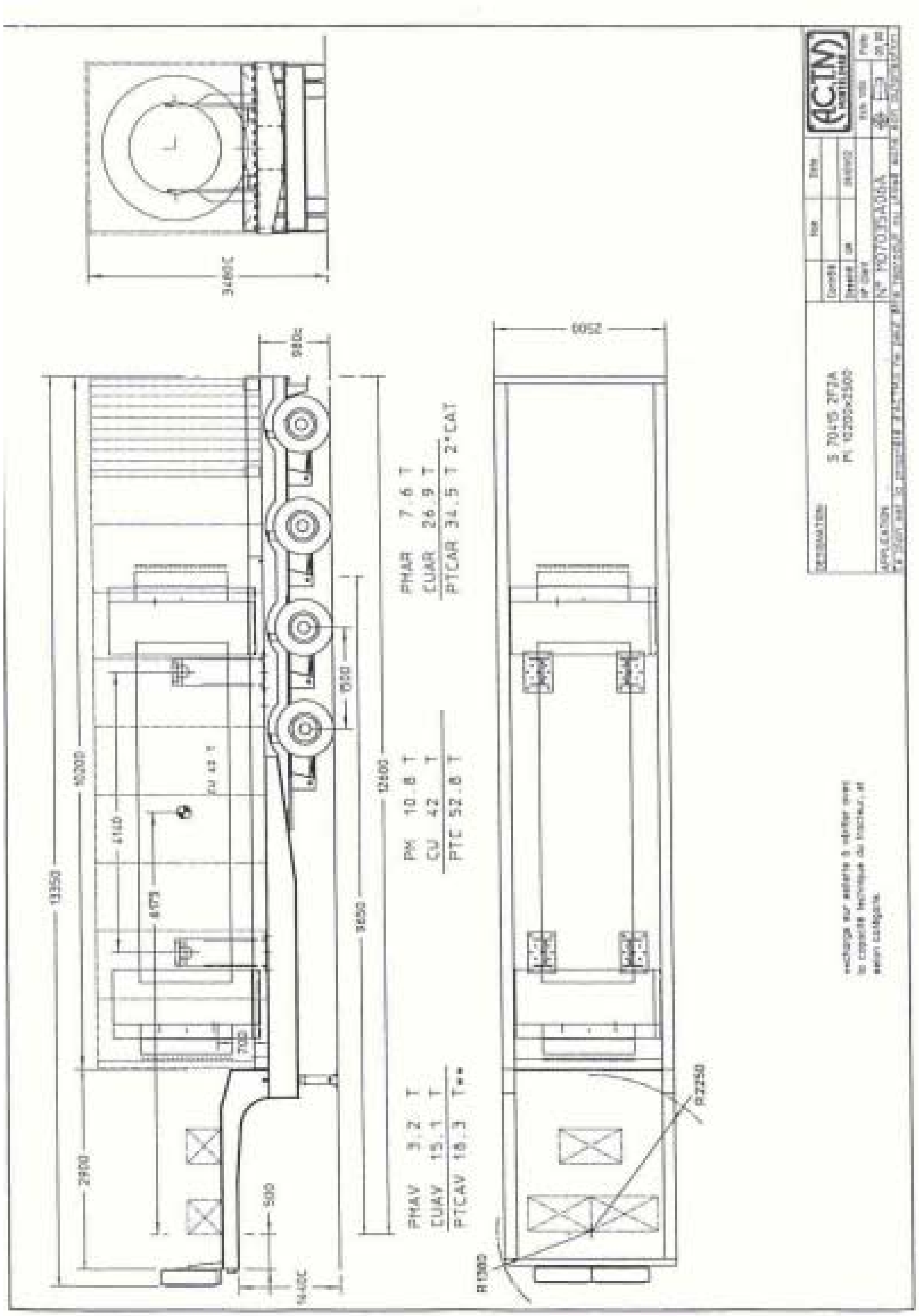


FIGURE N° 13: EXAMPLE OF 4 AXLES TRAILER

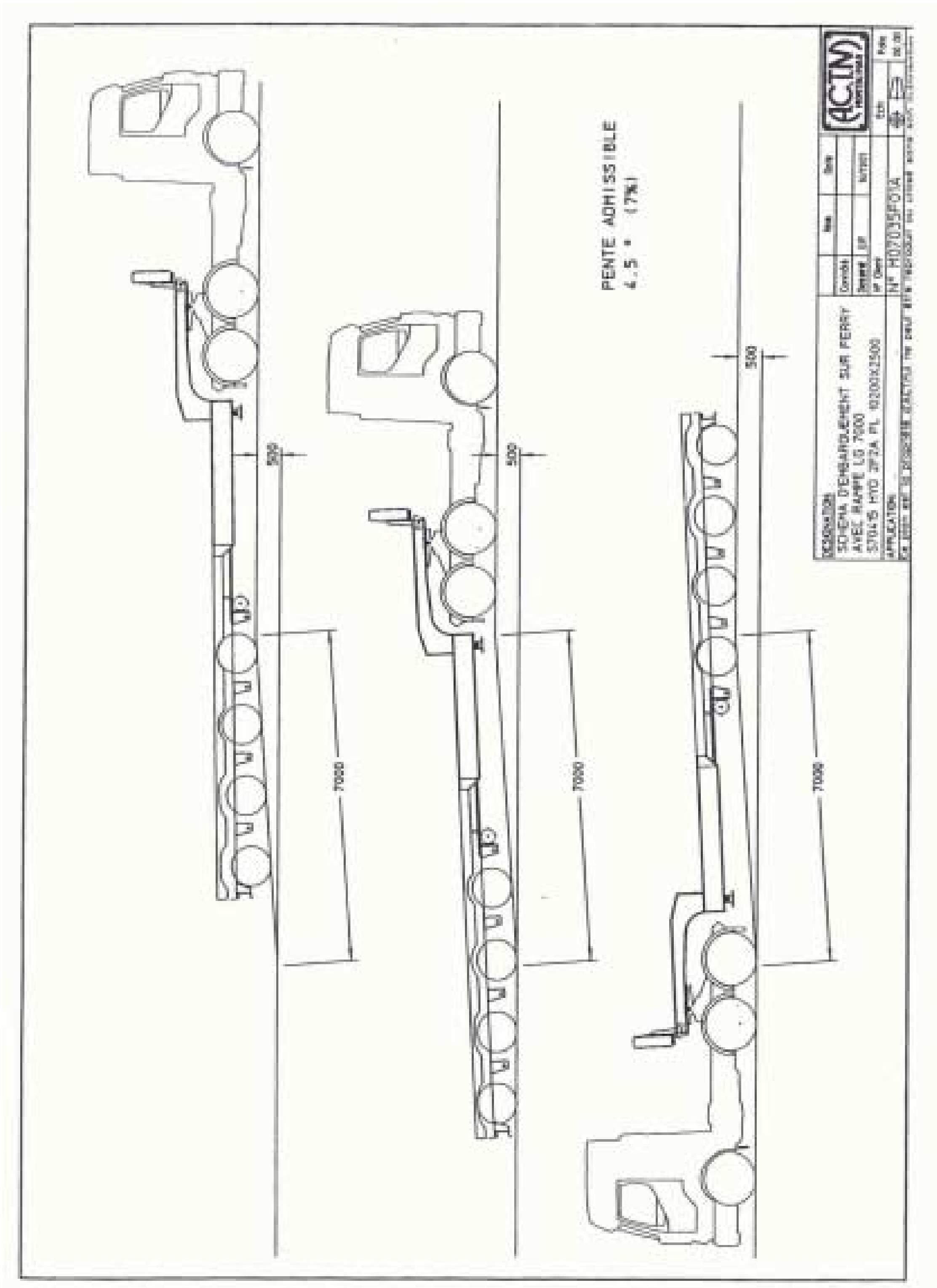


FIGURE N° 14: EXAMPLES OF A TRACTOR AND A 4 AXLES TRAILER

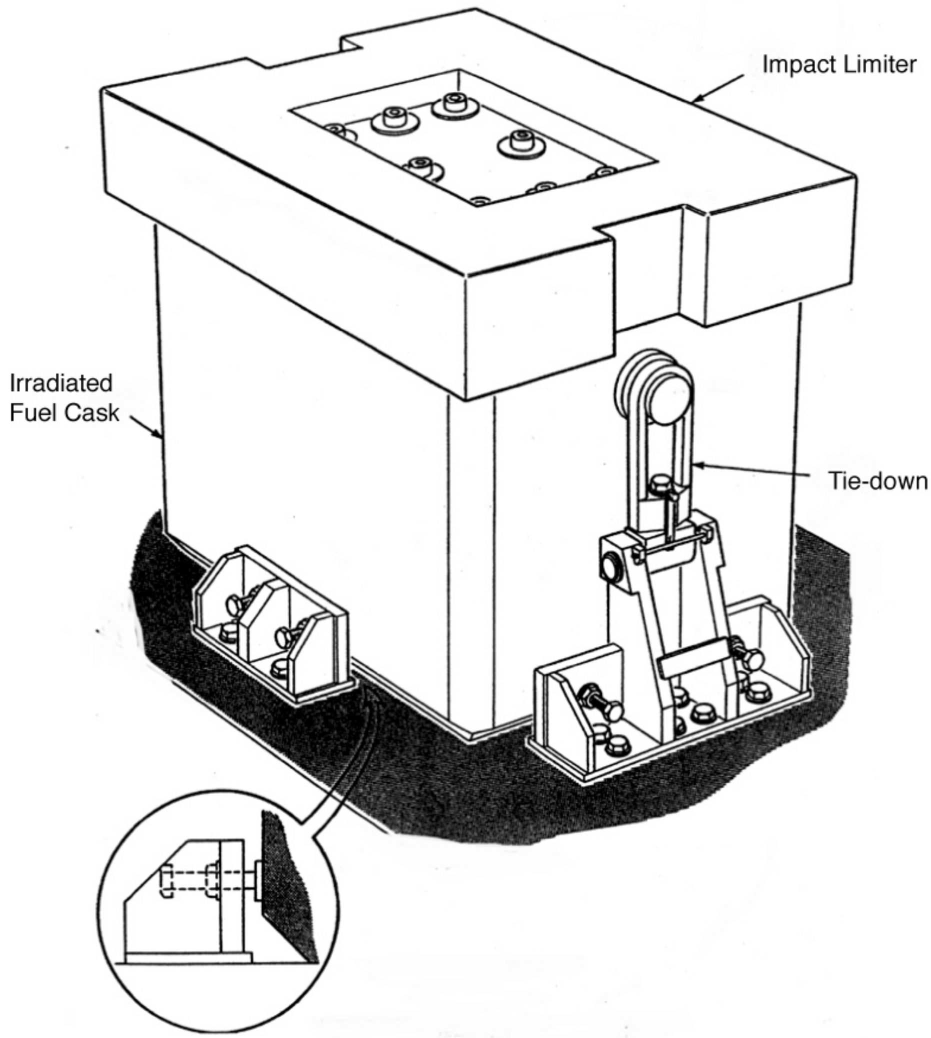


FIGURE N° 15: IFTC TIE DOWN (ROAD)

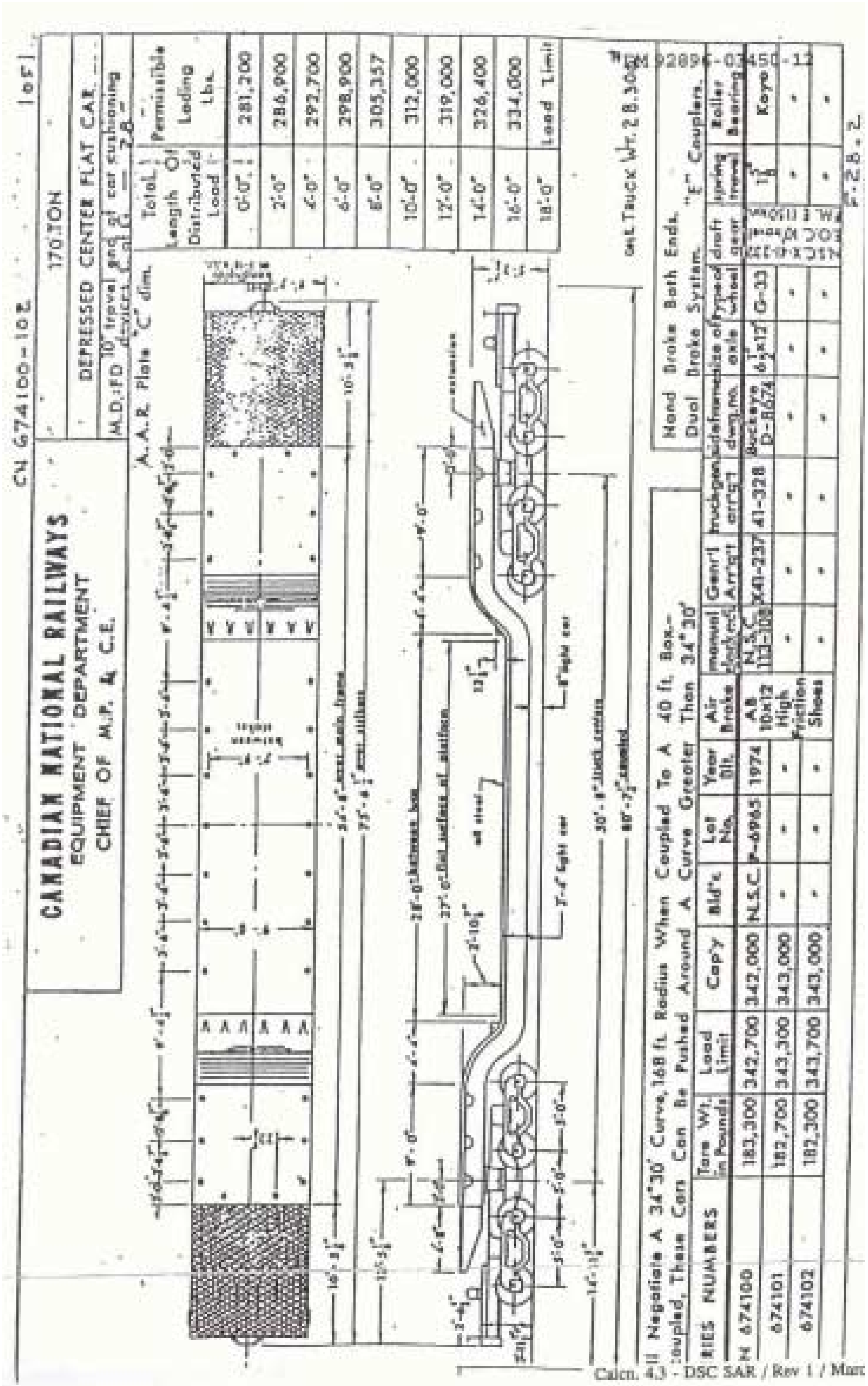


FIGURE N° 16: EXAMPLE OF A DEPRESSED CENTRE, FLAT BED CAR

Mr. D.J. RIBBANS 6 24 May 1994

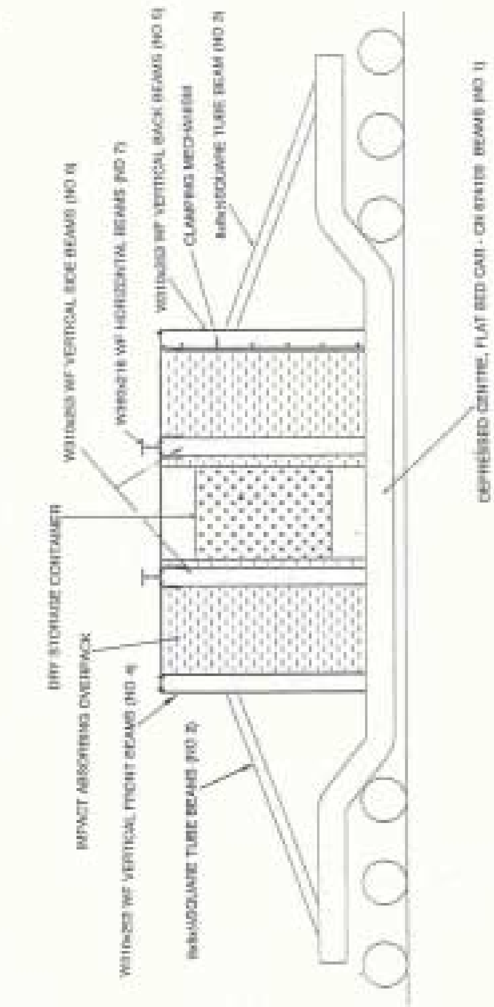


FIGURE 1

THE TIE-DOWN SYSTEM

Calcn. 4.4 - DSC SAR / Rev 1 / March 10, 1995

FIGURE N° 17: TIE-DOWN SYSTEM OF DSCTP ON DEPRESSED CENTRE, FLAT BED CAR

FIGURE N°18 : EXAMPLE OF A RAILCAR

FIGURE N° 19: EXAMPLE OF A VESSEL

Photo : COGEMA – Jean-Marie TAILLAT

FIGURE N° 20: EXAMPLE OF A WATER-ROAD-TRANSFER

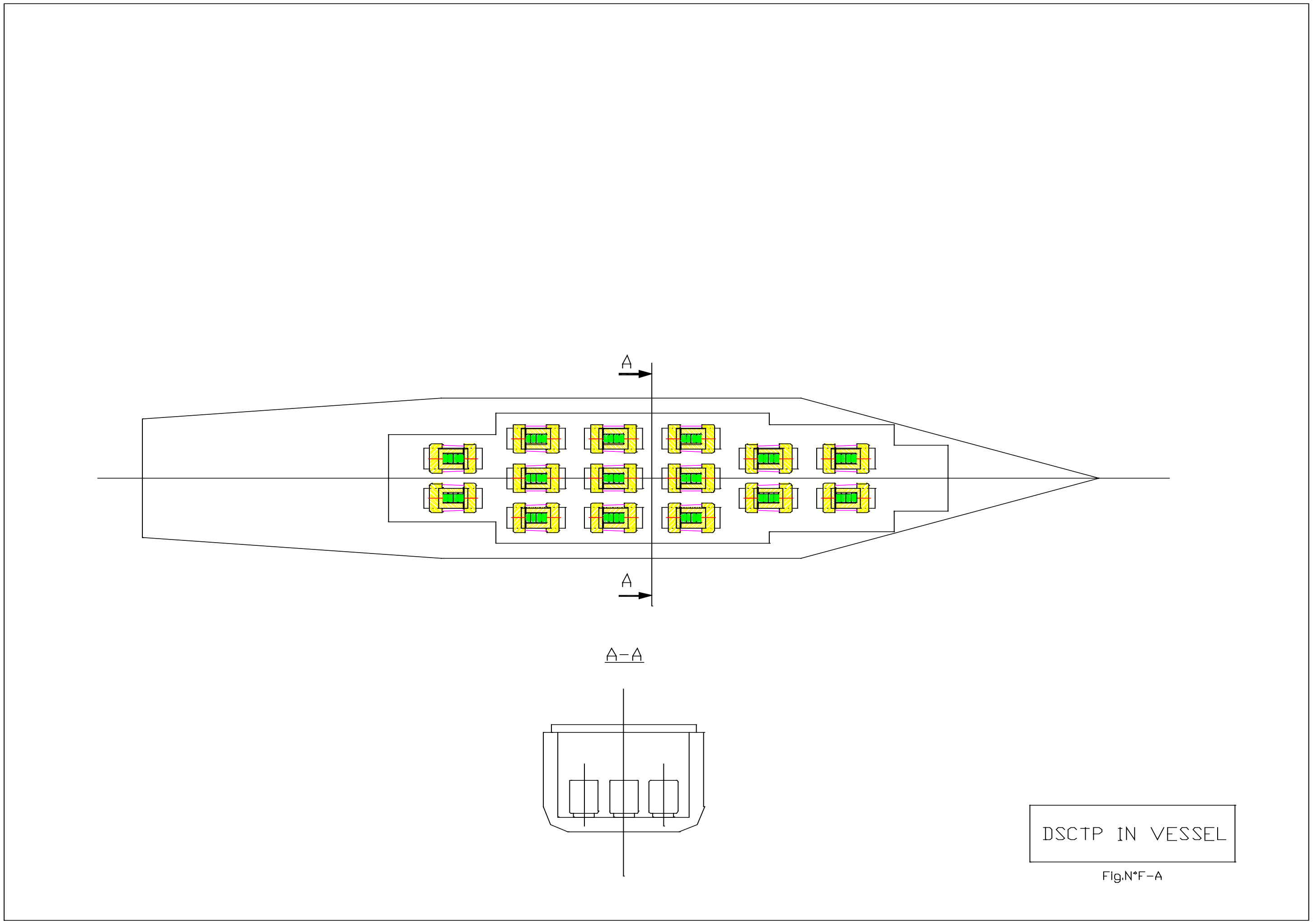


FIGURE N° 21: DSCTP IN VESSEL

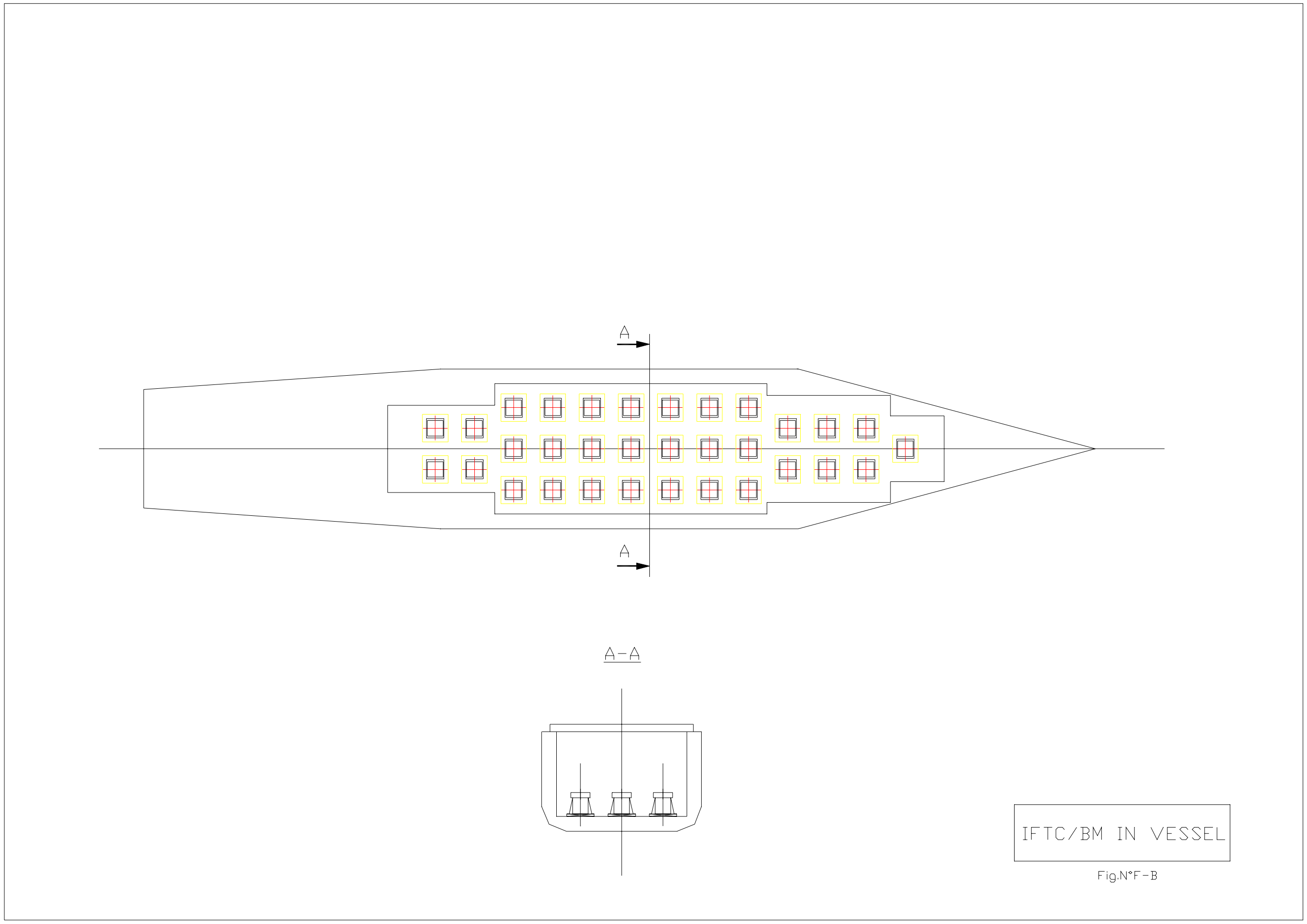


FIGURE N° 22: IFTC/BM IN VESSEL

APPENDIX B: BASIS AND INTERFACES

Table N°1: **Basis for "All road"**

Table N°2: **Basis for "Mostly rail"**

Table N°3: **Basis for "Mostly water"**

Table N°4: **Interfaces between storage and transportation for each site where the form of storage is baskets in Silo**

Table N°5: **Interfaces between storage and transportation for each site where the form of storage is baskets in Canstor**

Table N°6: **Interfaces between storage and transportation for each site where the form of storage is trays in wet bays**

Table N°7: **Interfaces between storage and transportation for each site where the form of storage is modules in wet bays**

Table N°8: **Interfaces between storage and transportation for each site where the form of storage is modules in DSC**

WASTE OWNER	CURRENT STORAGE SITE	REACTOR	STORAGE				ROAD MODE				
			Facility	Form of storage	Number of bundles	Number of DSCs	Transportation cask	Number of casks	Total Nr of casks/Site	Number of shipments/Facility Notes(3)	Number of shipments/Site
Ontario Power Generation	Pickering	Pickering A NGS (4 reactors)	Pickering A	Modules in wet bays	188936 (5) (6)	0	IFTC/BM	984		984	
			Pickering Used Fuel Dry Storage Facility	Modules in DSCs	218560 (5) (6)	580	IFTC/BM	1140		1140	
		Pickering B NGS (4 reactors)	Pickering B	Modules in wet bays	149048 (5) (6)	0	IFTC/BM	784		784	
			Pickering Used Fuel Dry Storage Facility	Modules in DSCs	373086 (5) (6)	972	IFTC/BM	1944	4852	1944	4852
Ontario Power Generation	Bruce	Bruce A NGS (4 reactors)	Bruce A	Trays in wet bays	0 (5) (7) (Note 1)	0		0		0	
			Western Used Fuel Dry Storage Facility	Modules in DSCs	625943 (5) (7) (Note 1)	1645	IFTC/BM	3290		3290	
		Bruce B NGS (4 reactors)	Bruce B	Trays in wet bays	377180 (5) (7) (Note 1)	0	IFTC/BM	1972		1972	
			Western Used Fuel Dry Storage Facility	Modules in DSCs	465588 (5) (7) (Note 1)	1224	IFTC/BM	2448		2448	
Atomic Energy of Canada Limited	Bruce	Douglas Point (1 reactor)	Douglas Point	Baskets in canisters Silo (2)	22256 (8) (9)	0	IFTC/BM	138	7848	138	7848
Ontario Power Generation	Darlington	Darlington NGS (4 reactors)	Darlington	Modules in wet bays	347088 (5) (7)	0	IFTC/BM	1811		1811	
			Darlington Used Fue Dry Storage Facility	Modules in DSCs	529004 (5) (7)	1386	IFTC/BM	2772	4583	2772	4583
New Brunswick Power	Point Lepreau	Point Lepreau 1 (1 reactor)	Point Lepreau	Baskets in canisters Silo (1)	119500 (10) (11)	0	IFTC/BM	664	664	664	664
Atomic Energy of Canada Limited	Chalk River	Chalk River Laboratories	Nuclear Power Demonstration fuel	Baskets in canisters Silo (2)	0 (12) (Note 2	0		0		0	
		Nuclear Power Demonstration (1 reactor) (stored at Chalk River)	Nuclear Power Demonstration fuel	Baskets in canisters Silo (2)	4853 (13) (9)	0	IFTC/BM	30	30	30	30
Atomic Energy of Canada Limited	Gentilly	Gentilly 1 (1 reactor)	Gentilly 1	Baskets in canisters Silo (4)	3213 (13) (14)	0	IFTC/BM	29		29	
Hydro Québec	Gentilly	Gentilly 2 (1 reactor)	Gentilly 2	Baskets in CANSTOR vaults (1)	132838 (15) (16)	0	IFTC/BM	738	767	738	767
Atomic Energy of Canada Limited	Whiteshell	Whiteshell Laboratories	Douglas Point Fuel	Baskets in canisters Silo (3)	360 (17) (Note 2)	0	IFTC/BM	3	3	3	3
					3557453	5807					18747

TABLE N° 1: BASIS FOR “ALL ROAD”

WASTE OWNER	CURRENT STORAGE SITE	REACTOR	STORAGE				RAIL MODE (POSSIBILITY OF A ROAD RAIL MODE FOR BRUCE AND POINT LEPREAU)					ROAD MODE				
			Facility	Form of storage	Number of bundles	Number of DSCs	Transportation cask	Number of casks	Total Nr of casks/Site	Number of shipments/Facility Note (3)	Number of shipments/Site	Transportation cask	Number of casks	Total Nr of caks/Site	Number of shipments/Facility Notes(3)	Number of shipments/Site
Ontario Power Generation	**Pickering**	Pickering A NGS (4 reactors)	Pickering A	Modules in wet bays	188936 (5) (6)	0	IFTC/ BM	984		100		IFTC/BM	984		984	
			Pickering Used Fuel Dry Storage Facility	Modules in DSCs	218560 (5) (6)	580	DSCTP	580		120		DSCTP	580		580	
		Pickering B NGS (4 reactors)	Pickering B	Modules in wet bays	149048 (5) (6)	0	IFTC/ BM	784		80		IFTC/BM	784		784	
			Pickering Used Fuel Dry Storage Facility	Modules in DSCs	373086 (5) (6)	972	DSCTP	972	3320	198	498	DSCTP	972	3320	972	3320
Ontario Power Generation	**Bruce**	Bruce A NGS (4 reactors)	Bruce A	Trays in wet bays	0 (5) (7) (Note 1)	0		0		0			0		0	
			Western Used Fuel Dry Storage Facility	Modules in DSCs	625943 (5) (7) (Note 1)	1645	DSCTP	1645		348		DSCTP	1645		1645	
		Bruce B NGS (4 reactors)	Bruce B	Trays in wet bays	377180 (5) (7) (Note 1)	0	IFTC/ BM	1972				IFTC/BM	1972		1972	
			Western Used Fuel Dry Storage Facility	Modules in DSCs	465588 (5) (7) (Note 1)	1224	DSCTP	1224		252		DSCTP	1224		1224	
Atomic Energy of Canada Limited	**Bruce**	Douglas Point (1 reactor)	Douglas Point	Baskets in canisters Silo (2)	22256 (8) (9)	0	IFTC /BM	138	4979	14	814	IFTC/BM	138	4979	138	4979
Ontario Power Generation	**Darlington**	Darlington NGS (4 reactors)	Darlington	Modules in wet bays	347088 (5) (7)	0	IFTC/ BM	1811		188		IFTC/BM	1811		1811	
			Darlington Used Fue Dry Storage Facility	Modules in DSCs	529004 (5) (7)	1386	DSCTP	1386	3197	286	474	DSCTP	1386	3197	1386	3197
New Brunswick Power	**Point Lepreau**	Point Lepreau 1 (1 reactor)	Point Lepreau	Baskets in canisters Silo(1)	119500 (10) (11)	0	IFTC/ BM	664	664	67	67	IFTC/BM	664	664	664	664
Atomic Energy of Canada Limited	**Chalk River**	Chalk River Laboratories	Nuclear Power Demonstration fuel	Baskets in canisters Silo (2)	0 (12) (Note 2	0							0		0	
		Nuclear Power Demonstration (1 reactor) (stored at Chalk River)	Nuclear Power Demonstration fuel	Baskets in canisters Silo (2)	4853 (13) (9)	0						IFTC/BM	30	30	30	30
Atomic Energy of Canada Limited	**Gentilly**	Gentilly 1 (1 reactor)	Gentilly 1	Baskets in canisters Silo (4)	3213 (13) (14)	0	IFTC/ BM	29	29	3		IFTC/BM	29	29	29	
Hydro Québec	**Gentilly**	Gentilly 2 (1 reactor)	Gentilly 2	Baskets in CANSTOR vaults (1)	132838 (15) (16)	0	IFTC/ BM	738	767	74	77	IFTC/BM	738	767	738	767
Atomic Energy of Canada Limited	**Whiteshell**	Whiteshell Laboratories	Douglas Point Fuel	Baskets in canisters Silo (3)	360 (17) (Note 2)	0						IFTC/BM	3	3	3	3
					3557453	5807					1930					12960

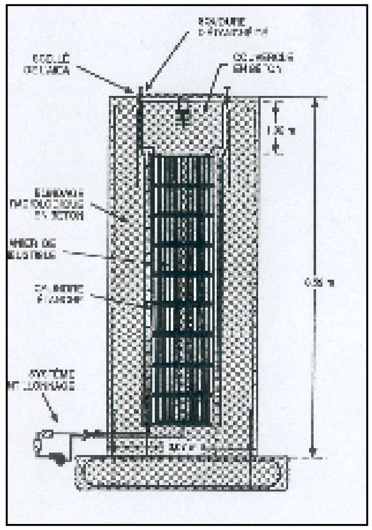
TABLE N° 2: BASIS FOR "MOSTLY RAIL"

WASTE OWNER	CURRENT STORAGE SITE	REACTOR	STORAGE				WATER MODE					ROAD MODE				
			Facility	Form of storage	Number of bundles	Number of DSCs	Transportation cask	Number of casks	Total Nr of casks/Site	Number of shipments/Facility Note (3)	Number of shipments/Site	Transportation cask	Number of casks	Total Nr of caks/Site	Number of shipments/Facility Notes (3)	Number of shipments/Site
Ontario Power Generation	**Pickering**	Pickering A NGS (4 reactors)	Pickering A	Modules in wet bays	188936 (5) (6)	0	IFTC/ BM	984		32		IFTC/BM	984			
			Pickering Used Fuel Dry Storage Facility	Modules in DSCs	218560 (5) (6)	580	DSCTP	580		40		DSCTP	580			
		Pickering B NGS (4 reactors)	Pickering B	Modules in wet bays	149048 (5) (6)	0	IFTC/ BM	784		25		IFTC/BM	784			
			Pickering Used Fuel Dry Storage Facility	Modules in DSCs	373086 (5) (6)	972	DSCTP	972	3320	72	169	DSCTP	972	3320		3320
Ontario Power Generation	**Bruce**	Bruce A NGS (4 reactors)	Bruce A	Trays in wet bays	0 (5) (7) (Note 1)	0		0		0			0			
			Western Used Fuel Dry Storage Facility	Modules in DSCs	625943 (5) (7) (Note 1)	1645	DSCTP	1645		109		DSCTP	1645			
		Bruce B NGS (4 reactors)	Bruce B	Trays in wet bays	377180 (5) (7) (Note 1)	0	IFTC/ BM	1972		66		IFTC/BM	1972			
			Western Used Fuel Dry Storage Facility	Modules in DSCs	465588 (5) (7) (Note 1)	1224	DSCTP	1224		88		DSCTP	1224			
Atomic Energy of Canada Limited	**Bruce**	Douglas Point (1 reactor)	Douglas Point	Baskets in canisters Silo (2)	22256 (8) (9)	0	IFTC/ BM	138	4979	5	268	IFTC/BM	138	4979		4979
Ontario Power Generation	**Darlington**	Darlington NGS (4 reactors)	Darlington	Modules in wet bays	347088 (5) (7)	0	IFTC/ BM	1811		60		IFTC/BM	1811			
			Darlington Used Fuel Dry Storage Facility	Modules in DSCs	529004 (5) (7)	1386	DSCTP	1386	3197	104	164	DSCTP	1386	3197		3197
New Brunswick Power	**Point Lepreau**	Point Lepreau 1 (1 reactor)	Point Lepreau	Baskets in canisters Silo (1)	119500 (10) (11)	0	IFTC/ BM	664	664	21	21	IFTC/BM	664	664		664
Atomic Energy of Canada Limited	**Chalk River**	Chalk River Laboratories	Nuclear Power Demonstration fuel	Baskets in canisters Silo (2)	0 (12) (Note 2	0									0	
		Nuclear Power Demonstration (1 reactor) (stored at Chalk River)	Nuclear Power Demonstration fuel	Baskets in canisters Silo (2)	4853 (13) (9)	0						IFTC/BM	30	30	30	30
Atomic Energy of Canada Limited	**Gentilly**	Gentilly 1 (1 reactor)	Gentilly 1	Baskets in canisters Silo (4)	3213 (13) (14)	0	IFTC/ BM	29		1		IFTC/BM	29			
Hydro Québec	**Gentilly**	Gentilly 2 (1 reactor)	Gentilly 2	Baskets in CANSTOR vaults (1)	132838 (15) (16)	0	IFTC/ BM	738	767	24	25	IFTC/BM	738	767		767
Atomic Energy of Canada Limited	**Whiteshell**	Whiteshell Laboratories	Douglas Point Fuel	Baskets in canisters Silo (3)	360 (17) (Note 2)	0						IFTC/BM	3	3	3	3
					3557453	5807					647					12960

TABLE N°3: BASIS FOR « MOSTLY WATER » (WATER ROAD TRANSFER)

(1): 60-bundle basket design
(2) : 54-bundle basket design
(3): 40-bundle basket design
(4): 38-bundle basket design
(5) : Reference OPG (2001a, 40 year scenario)
(6) : Fuel Bundle Dimensions (L x D in mm) and Mass (kg) 497 mm x 102 mm & 24.8 kg (Tait et al. 2000)
(7) : Fuel Bundle Dimensions (L x D in mm) and Mass (kg) 495 mm x 102.5 mm & 21.7 kg (Tait et al. 2000)
(8) : Reference AECL (1994), Dolinar 2000 (not including 360 bundles stored at Whiteshell Labs)
(9) : Fuel Bundle Dimensions (L x D in mm) and Mass (kg) 497 mm x 83 mm & 16.7 kg
(10) : Reference DeLong (2001a)
(11) : Fuel Bundle Dimensions (L x D in mm) and Mass (kg) 495 mm x 102.4 mm & 23.6 kg (DeLong 2001b)
(12) : Reference Dolinar (2000)
(13) : Reference AECL (1994), Dolinar (2000)
(14) : Fuel Bundle Dimensions (L x D in mm) and Mass (kg) 501.5 mm x 103 mm & 26.7 kg
(15) : Reference Lupien (2000)
(16) : Fuel Bundle Dimensions (L x D in mm) and Mass (kg) 495 mm x 102.5 mm & 21.7 kg (Frost 1994)
(17) : Reference Dolinar (2000) (Douglas Point bundles)

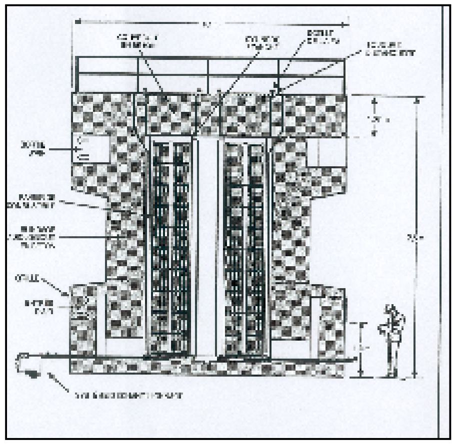
Note 1: Bruce A, Bruce B and Darlington use a small portion of "long" bundles with the following characteristics : 508 mm x 102.5 mm & 22.3 kg.
Note 2: Non-CANDU fuel materials are not included.
Note 3: The numbers of bundles differ slightly from those in **<1>** because the numbers in the tables have been calculated form the annual shipping programs given in **<9>**. Similarly the numbers of DSCs and IFTC/BMs are taken from the integer numbers of casks shipped each year.



BASKETS IN SILO

SITE	REACTOR	FACILITY	FORM OF STORAGE	INTERFACES "ALL ROAD"	INTERFACES "MOSTLY RAIL"	INTERFACES "MOSTLY WATER"
Whiteshell	Douglas Point Fuel	Douglas Point Facility	Baskets in Silo	Transfer flask similar to the one used to load silos ready to be loaded into the transportation casks	Transfer flask similar to the one used to load silos ready to be loaded into the transportation casks	Transfer flask similar to the one used to load silos ready to be loaded into the transportation casks
Chalk river	Nuclear Power Demonstration	NPD fuel Facility	Baskets in Silo	Transfer flask similar to the one used to load silos ready to be loaded into the transportation casks	Transfer flask similar to the one used to load silos ready to be loaded into the transportation casks	Transfer flask similar to the one used to load silos ready to be loaded into the transportation casks
Gentilly	Gentilly 1	Gentilly 1 Facility	Baskets in Silo	Transfer flask similar to the one used to load silos ready to be loaded into the transportation casks	Transfer flask similar to the one used to load silos ready to be loaded into the transportation casks	Transfer flask similar to the one used to load silos ready to be loaded into the transportation casks
Point Lepreau	Point Lepreau	Point Lepreau Facility	Baskets in Silo	Transfer flask similar to the one used to load silos ready to be loaded into the transportation casks	Transfer flask similar to the one used to load silos ready to be loaded into the transportation casks	Transfer flask similar to the one used to load silos ready to be loaded into the transportation casks

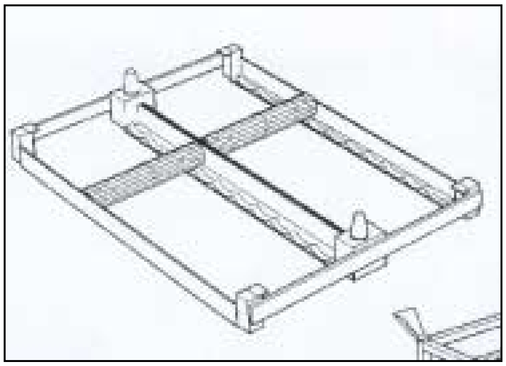
TABLE N° 4: INTERFACES BETWEEN STORAGE AND TRANSPORTATION FOR EACH SITE WHERE THE FORM OF STORAGE IS BASKETS IN SILO



BASKETS IN CANSTOR

SITE	REACTOR	FACILITY	FORM OF STORAGE	INTERFACES "ALL ROAD"	INTERFACES "MOSTLY RAIL"	INTERFACES "MOSTLY WATER"
Gentilly	Gentilly 2	Gentilly 2	Baskets in CANSTOR	Transfer flask similar to the one used to load Canstors ready to be loaded into the transportation casks	Transfer flask similar to the one used to load Canstors ready to be loaded into the transportation casks	Transfer flask similar to the one used to load Canstors ready to be loaded into the transportation casks

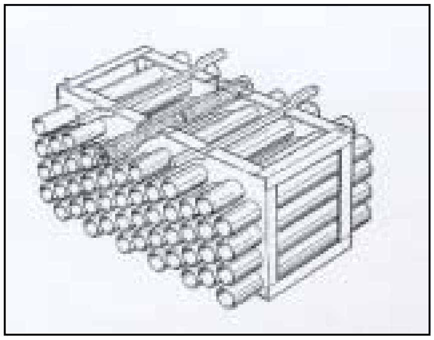
TABLE N° 5: INTERFACES BETWEEN STORAGE AND TRANSPORTATION FOR EACH SITE WHERE THE FORM OF STORAGE IS BASKETS IN CANSTOR



TRAYS IN WET BAYS

SITE	REACTOR	FACILITY	FORM OF STORAGE	INTERFACES "ALL ROAD"	INTERFACES "MOSTLY RAIL"	INTERFACES "MOSTLY WATER"
Bruce	Bruce B	Bruce B Facility	Trays in wet bays	The Used Fuel will be in transportation modules in the bay	The Used Fuel will be in transportation modules in the bay	The Used Fuel will be in transportation modules in the bay

TABLE N° 6: INTERFACES BETWEEN STORAGE AND TRANSPORTATION FOR EACH SITE WHERE THE FORM OF STORAGE IS TRAYS IN WET BAYS



MODULES IN WET BAYS

SITE	REACTOR	FACILITY	FORM OF STORAGE	INTERFACES “ALL ROAD”	INTERFACES “MOSTLY RAIL”	INTERFACES “MOSTLY WATER”
Pickering	Pickering A	Pickering A	Modules in wet bays	The Used Fuel will be in transportation modules in the bay	The Used Fuel will be in transportation modules in the bay	The Used Fuel will be in transportation modules in the bay
	Pickering B	Pickering B	Modules in wet bays	The Used Fuel will be in transportation modules in the bay	The Used Fuel will be in transportation modules in the bay	The Used Fuel will be in transportation modules in the bay
Darlington	Darlington	Darlington	Modules in wet bays	The Used Fuel will be in transportation modules in the bay	The Used Fuel will be in transportation modules in the bay	The Used Fuel will be in transportation modules in the bay

TABLE N° 7: INTERFACES BETWEEN STORAGE AND TRANSPORTATION FOR EACH SITE WHERE THE FORM OF STORAGE IS MODULES IN WET BAYS

MODULES IN DSC

SITE	REACTOR	FACILITY	FORM OF STORAGE	INTERFACES "ALL ROAD"	INTERFACES "MOSTLY RAIL"	INTERFACES "MOSTLY WATER"
Bruce	Bruce A	WUFDSF	Modules in DSCs	The Used Fuel will be in transportation modules in a hot cell at the facility ready for loading into the transportation cask	The Used Fuel will be in DSCs in the storage locations in the WUFDSF	The Used Fuel will be in DSCs in the storage locations in the WUFDSF
	Bruce B	WUFDSF	Modules in DSCs	The Used Fuel will be in transportation modules in a hot cell at the facility ready for loading into the transportation cask	The Used Fuel will be in DSCs in the storage locations in the WUFDSF	The Used Fuel will be in DSCs in the storage locations in the WUFDSF
Pickering	Pickering A	PUFDSF	Modules in DSCs	The Used Fuel will be in transportation modules in a hot cell at the facility ready for loading into the transportation cask	The Used Fuel will be in DSCs in the storage locations in the PUFDSF	The Used Fuel will be in DSCs in the storage locations in the PUFDSF
	Pickering B	PUFDSF	Modules in DSCs	The Used Fuel will be in transportation modules in a hot cell at the facility ready for loading into the transportation cask	The Used Fuel will be in DSCs in the storage locations in the PUFDSF	The Used Fuel will be in DSCs in the storage locations in the PUFDSF
Darlington	Darlington	DUFDSF	Modules in DSCs	The Used Fuel will be in transportation modules in a hot cell at the facility ready for loading into the transportation cask	The Used Fuel will be in DSCs in the storage locations in the DUFDSF	The Used Fuel will be in DSCs in the storage locations in the DUFDSF

TABLE N° 8: INTERFACES BETWEEN STORAGE AND TRANSPORTATION FOR EACH SITE WHERE THE FORM OF STORAGE IS MODULES IN DSCS

APPENDIX C: ROAD TRANSPORT FEASIBILITY OF IFTC/BM AND DSCTP

CONTENTS

1. REFERENCES

The following references were used for the completion of this study:

- *Regulations for the Safe Transport of Radioactive Material, No. TS-R-1* (international Atomic Energy Agency) **<32>**;

- *Transportation of Dangerous Goods Regulations (Transport Canada);*
  Packaging and Transport of Nuclear Substances Regulations (Canadian Nuclear Safety Commission) **<49>**;

Provincial regulations applicable to the transport of radioactive material;

- Manitoba Transportation and Government Services *Weights and Dimensions Compliance Guide* (October 2000) **<38>**;

- *Ontario Highway Traffic Act* **<41>**;

- Quebec Ministère des Transports, *Vehicle Load and Size Limits, The 2000 edition* **<43>**;
- *Guide to the Agreement on Uniform Vehicle Weights and Dimensions Limits in Atlantic Canada* (October 2001) **<31>**;

- New Brunswick Department of Transportation, Notice to transporters *: Guideline for Applying for and Obtaining Required Special Permits* (July 2001) **<40>**;

- New Brunswick Department of Transportation, *Motor Vehicle Act* **<39>**;

- Freightliner Argosy Brochure **<51>.**

2. PURPOSES

The objectives of this appendix are:

- To give the reason for the choice of one road weight transportation cask among the two (IFTC, IFTC/BM) in accordance with the regulations.

- To verify the transport feasibility of the DSCTP by road.

3. DATA

3.1. Description of the casks

- "Standard" IFTC

  Dimensions (approx.):
  - Length : 1.9 m (2.3 m with impact limiter)
  - Width : 1.6 m (2.1 m with impact limiter)
  - Height : 2.2 m
  - Weight : 35 T (total loaded weight)

- IFTC/BM

  Dimensions (approx.):
  - Length : 1.9 m (2.3 m with impact limiter)
  - Width : 1.6 m (2.1 m with impact limiter)
  - Height : 2.6 m

Calculation of the estimated weight:

Volume added to the "standard" IFTC (in dm3):
[(16.44*18.81*21.47)-(11.10*13.47*18.80)]-[(15.56*18.81*16.97)-(10.22*13.47*14.3)] = 830,1 dm3
See Appendix A for measurement details of the IFTC and IFTC/BM.

Mass = 830.1 * 7.6 = 6,309 kg (7.6 kg/dm3 is the density of the steel used in the IFTC)

IFTC mass (loaded)	= 35 T		
	+	6.3 T	mass of the added volume
	+	0.3 T	increased cap
	+	0.6 T	increased impact limiter (due to the global increase of the cask)
	+	0.3 T	space filler

➔ Mass of IFTC/BM: 42.5 T (total loaded estimated weight).

NB: the dimensions of the IFTC and of the IFTC/BM, when they are loaded on a low profile trailer (the same kind as the one shown on Appendix A), are within the limits of the Quebec, Ontario and New Brunswick road transport regulations [see References].

These limits are:	Max. height	-> 4.15m
	Max. width	-> 2.60m
	Max. length	-> 16.20m (for a tractor and a semi-trailer)

- DSCTP

  The DSCTP will be transported in horizontal position, and the dimensions are as follow:
  - Length : 5.950 m
  - Width : 3.370 m
  - Height : 3.670 m
  - Weight : 100 T (approx.)

3.2. Description of the vehicle

- Trailer (4 axles)

The trailer we choose for this study will be the one described in Appendix A.
- Length : 13,35 m
- Width : 2,5 m
- Height : 0,98 m (deck)
- Number of axles: 4
- Distance between two axles: 1,5 m
- Weight: 3 T (estimated)

- Tractor

The tractor presented in this study is as described in the "Argosy" brochure **<51>.**
- Number of axles: 4 (3 + 1 removable)
- Allowable front axle weight: 7,273 kg
- Allowable tandem drive axles weight: 20,900 kg
- Drive axle spacing: 1.5 m
- Front axle to last axle spacing: 4.9 m
- Weight of the tractor: 11 T

4. CALCULATIONS

4.1. Allowable Gross Weight for the vehicle

The method used for this calculation is described in the “Vehicle Weight and Dimension Limits in Ontario” Regulation.

The vehicle (tractor and semi-trailer) is composed of seven axle units and one 4 axles group (trailer) and we will not take into account the removable axle.
All axles are dual tires fitted except the steering axle of the tractor (single tire).
The maximum allowable weight of a 4 axles group (as indicated in the regulation) is 38,000 kg, if the axle group spacing is equal or superior to 7.5 m.

The maximum allowable gross weight of the vehicle will be:
Tractor front axle allowable weight: 7,273 kg (as indicated in the Argosy brochure)
+ Drive tandem axle allowable weight: 20,900 kg
+ 4 axles group max. allowable weight: 38,000 kg (27,100 kg for the presented trailer)

➔ Maximum allowable weight: **66,173 kg** or **55,273 kg** if we use the presented trailer.

4.2. Transport feasibility for each of the three casks

Estimated weight of the trailer: 3 T
Total weight of the vehicle (tractor and semi-trailer not loaded): 14 T

- “Standard” IFTC
  Weight of the cask: 35 T (loaded)
  Weight of the vehicle: 14 T
  Total weight: 49 T

➔ This cask can be transported with the presented trailer and tractor.

- IFTC/BM

  Weight of the cask: 42.5 T (estimated, loaded)
  Weight of the vehicle: 14 T
  Total weight: 56.5 T

➔ We can transport this cask with a 4 axles trailer if the axle group spacing is equal or superior to 5.0 m.
As mentioned in the regulation, the maximum allowable weight for a 4 axles group with a spacing of 5.0 m is 28,900 kg, so we have the following result: 28,900 + 20,900 + 7,273 = ***57,073 kg****, which is sufficient to transport a loaded IFTC/BM cask.*

- DSCTP

For the DSCTP, which weigh about 100 T, the calculation is reversed, and because it cannot be transported on a standard semi-trailer we need to determine how many axles are required to transport this cask by road.

On the “Weight and dimensions limits in Ontario” regulation, the maximum weight allowable for a single axle is 10,000 kg.
We can estimate with these data that the trailer should have at least 9 single axles (an example of this kind of trailer is shown in Figure N°12 / Appendix A), as shown on the calculation next page.

Calculation for an 9 axles semi-trailer with a 3 axles tractor (see the Argosy description above, but only for weight and dimensions purposes):

Tractor front axle allowable weight:	7,273 kg	(as indicated in the Argosy brochure)
+ Drive tandem axle allowable weight:	20,900 kg	
+ 9 axles max. allowable weight:	86,000 kg	(two 4 axles group + one single axle)
= Total allowable weight:	114,173 kg	

For the transports of DSCTP a special permit for an overweight and oversized convoy will be required because of the weight and the width, which exceed the limits allowed.

5. CONCLUSIONS

As we could notice with the above calculations, the changes made from the standard IFTC to the IFTC/BM represent a 7.5 tons increase in weight. But if the axles group spacing of the trailer is designed to meet the requirement of the provincial regulations on maximum allowable weights, it is possible to transport the IFTC/BM by road without additional constraint in comparison with the standard IFTC.

Concerning the DSCTP, a special permit is needed to transport it by road, due to its weight and its dimensions.

APPENDIX D: Conceptual design and description for all the UFTS components in the case of "All road" 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° 1.
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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 roadways [**<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 document.

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 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 flatbed 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 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.

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.

- IFTC/BM: See chapter 2.4, section 2.4.7.1.3, Figure N° 6 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 Transportation cask 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 Transportation cask (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 trailers, security, transportation, emergency response:

- Loading of Transportation cask onto the trailers, security, transportation as described in phase 6 of table paragraph 2.9.

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

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

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

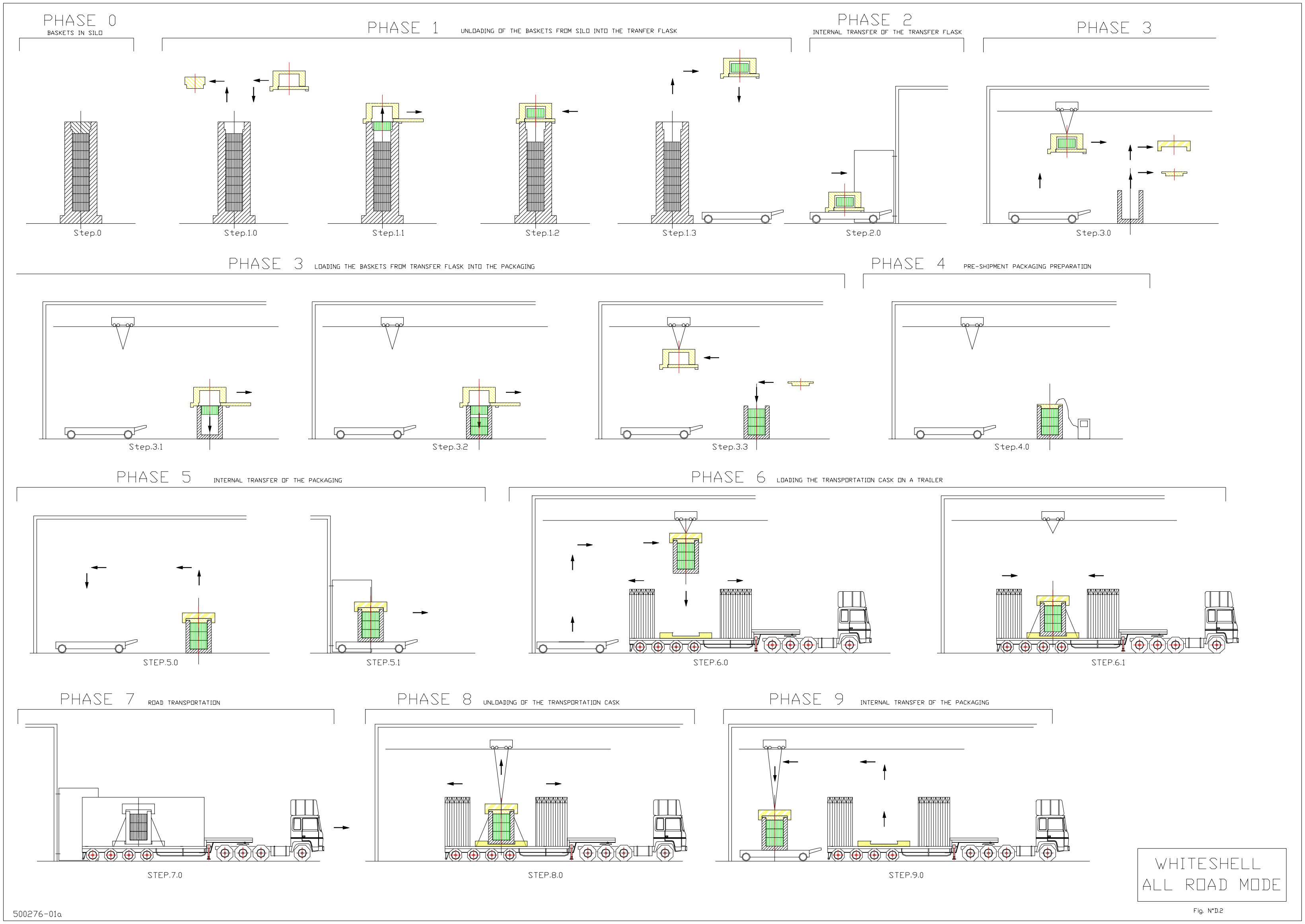
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.2
Phase 0	Baskets in Silo	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 2	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 chapter 2., 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 1 hoist (of 60 tons for the 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.	Lid handling tool of the Transportation cask		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 - 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. Bolting of the lid with the associated platform			3.3

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.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 equipment		
			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 trolley	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 full 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	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/	6.0
				Lifting Beam for packaging	To carry of the IFTC/BM (similar to the IFTC, **<3>**)	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 the packaging, trailer			6.1
			Fit the transport seals			6.1
			Close the weather cover	Weather cover		6.1
			Radiological control of the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	6.1

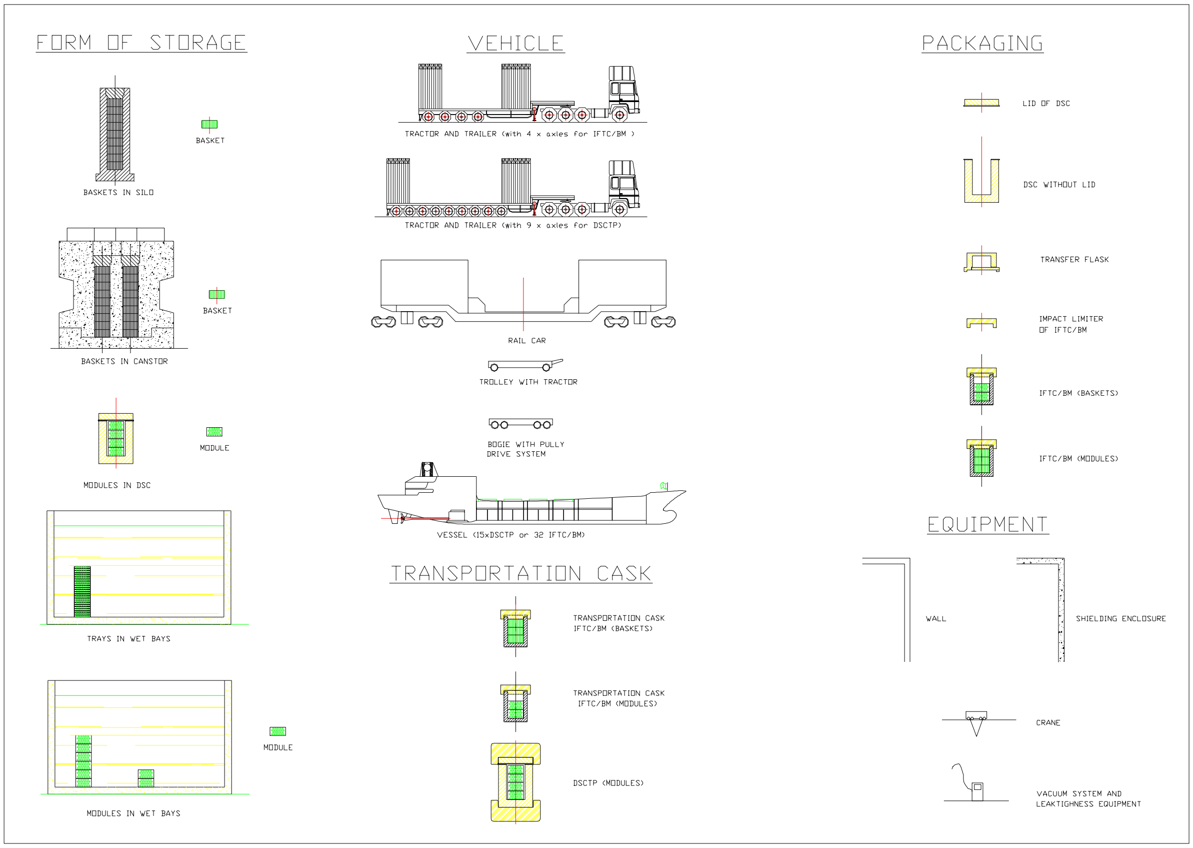
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.2
Phase 7	Road transportation	UFTS	Road transportation of the Transportation cask from the Facility to the Centralised Facility			7.0
			Real time tracking		Appendix H	7.0
Phase 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
ALL ROAD MODE
Fig. N°D.2
500276-01a

Key:


FORM OF STORAGE
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
BASKET
MODULES IN DSC
MODULE
TRAYS IN WET BAYS
MODULES IN WET BAYS
MODULE
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 WUFDSF to the Centralised Facility

Quantity of bundles to be transported from 2035 to 2064: see Appendix B, Table N° 1.

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.

Road transport is clearly feasible from this Site [**<52>**, **<53>**, **<27>** and **<54>**]. Public roadways are adequate to support transport from the site. Some strengthening of on-site roadways may be required to support the high volume of transports necessary for this portion of the shipping campaign. Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

Given the volume of used fuel to be transported to the site, use of the road mode would result in a larger number of individual shipments and offers the least potential for a consolidated transport program. The term “consolidated” refers to the physical consolidation of cargo into larger consignments as well as to the coordination of shipments between sites, according to the context.

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 trailer.

See phases 3, 4, 5 of paragraph 3.1.9 of the present document.

3.1.3. Transporter (vehicle)

Conceptual design of trailer and tractors (phase 6 of table paragraph 3.1.9)

3.1.3.1. Trolley with tractor

In order to transfer:
- The DSC from the storage to the hot cell (phase 1 of table paragraph 3.1.9),

3.1.3.2. Bogie pulley drive system

In order to transfer:

- The DSC in the hot cell (phase 2 of table paragraph 3.1.9),
- The IFTC/BM in the hot cell (phase 3 of table paragraph 3.1.9),
- The IFTC/BM to the pre-shipment packaging area (phase 4 of table paragraph 3.1.9),
- The IFTC/BM to the shipment area (phase 5 of table paragraph 3.1.9).

3.1.3.3. Trailer for the road transportation (phase 6 of table paragraph 3.1.9)

- 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

3.1.3.4. Tractor for the road transportation (phase 6 of table paragraph 3.1.9)

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

3.1.3.5. Weather cover for the road transportation (phases 6 and 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.

3.1.3.6. Frame of the Transportation cask for the road transportation (phase 6 of table paragraph 3.1.9)

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.

3.1.3.7. Specific equipment

- 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 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).

3.1.5. Casks

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

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

3.1.6. 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 3.1.9)
- Gantry Crane:
  One for loading the Transportation cask on the trailer (see phase 6 of table paragraph 3.1.9)
  One for loading the impact limiter on the packaging (see phase 4 of table paragraph 3.1.9)
- Lifting beam :
  One for the Transportation cask (see phase 6 of table paragraph 3.1.9)
  One for the impact limiter of the packaging (see phase 4 of table paragraph 3.1.9)
- Decontamination equipment (see paragraph 3.2 of Chapter 3).

3.1.7. UFTS Transportation system operation

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

- Loading of packages onto the trailers, security, transportation as described in phase 6 of table paragraph 3.1.9.
- Emergency response plan: see paragraph 9 of Appendix 9.
- Real time tracking: see paragraph 9 of Appendix 9.

3.1.8. Decommissioning

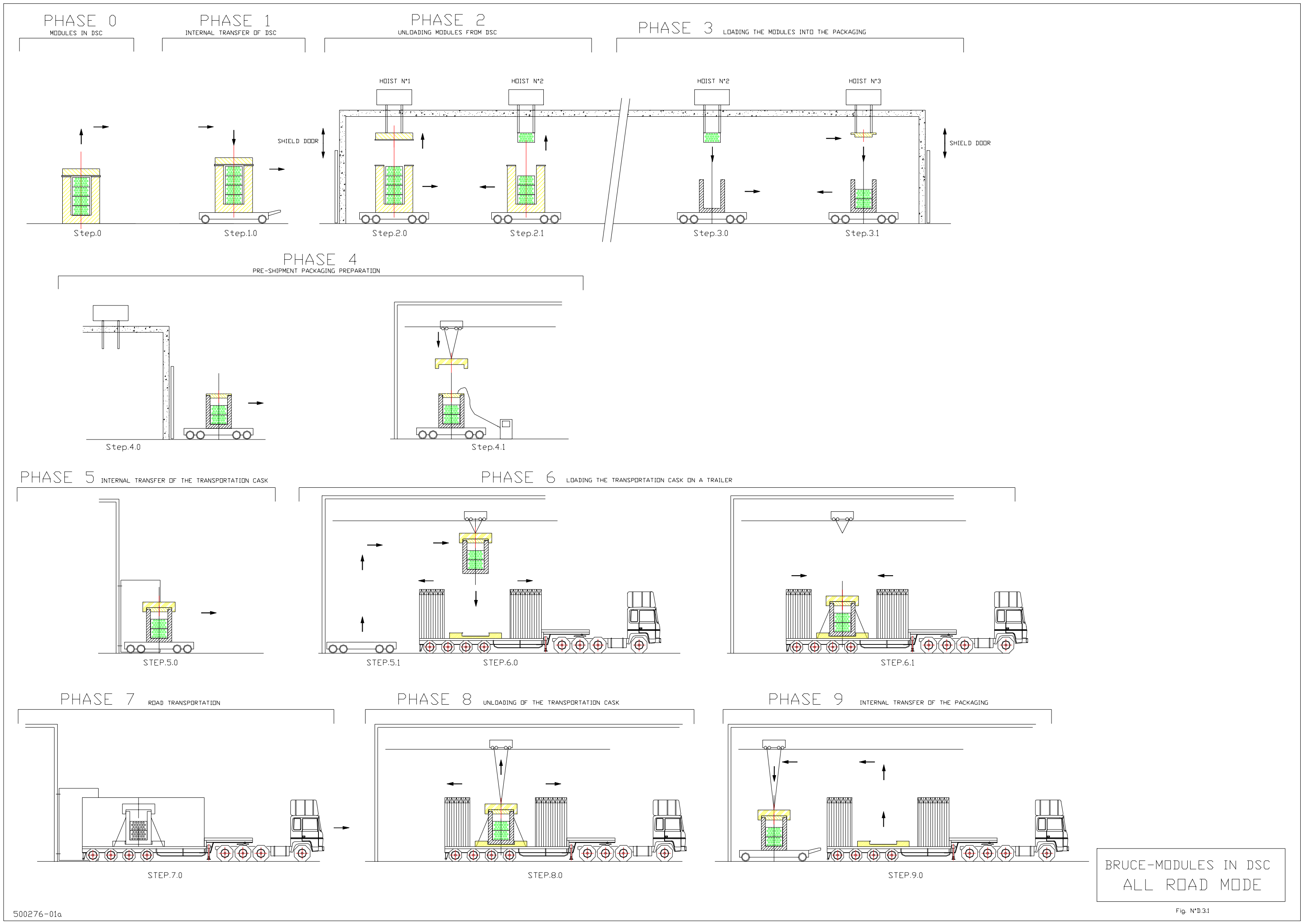
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

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).

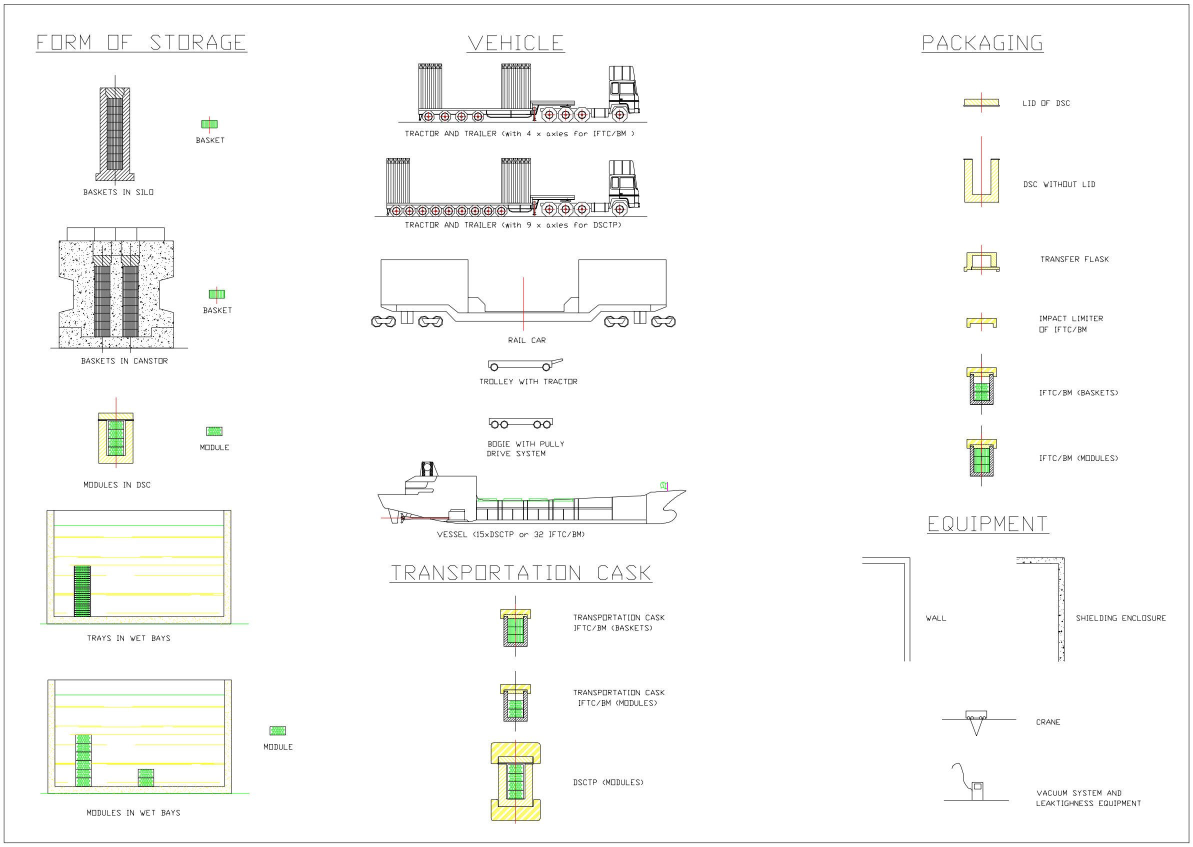
3.1.9. Table : Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.3.1
Phase 0	Modules in DSC	Interim storage	Initial phase			0
Phase 1	Internal transfer of the DSC	Interim storage				1.0
Phase 2	Unloading modules from DSC	Interim storage				2.0, 2, 1
Phase 3	Loading the modules into the packaging	UFTS	With the hoist N°3, open the lid of the packaging in a hot cell.	Packaging	IFTC/BM : See section 2.4.7.1.3 of D#5 Figures N°4 **<3>**, N°5 in Appendix A	3.1
			With hoist N°2 Load the modules into the packaging			3.0
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves,	4.0, 4.1
			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		
			Installing the impact limiter	Gantry crane	For the impact limiter (10 tons)	
Phase 5	Internal transfer of the packaging	UFTS	Approach of the Bogie	Bogie	Bogie with pulley drive system	5.0
			Radiological control of the Transportation cask and the Bogie	Non contamination, Dose Rate	"Smear test", Radiameter	
			Internal transfer	Tie down		
Phase 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	6.0, 6.1
			Open the weather cover	Weather cover		
			Loading the Transportation cask on a trailer	Gantry Crane	With 1 hoist (of 60 tons for the IFTC/BM)	
				Lifting Beam for the Transportation cask	To carry of the IFTC/BM similar to the IFTC, <**3**>)	
				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	
				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.	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.3.1
			Packaging tie-down on the trailer	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**)	
			Check the condition of the Transportation cask, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the trailer	Non contamination, Dose Rate	“Smear test”, Radiameter	
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	
Phase 8	Unloading of the Trans-portation cask	DGR/CES	Unloading of the Transportation cask from the trailer			8.0
Phase 9	Internal transfer of loaded Transportation cask	DGR/CES				9.0
Phase 10	Unloading the baskets from the Trans-portation 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
MODULES IN DSC
PHASE 1
INTERNAL TRANSFER OF DSC
PHASE 2
UNLOADING MODULES FROM DSC
PHASE 3
LOADING THE MODULES INTO THE PACKAGING
HOIST N°1
HOIST N°2
HOIST N°2
HOIST N°3
SHIELD DOOR
SHIELD DOOR
Step.0
Step.1.0
Step.2.0
Step.2.1
Step.3.0
Step.3.1
PHASE 4
PRE-SHIPMENT PACKAGING PREPARATION
Step.4.0
Step.4.1
PHASE 5
INTERNAL TRANSFER OF THE TRANSPORTATION CASK
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
BRUCE-MODULES IN DSC
ALL ROAD MODE
500276-01a
Fig. N°D3.1

Key:


FORM OF STORAGE
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
BASKET
MODULES IN DSC
MODULE
TRAYS IN WET BAYS
MODULES IN WET BAYS
MODULE
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
LEAKTIGHTNESS 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° 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 this Facility [**<52>**, **<53>**, **<27>** and **<54>**]. Public roadways are adequate to support transport from the site. Some strengthening of on-site roadways may be required to support the high volume of transports necessary for this portion of the shipping campaign. Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

Given the volume of used fuel to be transported to the site, use of the road mode would result in a larger number of individual shipments and offers the least potential for a consolidated transport program. The term "consolidated" refers to the physical consolidation of cargo into larger consignments as well as to the coordination of shipments between sites, according to the context.

3.2.1. 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, of paragraph 3.2.9 of the present document.

3.2.2. Transporter (vehicle)

Conceptual design of trailer and tractors (phase 5 of table paragraph 3.2.9).

3.2.2.1. Trolley with tractor

In order to transfer:

- The packaging from the pool to the pre-shipment packaging area (phase 3 of table paragraph 3.2.9),
- The packaging from the pre-shipment packaging area to the loading area (phase 4 of table paragraph 3.2.9).

3.2.2.2. Trailer for the road transportation (phase 5 of table paragraph 3.2.9)

- 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

3.2.2.3. Tractor for the road transportation (phase 5 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.

3.2.2.4. Weather cover for the road transportation (phases 5, 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.

3.2.2.5. Frame of the Transportation cask for the road transportation (phase 5 of table paragraph 3.2.9)

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.

3.2.2.6. Specific equipment

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

3.2.3. 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).

3.2.4. Casks

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

- Tie-down: similar to the IFTC.

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

3.2.5. UFTS Auxiliary equipment

Conceptual design for Auxiliary equipment work:

- Drainage (see phase 4 of table paragraph 3.2.9)

- 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 extraction of the packaging from the pool (see phase 2 of table paragraph 3.2.9)
  One for the preparation of the packaging (see phases 3, 4 of table paragraph 3.2.9)
  One for loading the Transportation cask on the trailer (see phase 5 of table paragraph 3.2.9)

- Lifting beam :
  One for the packaging transportation cask (see phase 2 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 5 of table paragraph 3.2.9)

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

3.2.6. UFTS Transportation system operation

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

- Loading of packages onto the trailers, security, transportation as described in phases 5 and 6 of table paragraph 3.2.9.

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

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

3.2.7. Decommissioning

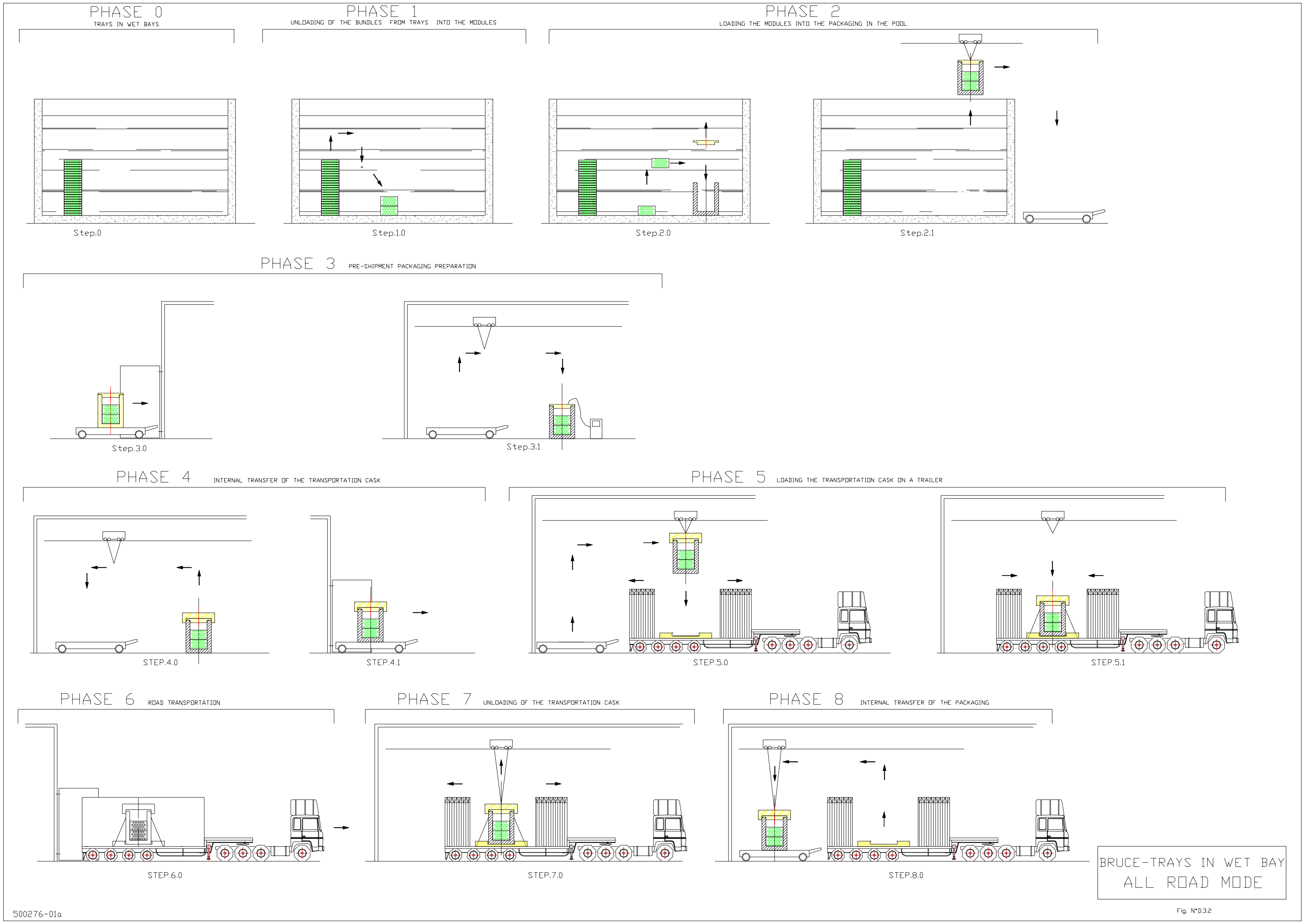
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

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).

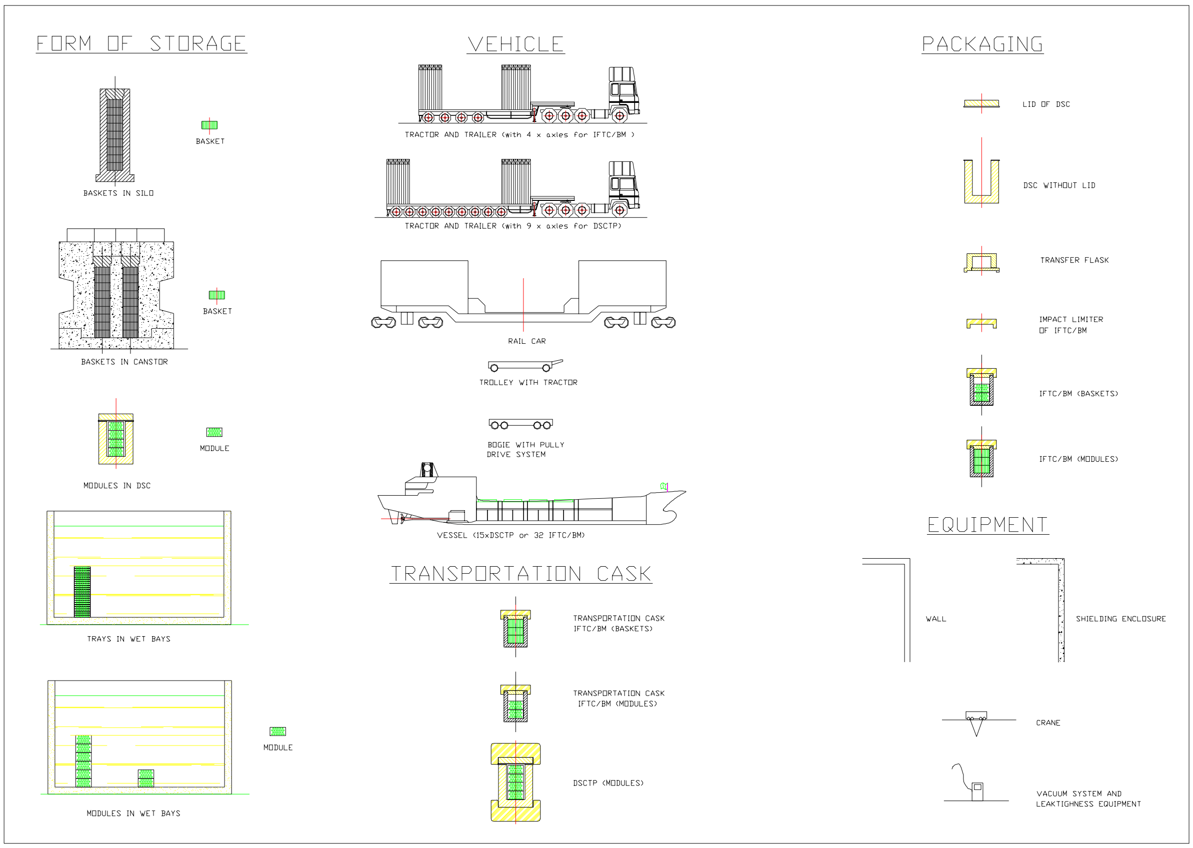
3.2.8. Table : Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.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	Gantry crane	Identical than the IFCT in the pool Decontamination of the IFTC/BM: identical as IFTC **<3>**	2.0, 2.1
				Packaging	IFTC/BM : See section 2.4.7.1.3 of D#5 Figure N°5 in Appendix A	
Phase 3	Pre-shipment packaging preparation	UFTS	Unloading of the packaging from the trolley	Gantry crane	60 tons	
			Drainage			3.0, 3.1
			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		
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	
			Loading of the full packaging on the Trolley			
			Installing the impact limiter			
			Radiological control of the Transportation cask and the Trolley	Non contamination, Dose Rate	"Smear test", Radiameter	
			Internal transfer	Tie down	Similar to the Tie down of the IFTC	
Phase 5	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	5.0, 5.1
			Open the weather cover	Weather cover		
			Loading the Transportation cask on a trailer	Gantry Crane	With hoist (of 60 tons for the IFTC/BM)	
				Lifting Beam for Transportation cask	To carry of the IFTC/BM similar to the IFTC, **<3>**)	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.3.2
				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	
				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 (Appendix A, Figure N°15, **<3>**)	
			Check the condition of the Transportation cask, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 6	Road transportation	UFTS	Road transportation of the Transportation cask from the Facility to the Centralised Facility			6.0
				Real time tracking	Appendix H	
Phase 7	Unloading of the Trans-portation cask	DGR/CES	Unloading of the Transportation cask from the trailer			7.0
Phase 8	Internal transfer of loaded Transportation cask	DGR/CES				8.0
Phase 9	Unloading the baskets from the Trans-portation cask	DGR/CES				
Phase 10	Storage of the baskets on the Centralised Facility	DGR/CES				
Phase 11	Road transportation of the empty Transportation cask from the Centralised Facility	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 TRANSPORTATION CASK
PHASE 5 LOADING THE TRANSPORTATION CASK ON A TRAILER
STEP.4.0
STEP.4.1
STEP.5.0
STEP.5.1
PHASE 6 ROAD TRANSPORTATION
PHASE 7 UNLOADING OF THE TRANSPORTATION CASK
PHASE 8 INTERNAL TRANSFER OF THE PACKAGING
STEP.6.0
STEP.7.0
STEP.8.0
BRUCE-TRAYS IN WET BAY
ALL ROAD MODE
Fig. N°D.3.2
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
LEAKTIGHTNESS EQUIPMENT

3.3. BASKETS IN SILO

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° 1.

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.

Road transport is clearly feasible from this Facility [**<52>**, **<53>**, **<27>** and **<55>**]. Public roadways are adequate to support transport from the site. Some strengthening of on-site roadways may be required to support the high volume of transports necessary for this portion of the shipping campaign. Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

Given the volume of used fuel to be transported to the site, use of the road mode would result in a larger number of individual shipments and offers the least potential for a consolidated transport program. The term “consolidated” refers to the physical consolidation of cargo into larger consignments as well as to the coordination of shipments between sites, according to the context.

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 trailer.

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

3.3.3. Transporter (vehicle)

Conceptual design of trailer and tractors (phase 6 of table paragraph 3.3.9)

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. Trailer for the road transportation (phase 6 of table paragraph 3.3.9)

- 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

3.3.3.4. Tractor for the road transportation (phase 6 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.

3.3.3.5. Weather cover for the road transportation (phase 7 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.

3.3.3.6. Frame of the Transportation cask for the road transportation (phase 6 of table paragraph 3.3.9)

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.

3.3.3.7. Specific equipment

- 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 IFTC.

- 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 installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 3.3.9)
  One for loading the Transportation cask on the trailer (see phase 6 of table paragraph 3.3.9)
  One for installing the impact limiter (see phase 4 of table paragraph 3.3.9)

- Lifting beam :
  One for the Transfer flask (see phase 3 of table paragraph 3.3.9)
  One for the Transportation cask (see phase 6 of table paragraph 3.3.9)
  One for the impact limiter of the packaging (see phase 4 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 trailers, security, transportation, emergency response:

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

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

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

3.3.8. Decommissioning

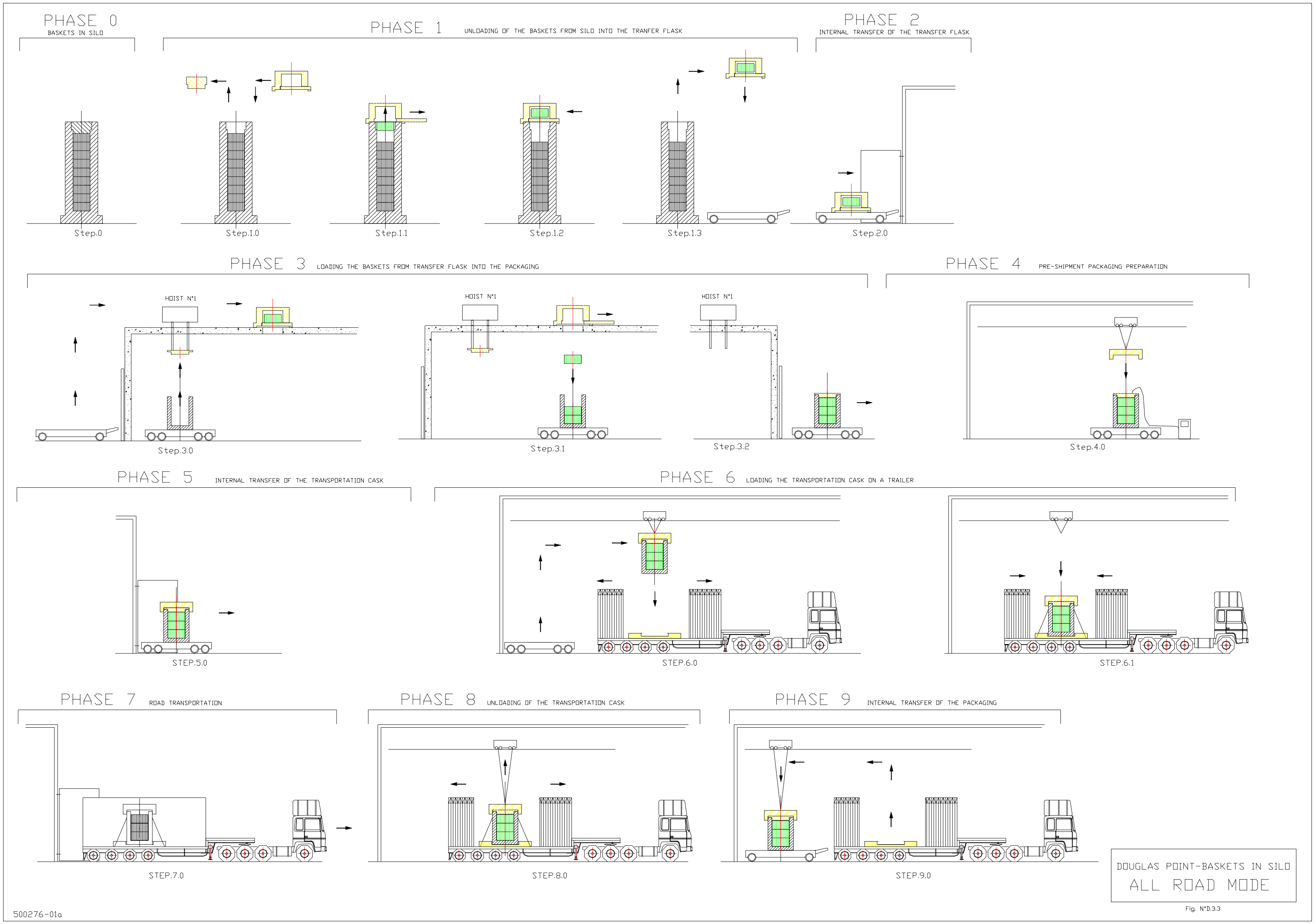
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

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° D.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
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	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		
			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	3.0
			Load the baskets into the packaging			3.1
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves, work plate-form for bolt the lid	4.0
			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		
			Installing the impact limiter	Gantry crane	For the impact limiter	
Phase 5	Internal transfer of the Transportation cask	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 contamina-tion, Dose Rate	"Smear test", Radiameter	5.0
			Loading of the 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	Similar to the Tie down of the IFTC	5.1

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. D.3.3
Phase 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask	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 IFTC, **<3>**)	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 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 the packaging, trailer			6.1
			Fit the transport seals			6.1
			Close the weather cover	Weather cover		6.1
			Radiological control of the trailer	Non contamina-tion, 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
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
DOUGLAS POINT-BASKETS IN SILO
ALL ROAD MODE
Fig. N°D.3.3
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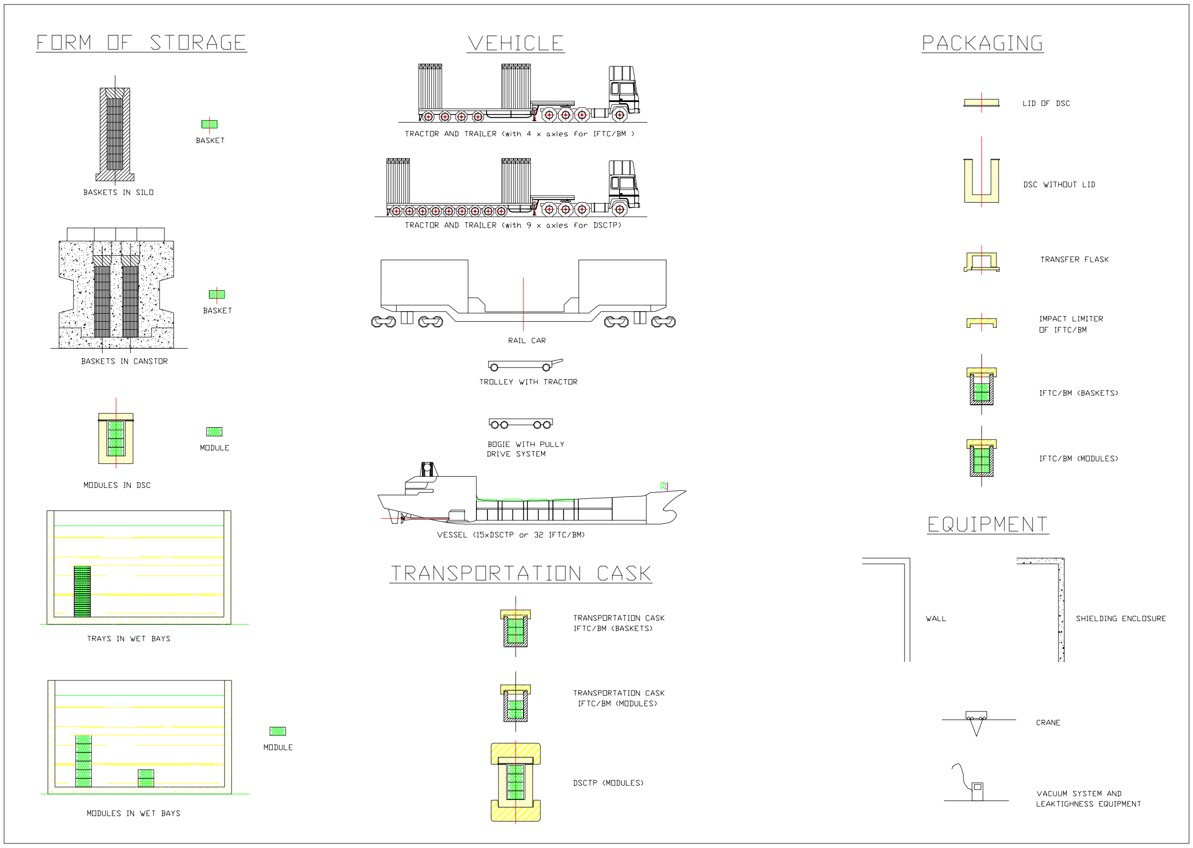
Key:


FORM OF STORAGE
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
BASKET
MODULES IN DSC
MODULE
TRAYS IN WET BAYS
MODULES IN WET BAYS
MODULE
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°1.

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.

Road transport is clearly feasible from this site [**<52>**, **<53>**, **<27>** and **<54>**]. The public road system is adequate to support transport from the site. On-site roadways would likely require strengthening and re-grading (especially noting the grade leaving the dry cask storage area). Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

Given the volume of used fuel to be transported to the site, use of the road mode would result in a larger number of individual shipments and offers the least potential for a consolidated transport program.

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 trailer.

See phases 3, 4, 5 of paragraph 4.1.9 of the present document.

4.1.3. Transporter (vehicle)

Conceptual design of trailer and tractors (phase 6 of table paragraph 4.1.9)

4.1.3.1. Trolley with tractor

In order to transfer:
- The DSC from the storage to the hot cell (phase 1 of table paragraph 4.1.9)

4.1.3.2. Bogie pulley drive system

In order to transfer:
- The DSC in the hot cell (phase 2 of table paragraph 4.1.9),
- The IFTC/BM in the hot cell (phase 3 of table paragraph 4.1.9),
- The IFTC/BM to the pre-shipment packaging area (phase 4 of table paragraph 4.1.9),
- The IFTC/BM to the shipment area (phase 5 of table paragraph 4.1.9).

4.1.3.3. Trailer for the road transportation (phase 6 of table paragraph 4.1.9)

- 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

4.1.3.4. Tractor for the road transportation (phase 6 of table paragraph 4.1.9)

- Standard commercial tractor sufficient for the loaded weight

- The weight for the fuelled reference tractor is roughly 9,075 kg.

4.1.3.5. Weather cover for the road transportation (phases 6 and 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.

4.1.3.6. Frame of the Transportation cask for the road transportation (phase 6 of table paragraph 4.1.9)

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.

4.1.3.7. Specific equipment

- 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 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).

4.1.5. Casks

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

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

4.1.6. 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 4.1.9)

- Gantry Crane:
  One for loading the Transportation cask on the trailer (see phase 6 of table paragraph 4.1.9)
  One for loading the impact limiter on the packaging (see phase 4 of table paragraph 4.1.9)

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

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

4.1.7. UFTS Transportation system operation

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

- Loading of packages onto the trailers, security, transportation as described in phase 6 of table paragraph 4.1.9.

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

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

4.1.8. Decommissioning

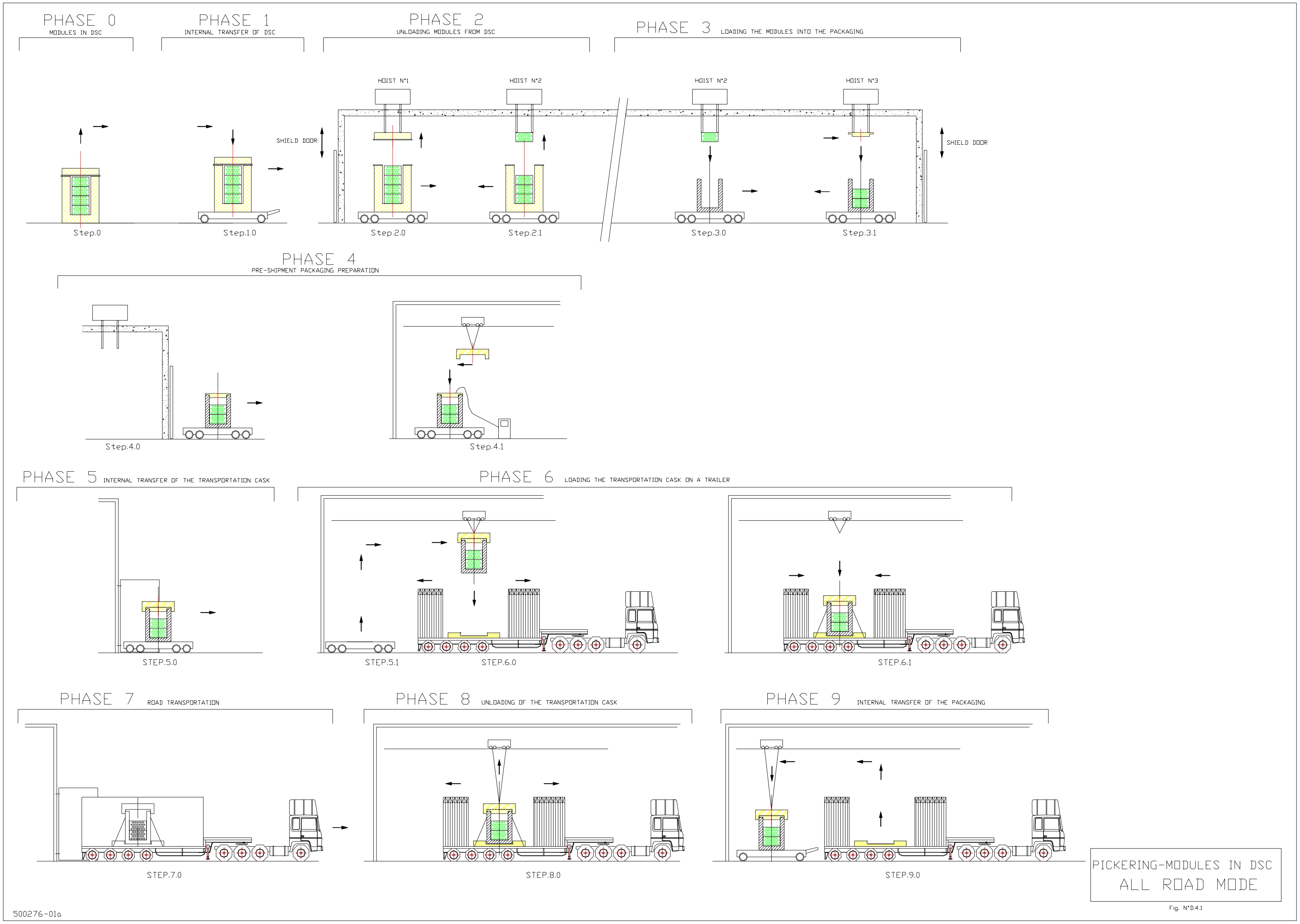
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

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).

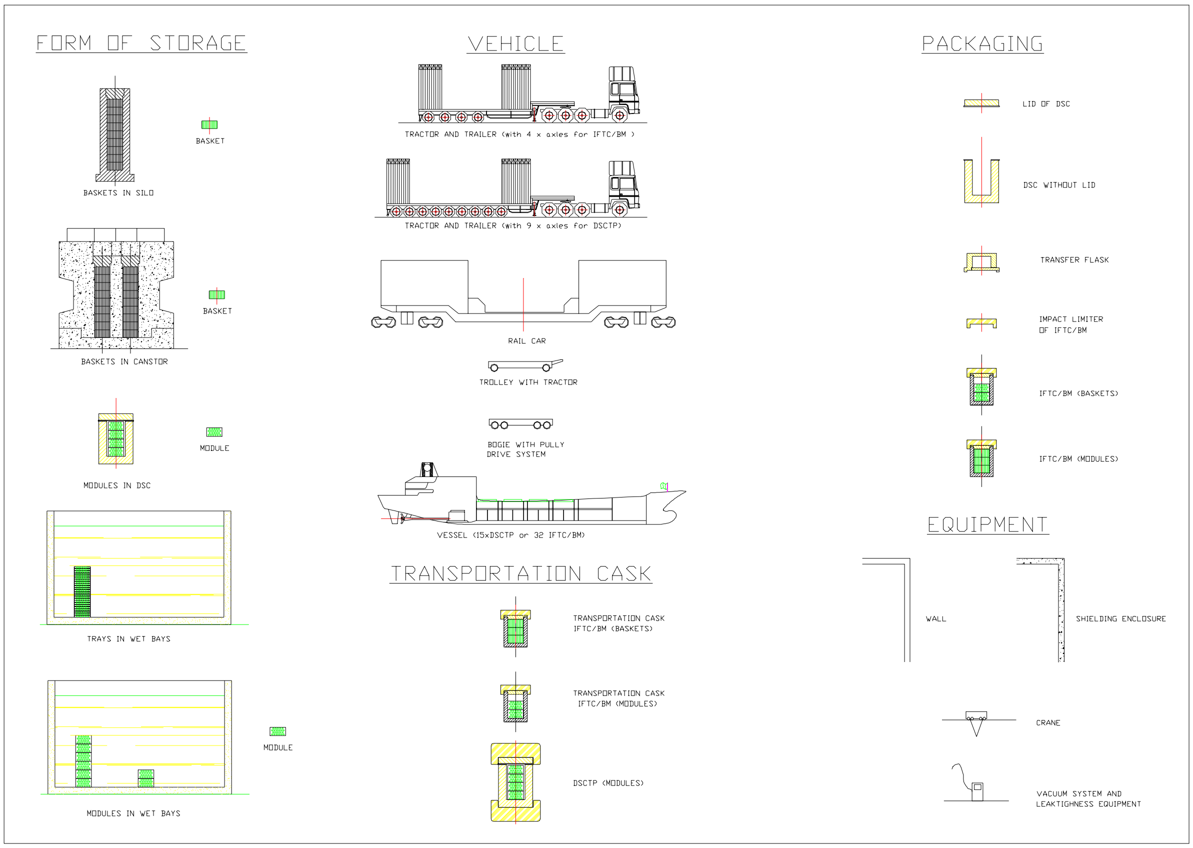
4.1.9. Table: Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. D.4.1
Phase 0	Modules in DSC	Interim storage	Initial phase			0
Phase 1	Internal transfer of the DSC	Interim storage				1.0
Phase 2	Unloading modules from DSC	Interim storage				2.0, 2, 1
Phase 3	Loading the modules into the packaging	UFTS	With the hoist N°3, open the lid of the packaging in a hot cell.	Packaging	IFTC/BM : See section 2.4.7.1.3 of D#5 Appendix A, Figures N°4 **<3>**, N° 5	3.1
			With hoist N°2 Load the modules into the packaging			3.0
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves,	4.0, 4.1
			Filling the cavity with helium	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves, compressed air line	
			Leaktightness check	Leaktightness equipment		
			Installing the impact limiter	Gantry crane	For the impact limiter (10 tons)	
			Depressurising the cavity	Vacuum circuit		
Phase 5	Internal transfer of the Transportation cask	UFTS	Approach of the Bogie	Bogie	Bogie with pulley drive system	5.0
			Radiological control of the Transportation cask and the Bogie	Non contamination, Dose Rate	“Smear test”, Radiameter	
			Internal transfer	Tie down		
Phase 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	6.0, 6.1
			Open the weather cover	Weather cover		
			Loading the packaging on a trailer	Gantry Crane	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>**)	
				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	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. D.4.1
				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. (Appendix A, Figure N°15, **<3>**)	
			Check the condition of the Transportation cask, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	
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	
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				9.0
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
MODULES IN DSC
PHASE 1
INTERNAL TRANSFER OF DSC
PHASE 2
UNLOADING MODULES FROM DSC
PHASE 3
LOADING THE MODULES INTO THE PACKAGING
HOIST N°1
HOIST N°2
HOIST N°2
HOIST N°3
SHIELD DOOR
SHIELD DOOR
Step.0
Step.1.0
Step.2.0
Step.2.1
Step.3.0
Step.3.1
PHASE 4
PRE-SHIPMENT PACKAGING PREPARATION
Step.4.0
Step.4.1
PHASE 5
INTERNAL TRANSFER OF THE TRANSPORTATION CASK
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
PICKERING-MODULES IN DSC
ALL ROAD MODE
Fig. N°D.4.1
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 and Pickering B to the Centralised Facility
Quantity of bundles to be transported from 2035 to 2064: see Appendix B, Table N° 1.

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.

Road transport is clearly feasible from this site [**<52>**, **<53>**, **<27>** and **<54>**]. The public road system is adequate to support transport from the site. On-site roadways would likely require strengthening. Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

Given the volume of used fuel to be transported to the site, use of the road mode would result in a larger number of individual shipments and offers the least potential for a consolidated transport program.

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 trailer.

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

4.2.3. Transporter (vehicle)

Conceptual design of trailer and tractors (phase 4 of table paragraph 4.2.9)

4.2.3.1. Trolley with tractor

In order to transfer:

- The packaging from the pool to the pre-shipment packaging area (phase 2 of table paragraph 4.2.9),
- The Transportation cask from the pre-shipment packaging area to the loading area (phase 3 of table paragraph 4.2.9).

4.2.3.2. Trailer for the road transportation (phase 4 of table paragraph 4.2.9)

- 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 non escort

4.2.3.3. Tractor for the road transportation (phase 4 of table paragraph 4.2.9)

- 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 (phases 4, 5 of table paragraph 4.2.9)

- 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 (phase 4 of table paragraph 4.2.9)

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

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

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.

- 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:

- Drainage (see phase 2 of table paragraph 4.2.9)

- 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 extraction of the packaging from the pool (see phase 1 of table paragraph 4.2.9)
  One for the preparation of the packaging (see phases 2, 3 of table paragraph 4.2.9)
  One for loading the Transportation cask on the trailer (see phase 4 of table paragraph 4.2.9)

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

- Loading of packages onto the trailers, security, transportation as described in phases 4 and 5 of table paragraph 4.2.9.

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

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

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° D.4.2
Phase 0	Modules in wet bays	Interim storage	Initial phase			0
Phase 1	Loading the modules into the packaging in the pool	UFTS	Loading the modules into the packaging in the pool		Identical than the IFTC in the pool **<3>** Decontamination of the IFTC/BM: identical as IFTC **<3>**	1.0, 1.1
				Packaging	IFTC/BM : See section 2.4.7.1.3 of D#5 Figure N°5 in Appendix A	
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		
Phase 3	Internal transfer of the packaging	UFTS	Unloading of the packaging from the trolley	Gantry crane	60 tons	
			Radiological control of the packaging	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	Gantry crane	For the impact limiter (10 tons)	
			Loading of the 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 trailer	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	4.0, 4.1
			Open the weather cover	Weather cover		
			Loading the Transportation cask on a trailer	Gantry Crane	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>**)	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.4.2
				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	
				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 (Appendix A, Figure N° 15, **<3>**)	
			Check the condition of the Transportation cask, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 5	Road transportation	UFTS	Road transportation of the Transportation cask from the Facility to the Centralised Facility			5.0
				Real time tracking	Appendix H	
Phase 6	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			6.0
Phase 7	Internal transfer of loaded Transportation cask	DGR/CES				7.0
Phase 8	Unloading the baskets from the Transportation cask	DGR/CES				
Phase 9	Storage of the baskets on the Centralised Facility	DGR/CES				
Phase 10	Road transportation of the empty Transportation cask from the Centralised Facility	DGR/CES				

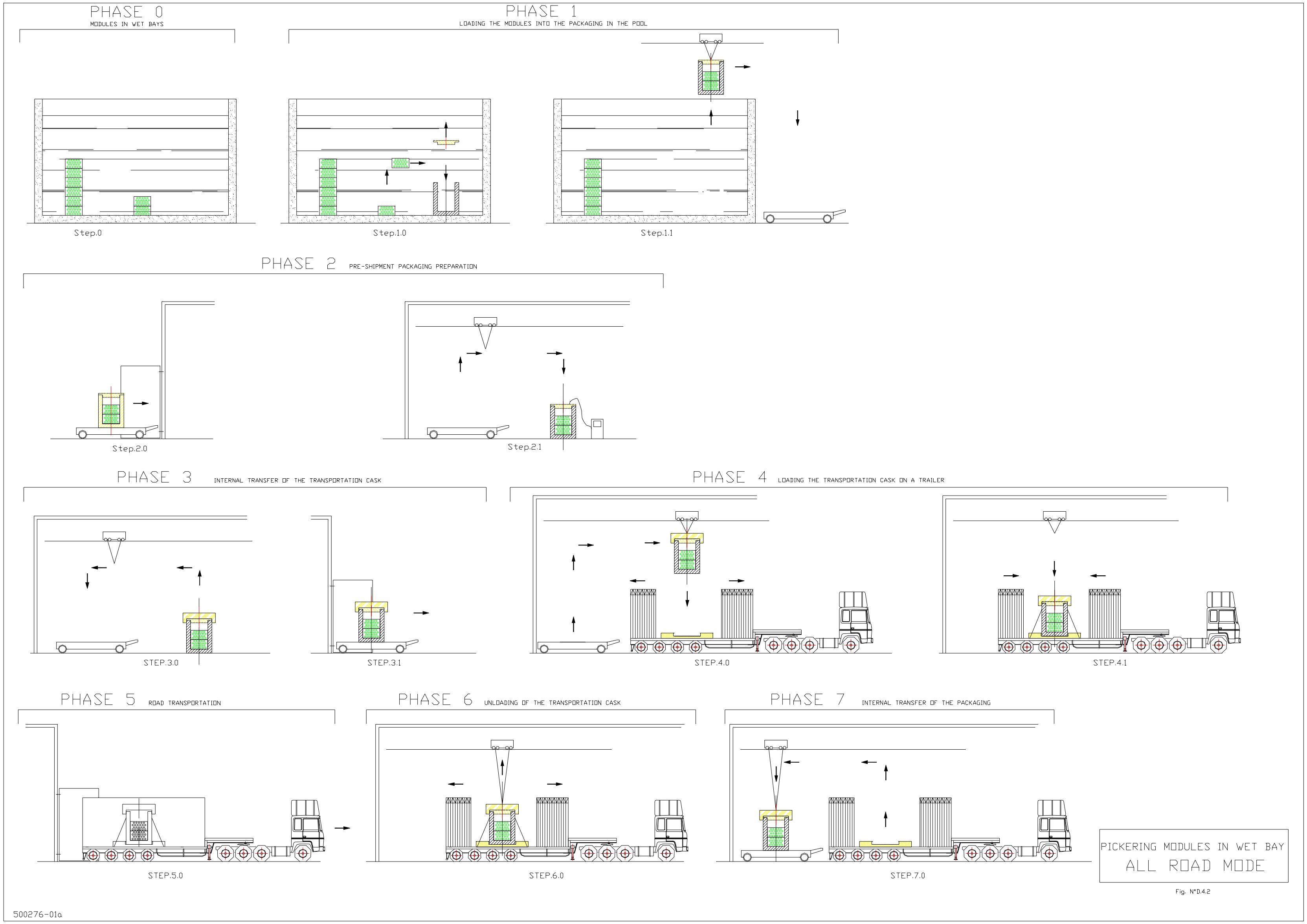
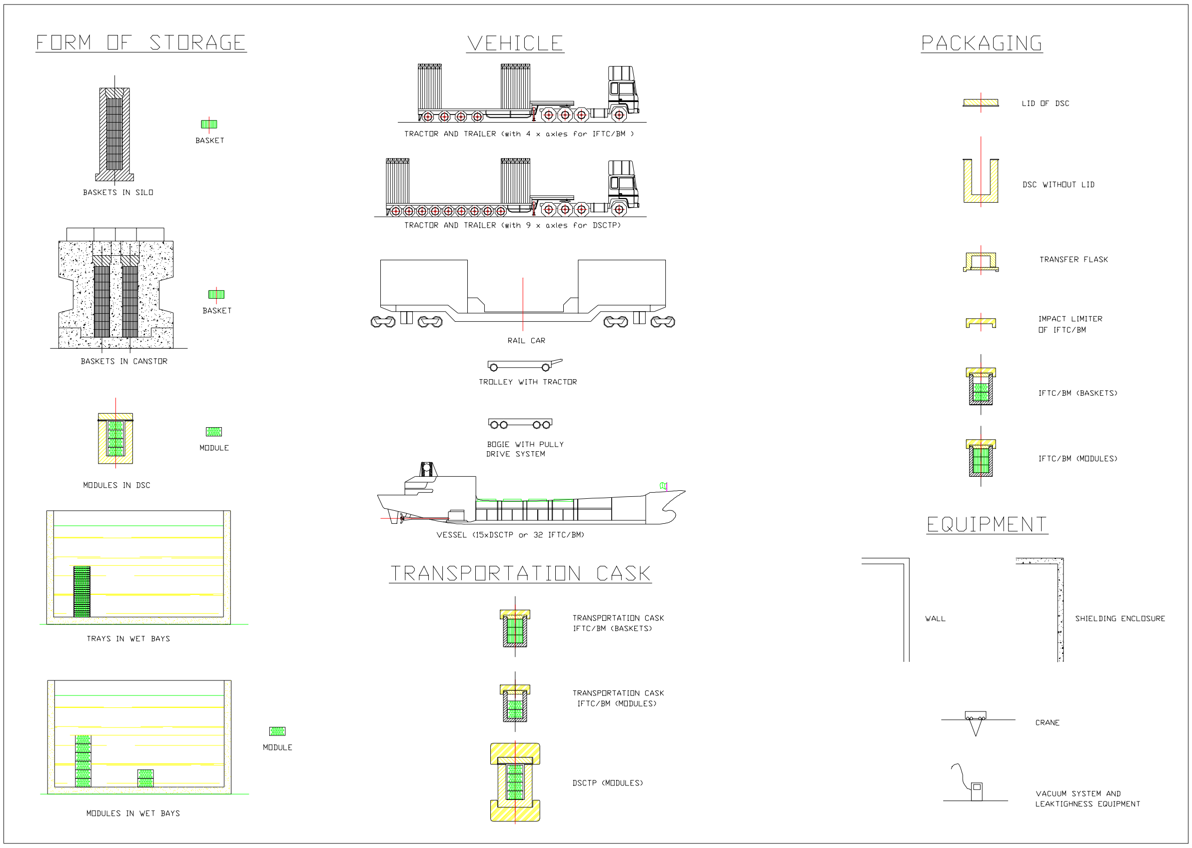

PHASE 0
MODULES IN WET BAYS
Step.0
PHASE 1
LOADING THE MODULES INTO THE PACKAGING IN THE POOL
Step.1.0
Step.1.1
PHASE 2
PRE-SHIPMENT PACKAGING PREPARATION
Step.2.0
Step.2.1
PHASE 3
INTERNAL TRANSFER OF THE TRANSPORTATION CASK
STEP.3.0
STEP.3.1
PHASE 4
LOADING THE TRANSPORTATION CASK ON A TRAILER
STEP.4.0
STEP.4.1
PHASE 5
ROAD TRANSPORTATION
STEP.5.0
PHASE 6
UNLOADING OF THE TRANSPORTATION CASK
STEP.6.0
PHASE 7
INTERNAL TRANSFER OF THE PACKAGING
STEP.7.0
PICKERING MODULES IN WET BAY
ALL ROAD MODE
500276-01a

Fig. N°D.4.2

Key:


FORM OF STORAGE
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
BASKET
MODULES IN DSC
MODULE
TRAYS IN WET BAYS
MODULES IN WET BAYS
MODULE
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 DSCS (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°1.

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.

Road transport is clearly feasible from this site [**<52>**, **<53>**, **<27>** and **<54>**]. The public road system is adequate to support transport from the site. On-site roadways are also deemed adequate based on present condition. Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

Given the volume of used fuel to be transported to the site, use of the road mode would result in a larger number of individual shipments and offers the least potential for a consolidated transport program.

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 trailer.

See phases 3, 4, 5 of paragraph 5.1.9 of the present document.

5.1.3. Transporter (vehicle)

Conceptual design of trailer and tractors (phase 6 of table paragraph 5.1.9)

5.1.3.1. Trolley with tractor

In order to transfer:
- The DSC from the storage to the hot cell (phase 1 of table paragraph 5.1.9).

5.1.3.2. Bogie pulley drive system

In order to transfer:

- The DSC in the hot cell (phase 2 of table paragraph 5.1.9),
- The IFTC/BM in the hot cell (phase 3 of table paragraph 5.1.9),
- The IFTC/BM to the pre-shipment packaging area (phase 4 of table paragraph 5.1.9),
- The IFTC/BM to the shipment area (phase 5 of table paragraph 5.1.9).

5.1.3.3. Trailer for the road transportation (phase 6 of table paragraph 5.1.9)

- 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

5.1.3.4. Tractor for the road transportation (phase 6 of table paragraph 5.1.9)

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

5.1.3.5. Weather cover for the road transportation (phases 6 and 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.

5.1.3.6. Frame of the Transportation cask for the road transportation (phase 6 of table paragraph 5.1.9)

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.

5.1.3.7. Specific equipment

- 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 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).

5.1.5. Casks

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

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

5.1.6. 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 5.1.9)
- Gantry Crane:
  One for loading the Transportation cask on the trailer (see phase 6 of table paragraph 5.1.9)
  One for loading the impact limiter on the packaging (see phase 4 of table paragraph 5.1.9)
- Lifting beam:
  One for the Transportation cask (see phase 6 of table paragraph 5.1.9)
  One for the impact limiter of the packaging (see phase 4 of table paragraph 5.1.9)
- Decontamination equipment (see paragraph 3.2 of Chapter 3).

5.1.7. Transportation system operation

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

- Loading of packages onto the trailers, security, transportation as described in phase 6 of table paragraph 5.1.9.
- Emergency response plan: see paragraph 9 of Appendix D.
- Real time tracking: see paragraph 9 of Appendix D.

5.1.8. Decommissioning

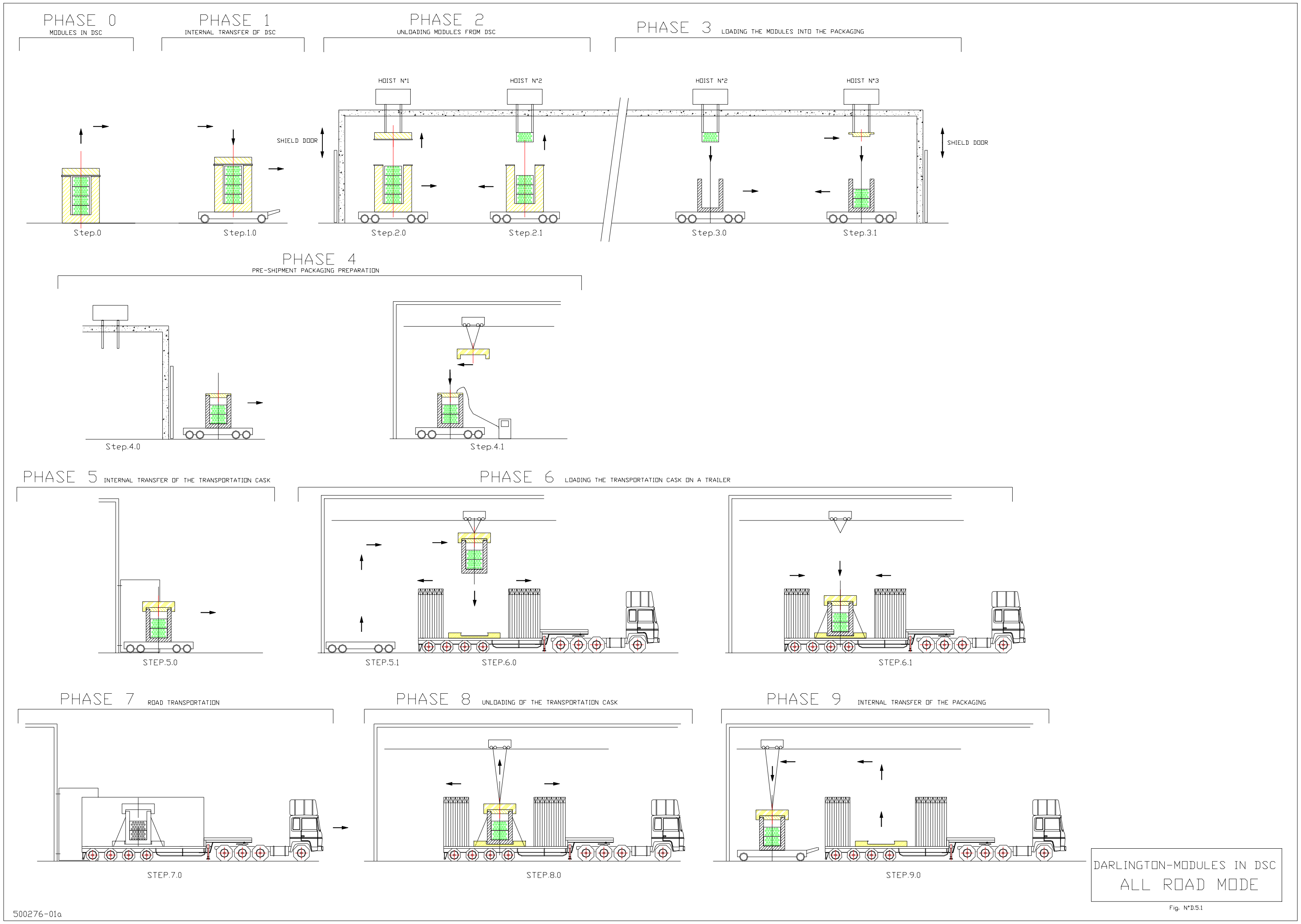
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

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).

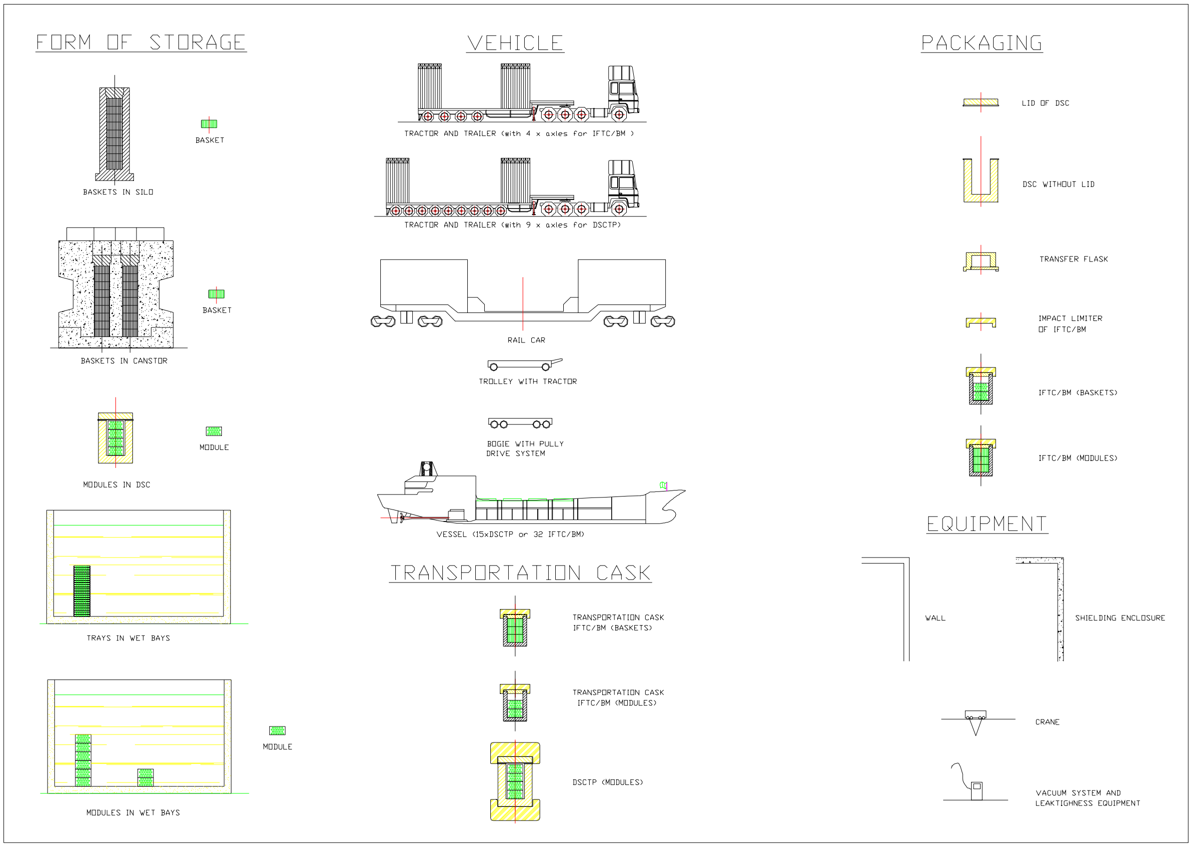
5.1.9. Table: Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.5.1
Phase 0	Modules in DSC	Interim storage	Initial phase			0
Phase 1	Internal transfer of the DSC	Interim storage				1.0
Phase 2	Unloading modules from DSC	Interim storage				2.0, 2, 1
Phase 3	Loading the modules into the packaging	UFTS	With the hoist N°3, open the lid of the packaging in a hot cell.	Packaging	IFTC/BM : See section 2.4.7.1.3 of D#5 Figures N°4 **<3>**, N°5 in Appendix A	3.1
			With hoist N°2 Load the modules into the packaging			3.0
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves,	4.0, 4.1
			Filling the cavity with helium	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves, compressed air line	
			Leaktightness check	Leaktightness equipment		
			Installing the impact limiter	Gantry crane	For the impact limiter (10 tons)	
			Depressurising the cavity	Vacuum circuit		
Phase 5	Internal transfer of the packaging	UFTS	Approach of the Bogie	Bogie	Bogie with pulley drive system	5.0
			Radiological control of the Transportation cask and the Bogie vehicle	Non contamination, Dose Rate	“Smear test”, Radiameter	
			Internal transfer	Tie down		
Phase 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	6.0, 6.1
			Open the weather cover	Weather cover		
			Loading the Transportation cask on a trailer	Gantry Crane	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>**)	
				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	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.5.1
				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 (Appendix A, Figure N°15, **<3>**)	
			Check the condition of the packaging, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the trailer	Non contamination, Dose Rate	“Smear test”, Radiameter	
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	
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				9.0
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
MODULES IN DSC
PHASE 1
INTERNAL TRANSFER OF DSC
PHASE 2
UNLOADING MODULES FROM DSC
PHASE 3
LOADING THE MODULES INTO THE PACKAGING
HOIST N°1
HOIST N°2
HOIST N°2
HOIST N°3
SHIELD DOOR
SHIELD DOOR
Step.0
Step.1.0
Step.2.0
Step.2.1
Step.3.0
Step.3.1
PHASE 4
PRE-SHIPMENT PACKAGING PREPARATION
Step.4.0
Step.4.1
PHASE 5
INTERNAL TRANSFER OF THE TRANSPORTATION CASK
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
DARLINGTON-MODULES IN DSC
ALL ROAD MODE
Fig. N°D5.1
500276-01a

Key:


FORM OF STORAGE
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
BASKET
MODULES IN DSC
MODULE
TRAYS IN WET BAYS
MODULES IN WET BAYS
MODULE
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° 1.

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.

Road transport is clearly feasible from this site [**<52>**, **<53>**, **<27>** and **<54>**]. The public road system is adequate to support transport from the site. On-site roadways are also deemed adequate based on present condition. Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

Given the volume of used fuel to be transported to the site, use of the road mode would result in a larger number of individual shipments and offers the least potential for a consolidated transport program.

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 trailer.

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

5.2.3. Transporter (vehicle)

Conceptual design of trailer and tractors (phase 4 of table paragraph 5.2.9)

5.2.3.1. Trolley with tractor

In order to transfer:

- The packaging from the pool to the pre-shipment packaging area (phase 2 of table paragraph 5.2.9),

- The packaging and Transportation cask from the pre-shipment packaging area to the loading area (phase 3 of table paragraph 5.2.9).

5.2.3.2. Trailer for the road transportation (phase 4 of table paragraph 5.2.9)

- 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

5.2.3.3. Tractor for the road transportation (phase 4 of table paragraph 5.2.9)

- 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 (phases 4, 5 of table paragraph 5.2.9)

- 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 (phase 4 of table paragraph 5.2.9)

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

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

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.

- 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:

- Drainage (see phase 2 of table paragraph 5.2.9)

- 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 extraction of the packaging from the pool (see phase 1 of table paragraph 5.2.9)
  One for the preparation of the packaging (see phases 2, 3 of table paragraph 5.2.9)
  One for loading the Transportation cask on the trailer (see phase 4 of table paragraph 5.2.9)

- Lifting beam:

  One for the packaging and Transportation cask (see phases 1 to 4 of table paragraph 5.2.9)
  One for the impact limiter of the packaging (see phase 3 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 trailers, security, transportation, emergency response:

- Loading of packages onto the trailers, security, transportation as described in phases 4 and 5 of table paragraph 5.2.9.

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

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

5.2.8. Decommissioning

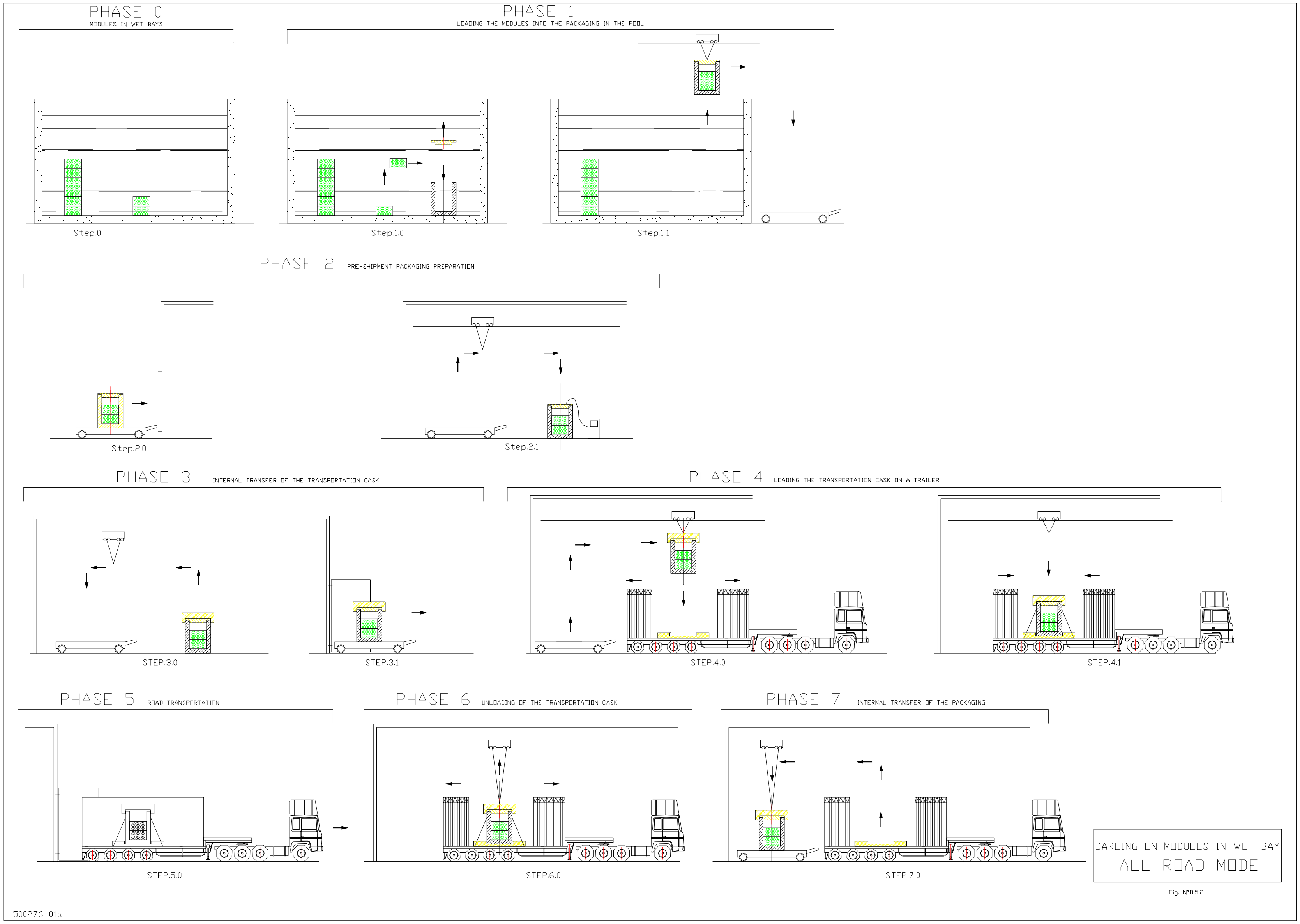
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

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° D.5.2
Phase 0	Modules in wet bays	Interim storage	Initial phase			0
Phase 1	Loading the modules into the packaging in the pool	UFTS	Loading the modules into the packaging in the pool		Identical than the IFTC in the pool **<3>** Decontamination of the IFTC/BM: identical as IFTC **<3>**	1.0, 1.1
Phase 2	Pre-shipment packaging preparation	UFTS	Drainage			2.0, 2.1
				Packaging	IFTC/BM : See section 2.4.7.1.3 of D#5 Figure N°5 in Appendix A	
			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		
Phase 3	Internal transfer of the packaging	UFTS	Unloading the packaging from the trolley	Gantry crane	60 tons	
			Installing the impact limiter	Gantry crane	For the impact limiter	
			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	
			Loading of the 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 trailer	UFTS	Radiological control of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	4.0, 4.1
			Open the weather cover	Weather cover		
			Loading the Transportation cask on a trailer	Gantry Crane	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>**)	
				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	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.5.2
				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 (Appendix A, Figure N° 15, **<3>**)	
			Check the condition of the packaging, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 5	Road transportation	UFTS	Road transportation of the Transportation cask from the Facility to the Centralised Facility			5.0
				Real time tracking	Appendix H	
Phase 6	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			6.0
Phase 7	Internal transfer of loaded Transportation cask	DGR/CES				7.0
Phase 8	Unloading the baskets from the Transportation cask	DGR/CES				
Phase 9	Storage of the baskets on the Centralised Facility	DGR/CES				
Phase 10	Road transportation of the empty Transportation cask from the Centralised Facility	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 TRANSPORTATION CASK
PHASE 4
LOADING THE TRANSPORTATION CASK ON A TRAILER
STEP.3.0
STEP.3.1
STEP.4.0
STEP.4.1
PHASE 5
ROAD TRANSPORTATION
PHASE 6
UNLOADING OF THE TRANSPORTATION CASK
PHASE 7
INTERNAL TRANSFER OF THE PACKAGING
STEP.5.0
STEP.6.0
STEP.7.0
DARLINGTON MODULES IN WET BAY
ALL ROAD MODE
Fig. N°D5.2
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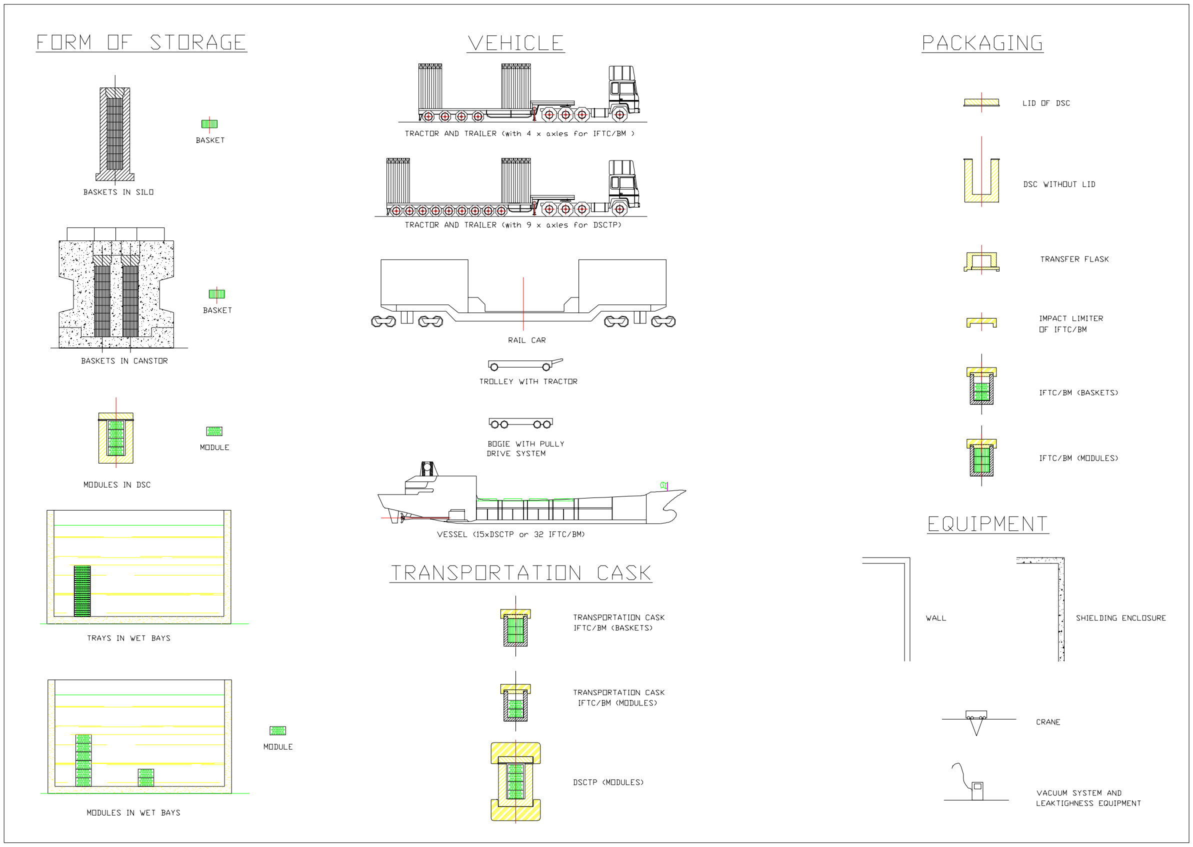

FORM OF STORAGE
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
BASKET
MODULES IN DSC
MODULE
TRAYS IN WET BAYS
MODULES IN WET BAYS
MODULE
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY DRIVE SYSTEM
VESSEL (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 Facility to the Centralised Facility
Quantity of bundles to be transported from 2035 to 2064: see Appendix B, Table N°1.

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.

Road transport is clearly feasible from Point Lepreau [**<52>**, **<55>**, **<53>**, **<56>**, **<27>** and **<54>**]. The public road system is adequate to support the transport, taking into account use of legal weight and size loads. Given the distance from either of the hypothesised northern or southern Ontario storage facilities, road transport from Point Lepreau would represent the longest shipment distances and durations for the entire program.

Based on a site evaluation, it is predicted that strengthening and re-grading of facility roadways would be necessary to support on-site transport. Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

Additionally, given the distances involved, keyed to availability of a finite number of transport vehicles, removal of the used fuel from Point Lepreau would be a lengthy process. It would also be difficult to obtain savings in shipment times and costs that could be obtained through economies of scale available through rail or water 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 trailer.

See phases 3, 4, 5 of paragraph 6.9 of the present document.

6.3. TRANSPORTER (VEHICLE)

Conceptual design of trailer and tractors (phase 6 of table paragraph 6.9)

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),

6.3.1.1. 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),

6.3.2. Trailer for the road transportation (phase 6 of table paragraph 6.9)

- 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

6.3.3. Tractor for the road transportation (phase 6 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.

6.3.4. Weather cover for the road transportation (phase 7 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 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.

6.3.5. 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.

6.3.6. Specific equipment

- 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 IFTC.
- 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 installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 6.9)
  One for loading the transportation cask on the trailer (see phase 6 of table paragraph 6.9)
- Lifting beam :
  One for the Transfer flask (see phase 3 of table paragraph 6.9)
  One for the Transportation cask (see phases 5 and 6 of table paragraph 6.9)
  One for the impact limiter of the packaging (see phase 4 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 trailers, security, transportation, emergency response:

- Loading of packages onto the trailers, security, transportation as described in phase 6 of table paragraph 6.9
- Emergency response plan: see paragraph 9 of Appendix D.
- Real time tracking: see paragraph 9 of Appendix D.

6.8. DECOMMISSIONING

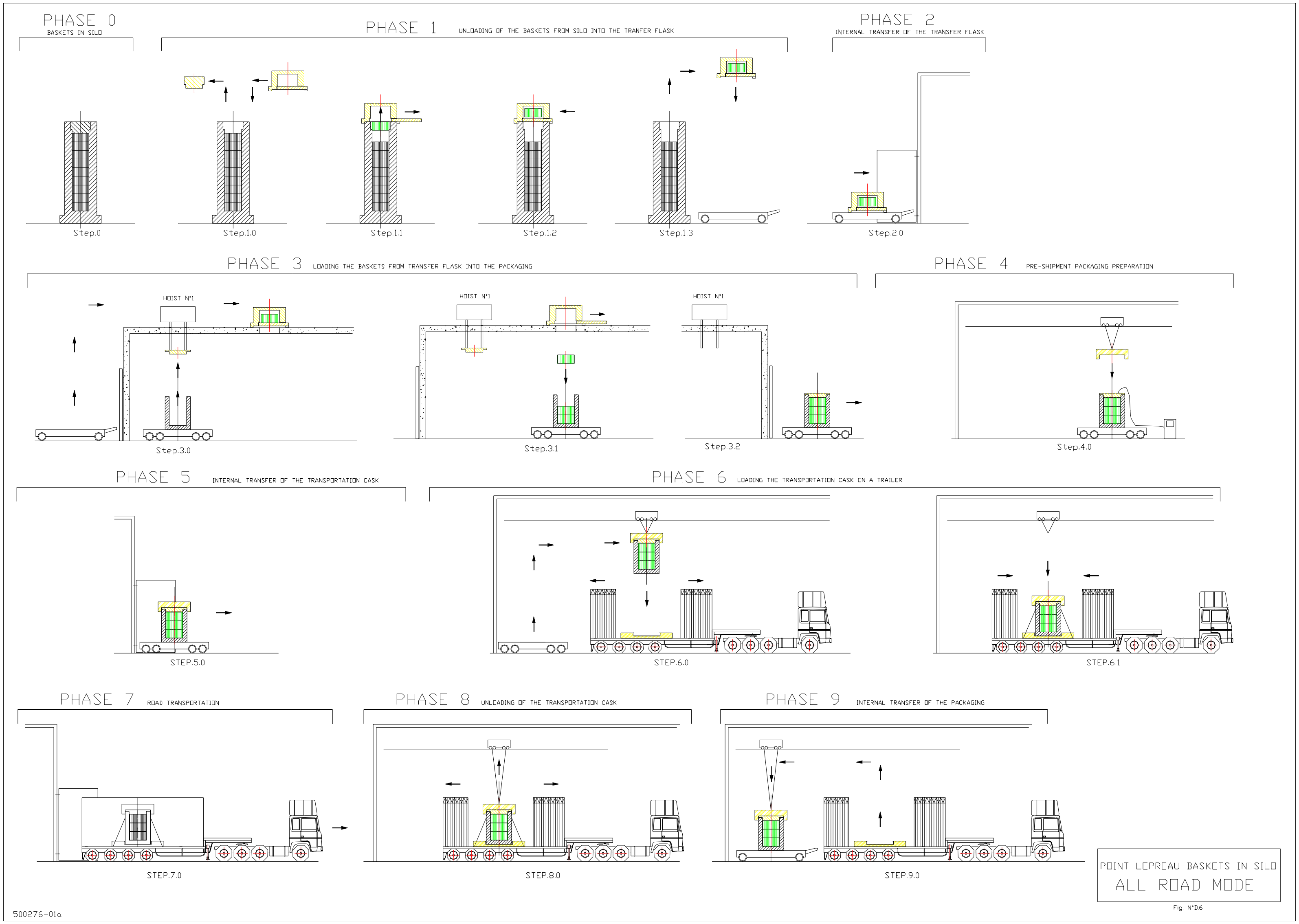
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

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° D.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
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	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		
			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	3.0
			With hoist N°2 Load the baskets into the packaging			3.1
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves, work plate-form for bolt the lid	4.0
			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		
			Installing the impact limiter			
Phase 5	Internal transfer of the Transportation cask	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 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	Similar to the Tie down of the IFTC	5.1

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.6
Phase 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask	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 IFTC, **<3>**)	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 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 the packaging, trailer			6.1
			Fit the transport seals			6.1
			Close the weather cover	Weather cover		6.1
			Radiological control of the trailer	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
POINT LEPREAU-BASKETS IN SILO
ALL ROAD MODE
Fig. N°D6
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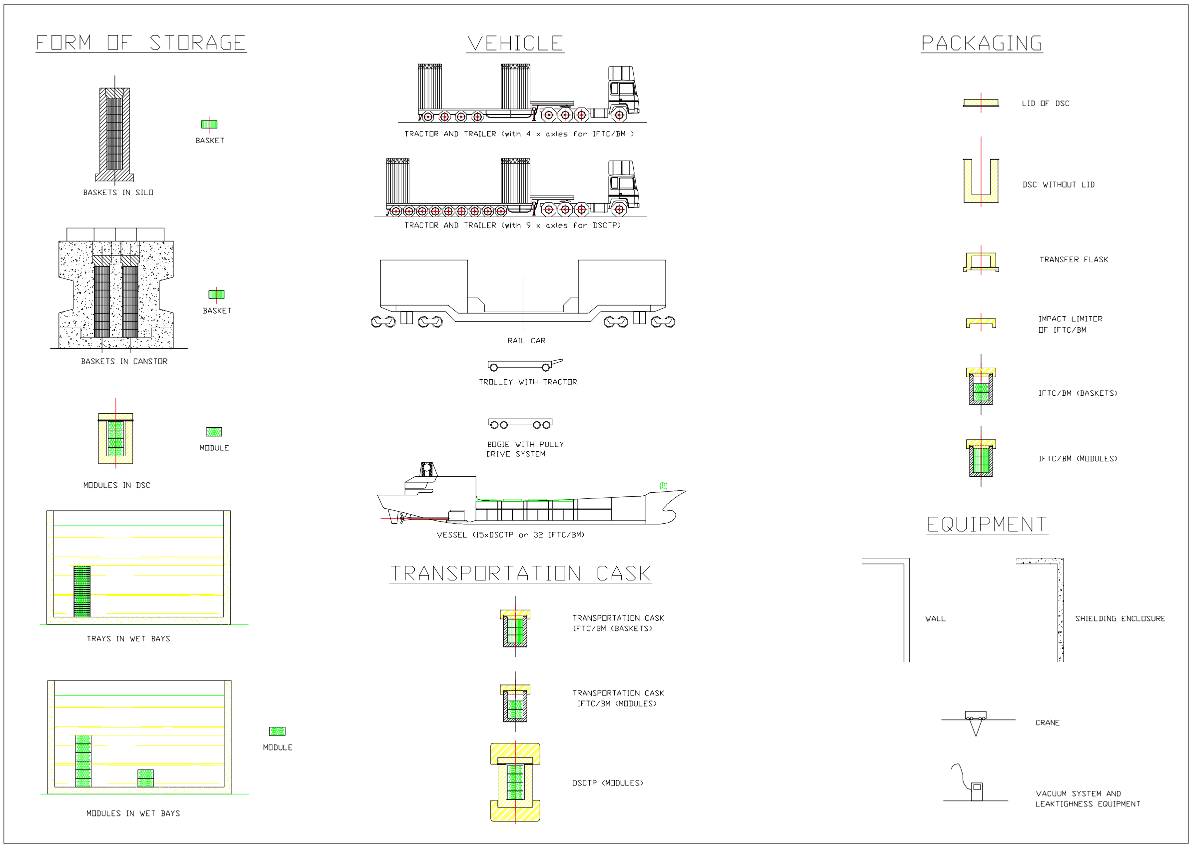
Key:


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

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 2.11 of the present document.

7.3. TRANSPORTER (VEHICLE)

Conceptual design of trailer and tractors (phase 6 of table paragraph 7.9)

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).

7.3.3. Trailer for the road transportation (phase 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

7.3.4. 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.

7.3.5. 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.

7.3.6. 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.

7.3.7. 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.
- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 6 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 installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 7.9)
  One for loading the Transportation 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 Transportation 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 trailers, security, transportation, emergency response:

- Loading of packages onto the trailers, security, transportation as described in phase 6 of table paragraph 7.9
- Emergency response plan: see paragraph 9 of Appendix D.
- Real time tracking: see paragraph 9 of Appendix D.

7.8. DECOMMISSIONING

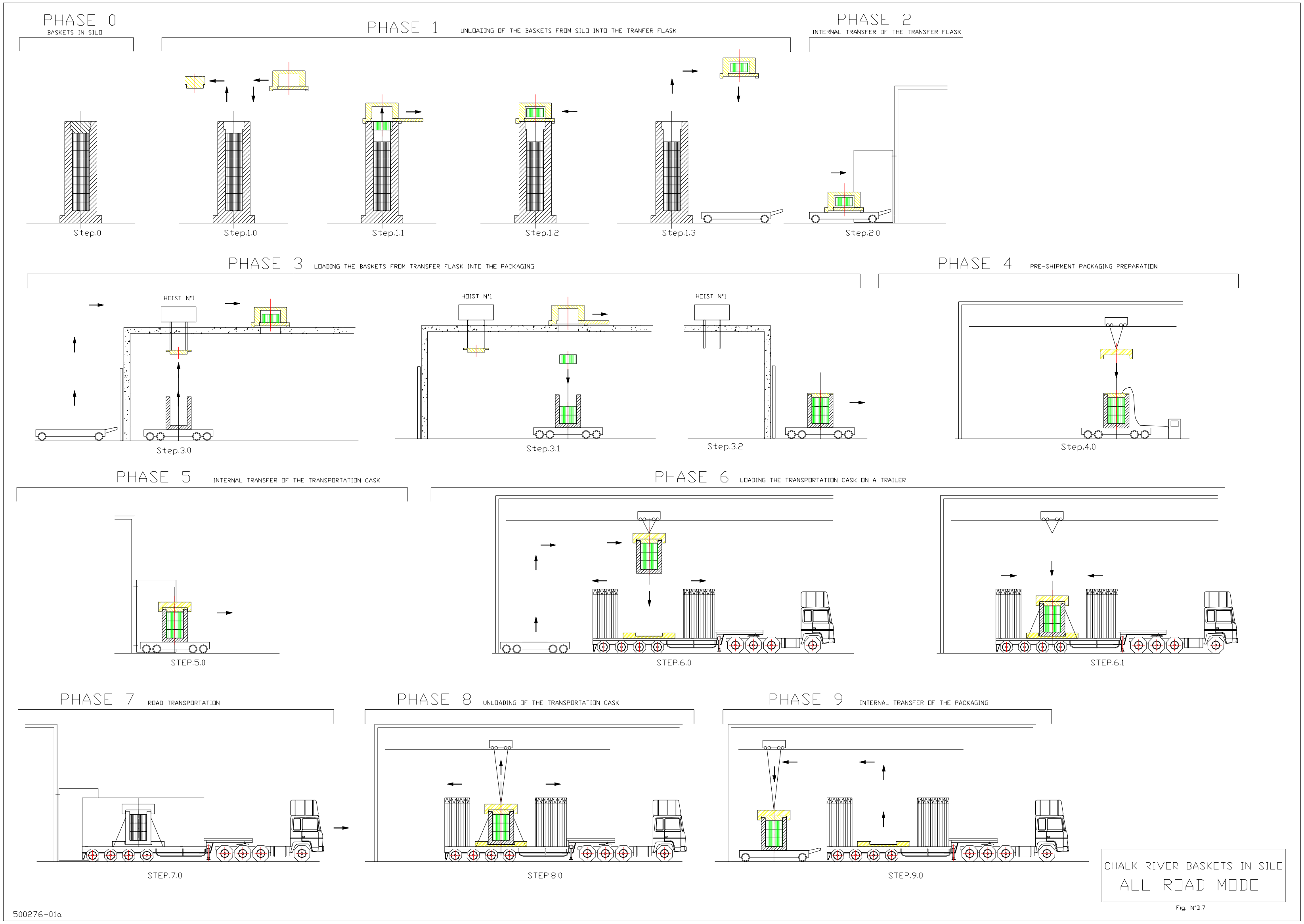
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

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° D.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
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	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		
			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	3.0
			With hoist N°2 Load the baskets into the packaging			3.1
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves, work plate-form for bolt the lid	4.0
			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		
			Installing the impact limiter			
Phase 5	Internal transfer of the Transportation cask	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 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	Similar to the Tie down of the IFTC	5.1

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.7
Phase 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask	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 IFTC, **<3>**)	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 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 the packaging, trailer			6.1
			Fit the transport seals			6.1
			Close the weather cover	Weather cover		6.1
			Radiological control of the trailer	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
ALL ROAD MODE
Fig. N°D.7
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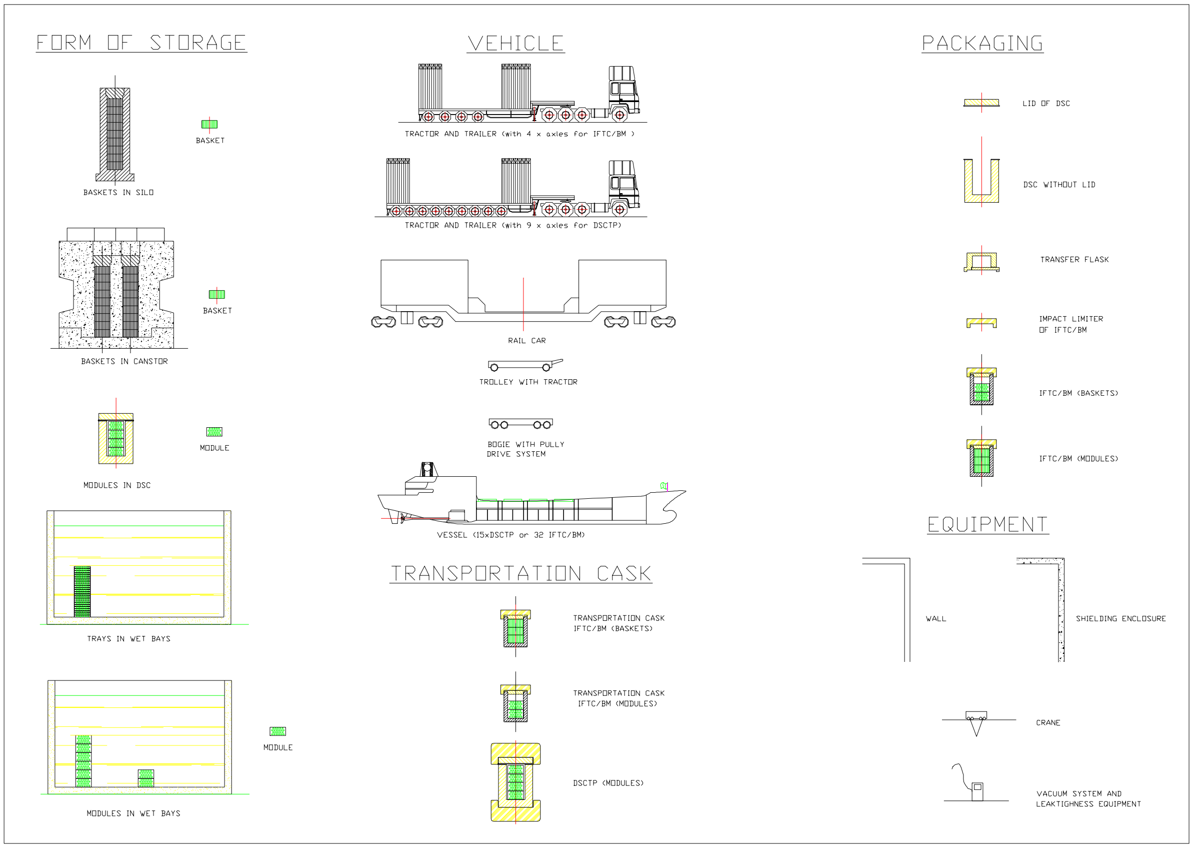
FORM OF STORAGE
BASKET
BASKETS IN SILO
BASKET
BASKETS IN CANISTOR
MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH PULLY
DRIVE SYSTEM
VESSEL (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
LEAKTIGHTNESS 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°1.

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.

Road transport is clearly feasible from the Gentilly sites [**<52>**, **<53>**, **<56>**, **<27>**, **<54>** and **<57>**]. The public road system is generally adequate to support shipments from this site, however some improvement may be necessary to public roadways at the time of shipment. (It should be noted that a review of the bridge spanning the St. Lawrence River at Trois Rivières was not specifically included herein).

On-site roadways would also likely require strengthening and re-grading. Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

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 trailer.

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

8.1.3. Transporter (vehicle)

Conceptual design of trailer and tractors (phase 6 of table paragraph 8.1.9)

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. Trailer for the road transportation (phase 6 of table paragraph 8.1.9)

- 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

8.1.3.4. Tractor for the road transportation (phase 6 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.

8.1.3.5. Weather cover for the road transportation (phase 7 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.

8.1.3.6. 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.

8.1.3.7. Specific equipment

- 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 IFTC.

- 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 installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 8.1.9)
  One for loading the Transportation cask on the trailer (see phase 6 of table paragraph 8.1.9)

- Lifting beam :
  One for the Transfer flask (see phase 3 of table paragraph 8.1.9)
  One for the transportation cask (see phase 6 of table paragraph 8.1.9)
  One for the impact limiter of the packaging (see phase 4 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 trailers, security, transportation, emergency response:

- Loading of packages onto the trailers, security, transportation as described in phase 6 of table paragraph 8.1.9

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

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

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° D.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
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	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		
			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	3.0
			Load the baskets into the packaging			3.1
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves, work plate-form for bolt the lid	4.0
			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		
			Installing the impact limiter			
Phase 5	Internal transfer of the Transpor-tation cask	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 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	Similar to the Tie down of the IFTC	5.1

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.8.1
Phase 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask	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 IFTC, **<3>**)	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 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 the packaging, trailer			6.1
			Fit the transport seals			6.1
			Close the weather cover	Weather cover		6.1
			Radiological control of the trailer	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				

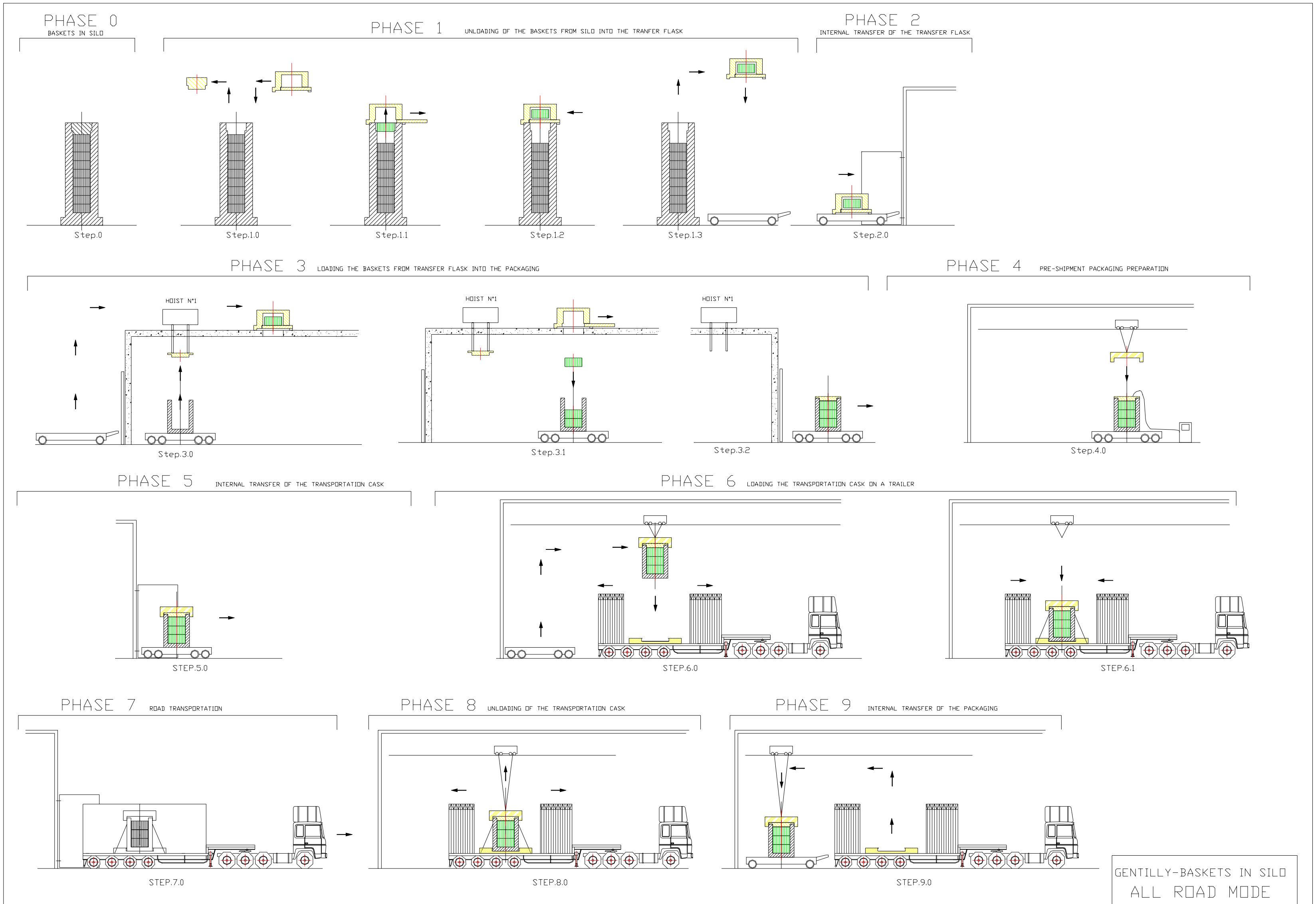
PHASE 0
BASKETS IN SILO
PHASE 1
UNLOADING OF THE BASKETS FROM SILO INTO THE TRANFER FLASK
PHASE 2
INTERNAL TRANSFER OF THE TRANSFER FLASK
Step.0
Step.1.0
Step.1.1
Step.1.2
Step.1.3
Step.2.0
PHASE 3
LOADING THE BASKETS FROM TRANSFER FLASK INTO THE PACKAGING
PHASE 4
PRE-SHIPMENT PACKAGING PREPARATION
HOIST 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
GENTILLY-BASKETS IN SILO
ALL ROAD MODE
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Fig. N°D.8.1

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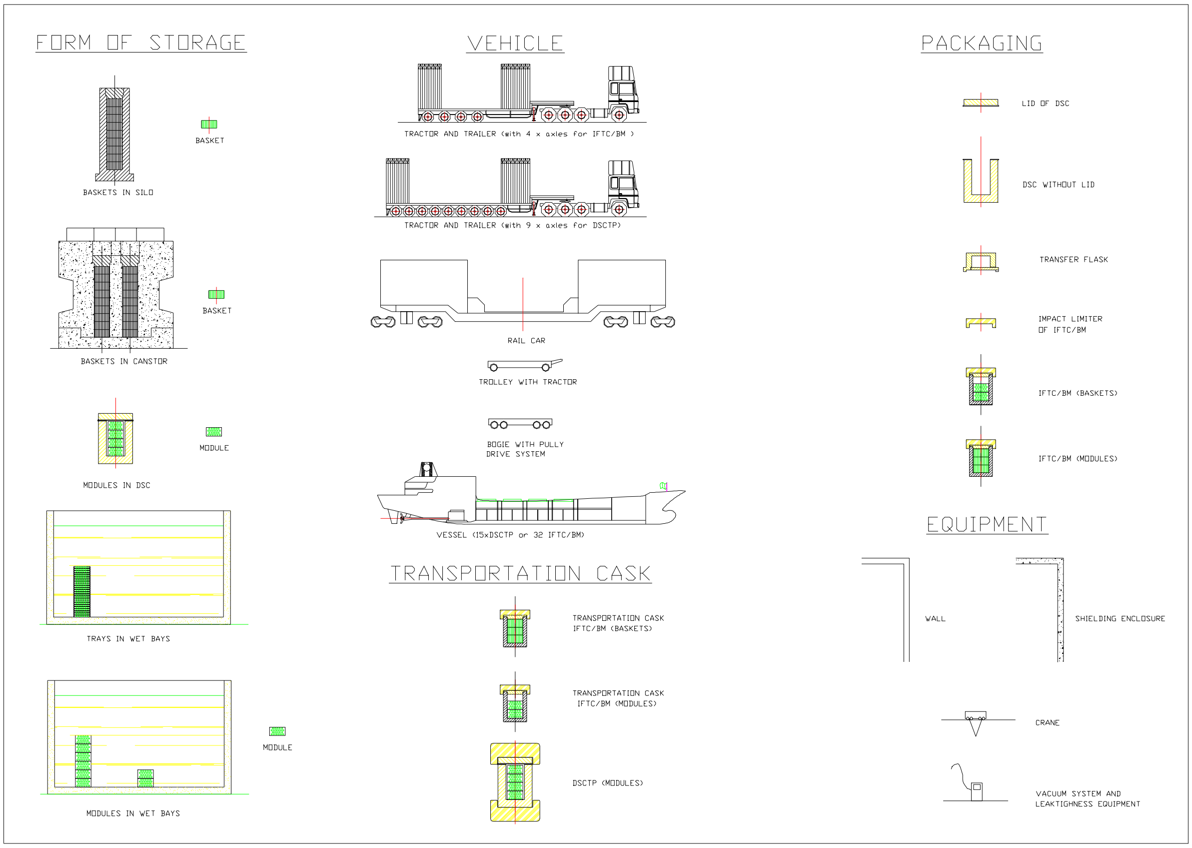
FORM OF STORAGE
BASKET
BASKETS IN SILO
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MODULE
MODULES IN DSC
TRAYS IN WET BAYS
MODULE
MODULES IN WET BAYS
VEHICLE
TRACTOR AND TRAILER (with 4 x axles for IFTC/BM)
TRACTOR AND TRAILER (with 9 x axles for DSCTP)
RAIL CAR
TROLLEY WITH TRACTOR
BOGIE WITH 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°1.

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.

Road transport is clearly feasible from the Gentilly sites [**<52>**, **<53>**, **<56>**, **<27>, <54>** and **<57>**]. The public road system is generally adequate to support shipments from this site, however some improvement may be necessary to public roadways at the time of shipment. (It should be noted that a review of the bridge spanning the St. Lawrence River at Trois Rivières was not specifically included herein).

On-site roadways would also likely require strengthening and re-grading. Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

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 trailer.

See phases 3, 4, 5 of paragraph 8.2.9 of the present document.

8.2.3. Transporter (vehicle)

Conceptual design of trailer and tractors (phase 6 of table paragraph 8.2.9)

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 paragraph 8.2.9).

8.2.3.3. Trailer for the road transportation (phase 6 of table paragraph 8.2.9)

- 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

8.2.3.4. for the road transportation (phase 6 of table paragraph 8.2.9)

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

8.2.3.5. Weather cover for the road transportation (phase 7 of table paragraph 8.2.9)

- 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.

8.2.3.6. 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.

8.2.3.7. Specific equipment

- 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 IFTC.

- 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 8.2.9)

- Gantry Crane:
  One for installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 8.2.9)
  One for loading the Transportation cask on the trailer (see phase 6 of table paragraph 8.2.9)

- Lifting beam :
  One for the Transfer flask (see phase 3 of table paragraph 8.2.9)
  One for the transportation cask (see phase 6 of table paragraph 8.2.9)
  One for the impact limiter of the packaging (see phase 4 of table paragraph 8.2.9)

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

8.2.7. UFTS Transportation system operation

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

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

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

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

8.2.8. Decommissioning

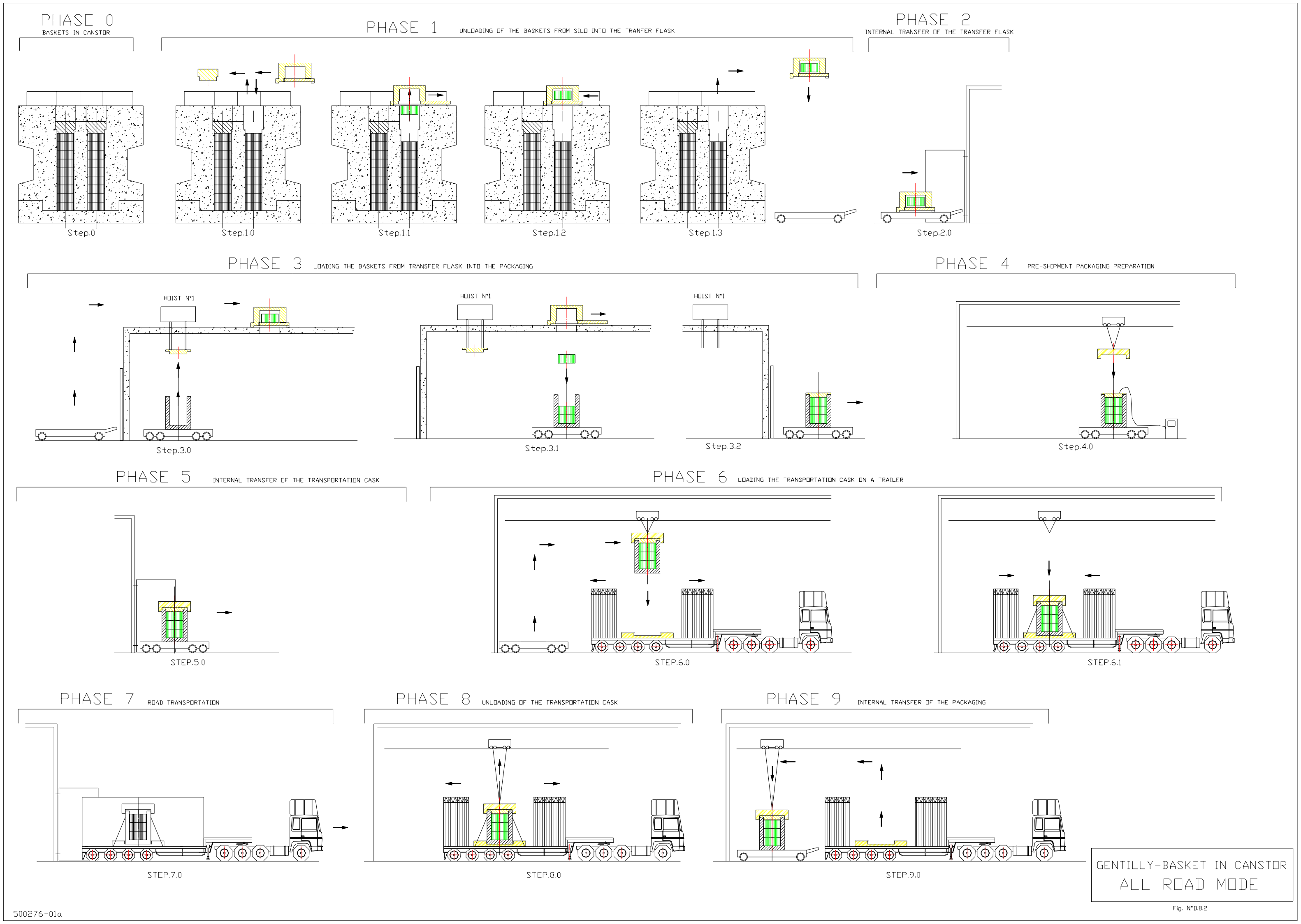
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

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).

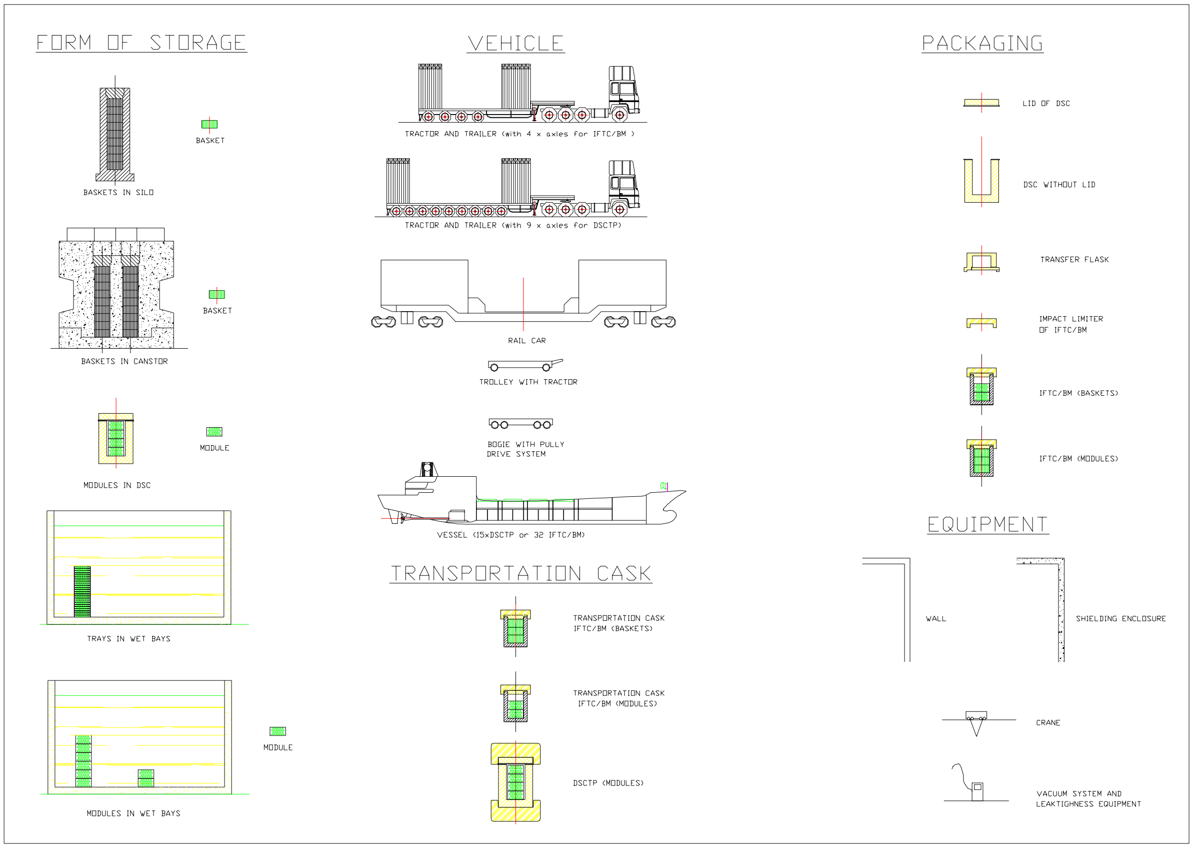
8.2.9. Table: Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.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
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	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		
			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	3.0
			Load the baskets into the packaging			3.1
Phase 4	Pre-shipment packaging preparation	UFTS	Drying the cavity	Vacuum circuit	Air/water separator , pump, vacuum gauges, valves, work plate-form for bolt the lid	4.0
			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		
			Installing the impact limiter			
Phase 5	Internal transfer of the Transportation cask	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 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

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° D.8.2
			Internal transfer	Tie down	Similar to the Tie down of the IFTC	5.1
Phase 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask	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 IFTC, **<3>**)	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 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 the packaging, trailer			6.1
			Fit the transport seals			6.1
			Close the weather cover	Weather cover		6.1
			Radiological control of the trailer	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 transpor-tation of the empty Transpor-tation cask from the Centralised Facility	DGR/CES				


PHASE 0
BASKETS IN CANSTOR
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 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
GENTILLY-BASKET IN CANSTOR
ALL ROAD MODE
Fig. N°D.82
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

9. CENTRALISED SITE

Quantity of bundles to be transported from 2035 to 2064: see Appendix A, Table N° 1.

9.1. MODE AND ROUTE DEVELOPMENT

In accordance with the shipment rate:

- Creation of an area to unload the Transportation cask from the trailer (scope of DGR/CES 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 the present document 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, TERP (Transport Emergency Response Plan) 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 the present document, 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.

APPENDIX E: Conceptual design and description for all the UFTS components in the case of "Mostly rail" 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° 2.

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 roadways [**<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 document.

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 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 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.

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.
- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 6 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 Transportation cask 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 and transportation cask (see phases 5 and 6 of table paragraph 2.9)
  One for the impact limiter of the Transportation cask (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 trailers, security, transportation, emergency response:

- Loading of packages onto the trailers, security, transportation as described in phase 6 of table paragraph 2.9
- Emergency response plan: see paragraph 9 of Appendix E.
- Real time tracking: see paragraph 9 of Appendix E.

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° E.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 packaging. 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.	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 : Shielded fuel transfer cask, Appendix A, Figure N°10 - 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 Bolting of the lid with the associated platform			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° E.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 trolley	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 full 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 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 the 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 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° E.2
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				9.0
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 repeated three times.

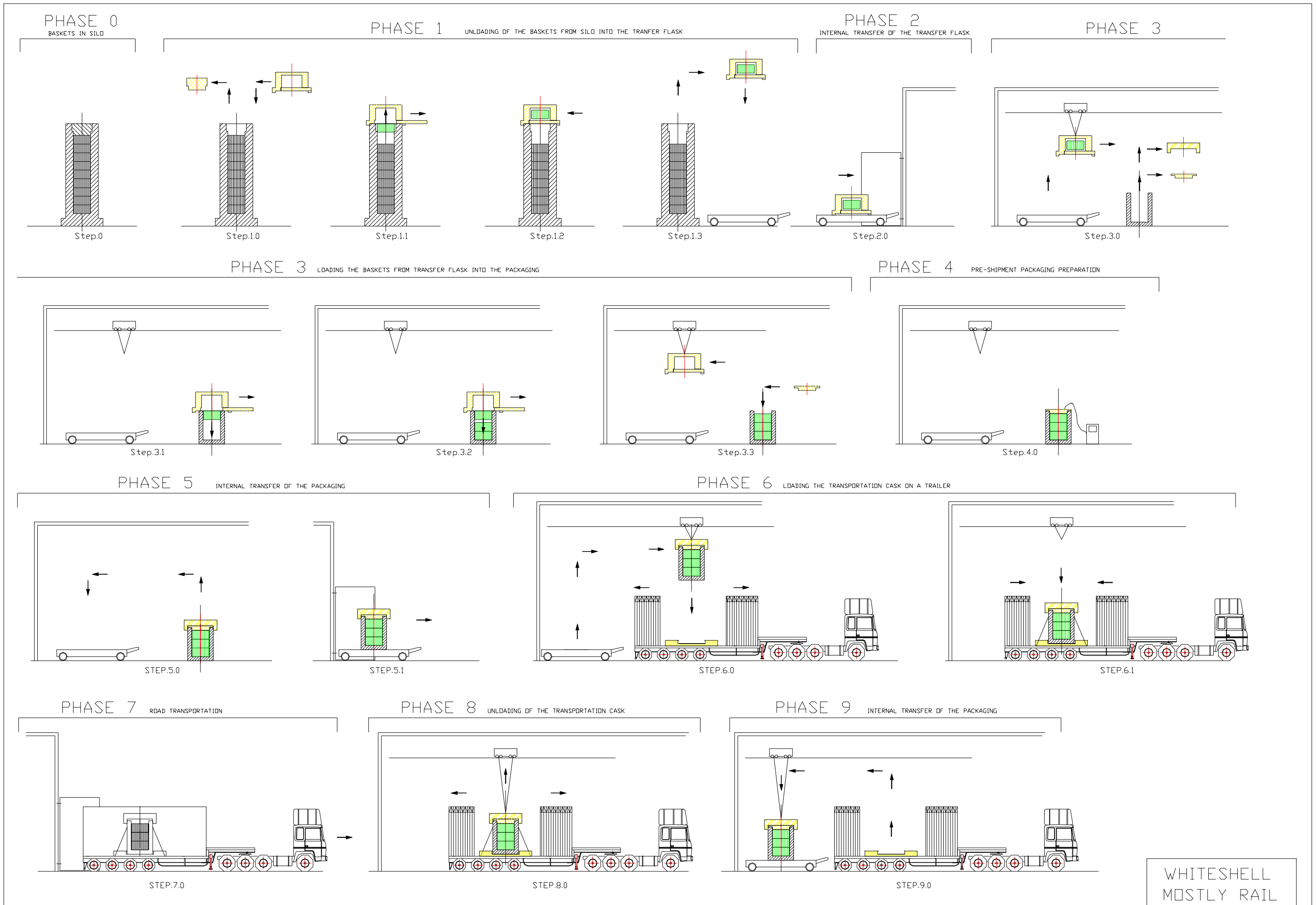
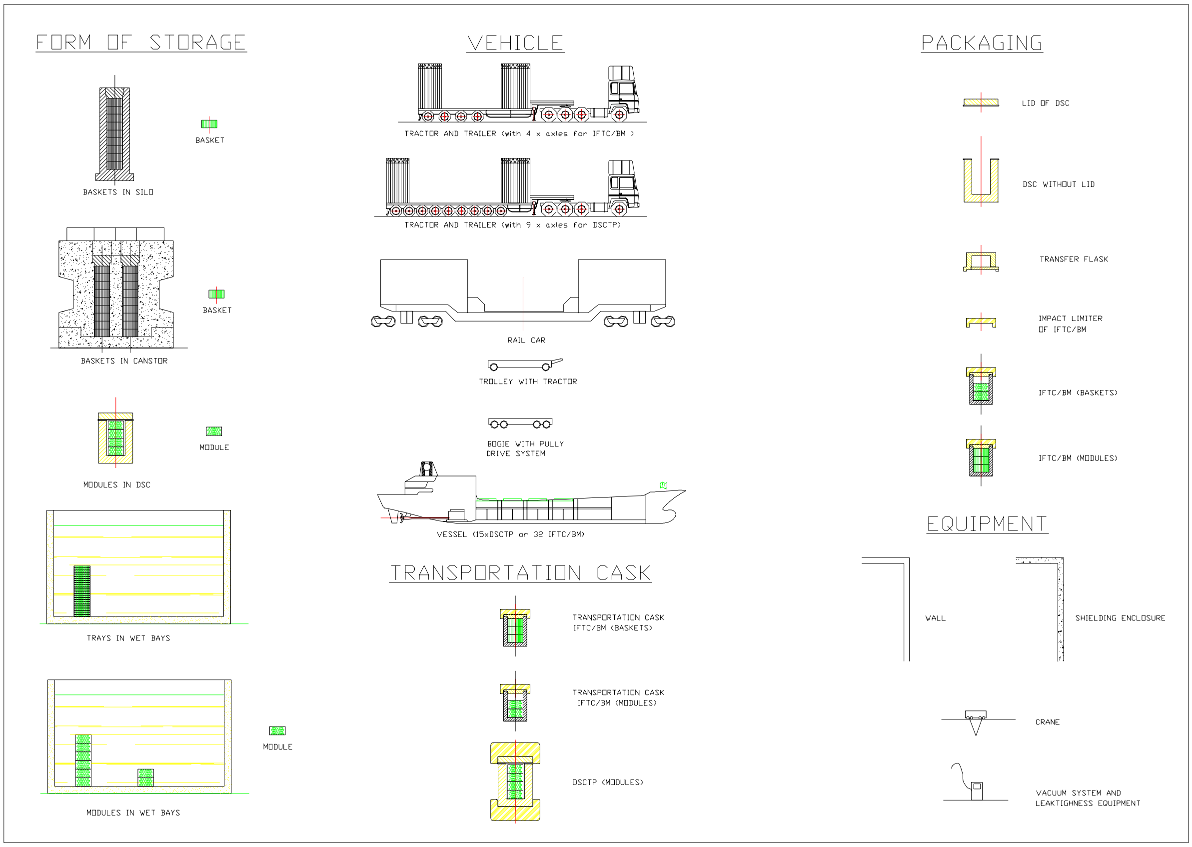

PHASE 0
BASKETS IN SILO
PHASE 1
UNLOADING OF THE BASKETS FROM SILO INTO THE TRANFER FLASK
PHASE 2
INTERNAL TRANSFER OF THE TRANSFER FLASK
PHASE 3
Step.0
Step.1.0
Step.1.1
Step.1.2
Step.1.3
Step.2.0
Step.3.0
PHASE 3
LOADING THE BASKETS FROM TRANSFER FLASK INTO THE PACKAGING
PHASE 4
PRE-SHIPMENT PACKAGING 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 RAIL
500276-01a

Fig. N°E.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 WUFDSF to the Centralised Facility
Quantity of bundles to be transported from 2035 to 2064: see appendix B, Table N° 2.

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.

Road: Road transport is clearly feasible from Bruce [**<52>**, **<53>**, **<27>**and **<54>**]. Public roadways are adequate to support transport from the site. Some strengthening of on-site roadways may be required to support the high volume of transports necessary for this portion of the shipping campaign. Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

Given the volume of used fuel to be transported to the site, use of the road mode would result in a larger number of individual shipments and offers the least potential for a consolidated transport program. The term “consolidated” refers to the physical consolidation of cargo into larger consignments as well as to the coordination of shipments between sites, according to the context.

Creation of two rail road terminals:

Example given Appendix G: Example of the COGEMA LOGISTICS road rail Terminal at Valognes.

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 trailer and rail car.

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

3.1.3. Transporter (vehicle)

3.1.3.1. Rail car (phase 5 of table paragraph 3.1.9)

The sample rail transportation system is predicated on the following elements:

- The train is dedicated to movement of used fuel under exclusive use conditions;
- Use of depressed center, flat bed car see Appendix A, Figure N°16;
- Each flat car is loaded with two IFTC/BMs or one DSCTP;
- Each train equipped with locomotive and caboose;
- The locomotive is assumed to have sufficient power to safely and efficiently haul the load.

3.1.3.2. Weather cover for the rail transportation (phase 5 of table paragraph 3.1.9)

- Rolling removable aluminium weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. One man can manually open or close the weather cover which can rolls on a rail fixed on the frame of the rail car.

- 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. The real time tracking system is placed on the two parts (See Appendix H).

3.1.3.3. Specific equipment for the rail transportation

- GPS antenna (tracking) on the rail car (Appendix H)
- Tools box adapted to the Transportation cask

3.1.3.4. Trailer for the road transportation (phases 4, 8 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 4, 8 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 3, 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

- 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 as developed in paragraph 3.2 of Chapter 3.

- Maintenance Equipment for Rail car: shared facility at the centralised site (see paragraph 3.4 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 railcar as described in **<8>** Appendix A, Figure N° 17.

- DSCTP: See Chapter 2, section 2.4.7.1.3, Figure N° 8 in Appendix A, 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 phase 2 of table paragraph 3.1.9) and for loading the Transportation cask on the trailer (see phase 3 of table paragraph 3.1.9).
  One for loading the Transportation cask on the rail car (see phase 5 of table paragraph 3.1.9).
  One for loading the Transportation cask on the trailer (see phase 7 of table paragraph 3.1.9).

- 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 2, 3, 5, 7 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 rail cars, security, transportation, emergency response:

- Loading of Transportation cask onto the trailer, the rail car, security, transportation as described in phases 3, 5, 7 of table paragraph 3.1.9.
- Emergency response plan: see paragraph 9 of Appendix E.
- Real time tracking: see paragraph 9 of Appendix E.

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

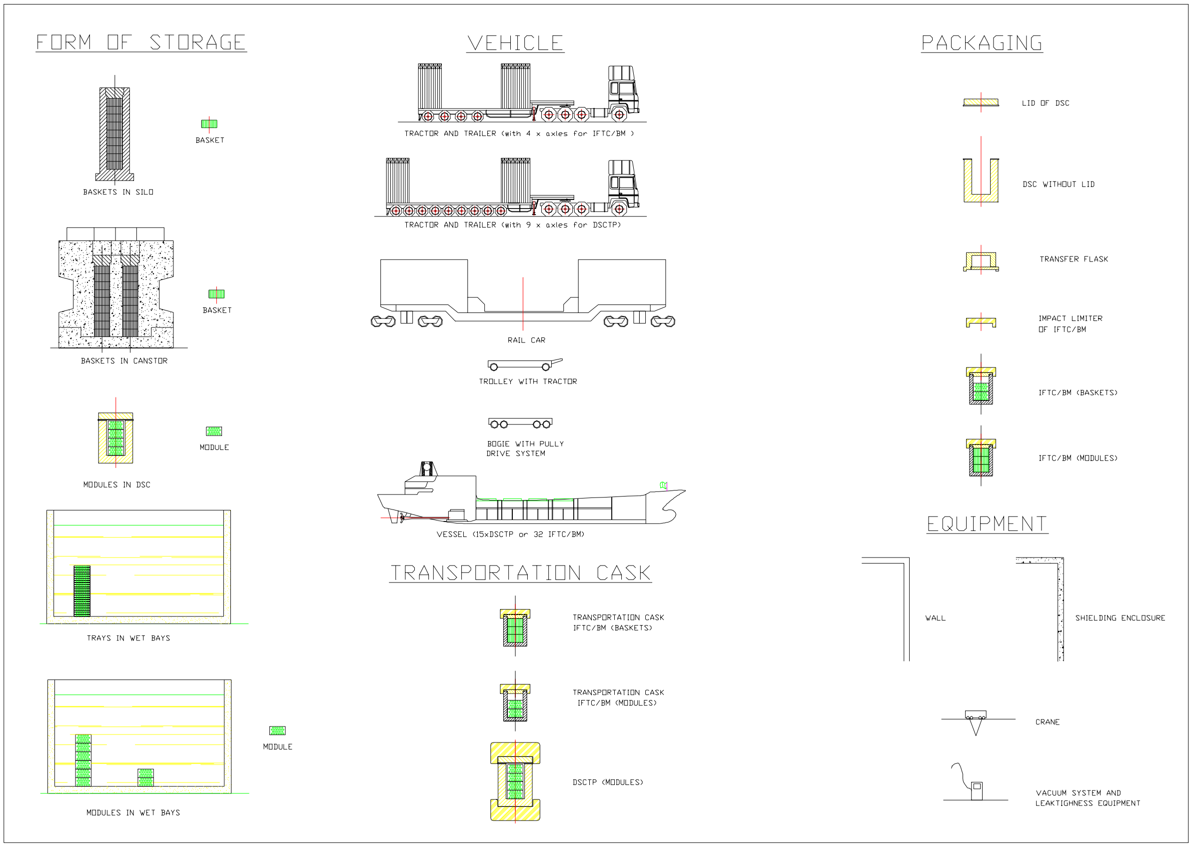
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° E.3.1
Phase 0	Modules in DSC	Interim storage	Initial phase			0
Phase 1	Internal transfer of the DSC	Interim storage			DSC, Appendix A, Figure N°7	1.0
Phase 2	Pre-shipment packaging 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 trailer	UFTS	Radiological control of the packaging and the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	3.0
			Open the weather cover	Weather cover		3.0
			Loading the packaging on a trailer	Trailer (Appendix A, Figure N°12)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic or air ride suspension to cushion the load - Trailer equipped with nine axles - One loaded cask per trailer	3.1
				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.	3.1
				Gantry crane	With 1 hoist (of 120 tons for the DSCTP)	3.1
			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>**)	3.1
			Check the condition of the packaging, trailer			3.1
			Fit the transport seals			3.1
			Close the weather cover	Weather cover		3.1
			Radiological control of the trailer and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	3.1

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.3.1
Phase 4	Road transportation	UFTS	Road transportation of the Transportation cask from the Facility to the Road Rail Terminal			4.0
				Real time tracking	Appendix H	4.0
Phase 5	Road/Rail transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask and the rail car	Non contamination, Dose Rate	"Smear test", Radiameter	5.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the trailer to the rail car	Gantry Crane	With 1 hoist (of 120 tons for the DSCTP)	
				Lifting Beam for Transportation cask	**<8>**	
				Rail car (Appendix A, Figure 16 **<3>**)	- The train is dedicated to movement of used fuel under exclusive use conditions; - Use of depressed centre, flat bed car; - Each flat car is loaded with two Transportation casks; - Each train equipped with locomotive and caboose; - The locomotive is assumed to have sufficient power to safely and efficiently haul the load.	
			Packaging tie-down on the rail car	Tie down	Tie-down of the DSCTP for the rail (Appendix A, Figure N°17 , **<8>**)	
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover of the rail car	Weather cover		
			Radiological control of the rail car and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 6	Rail transportation	UFTS	Rail transportation of the Transportation cask from the road rail terminal to the rail road terminal			6.0
				Real Time Tracking	Appendix H	
Phase 7	Rail/Road transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask, the rail car and the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	7.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the rail car to the trailer	Gantry Crane	With 1 hoist (of 120 tons for the DSCTP)	
				Lifting Beam for Transpor-tation cask	**<8>**	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.3.1
				Trailer (Appendix A, Figure N°12,)	- Modified 48 foot flatted trailer with integrated tie-down - Trailer equipped with hydraulic or air ride suspension to cushion the load - Trailer equipped with eight 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 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		
			Radiological control of the trailer and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 8	Road transportation	UFTS	Road transportation of the Transportation cask from the rail 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			
Phase 10	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 THE TRANSPORTATION CASK ON A TRAILER
PHASE 4
ROAD TRANSPORTATION
Step.2.4
Step.3.0
STEP.3.1
STEP.4.1
PHASE 5
ROAD / RAIL TRANSFER
Step.5.1
Step.5.2
PHASE 6
RAIL TRANSPORTATION
PHASE 7
RAIL / ROAD TRANSFER
PHASE 8
ROAD TRANSPORTATION
Step.6.0
Step.7.0
STEP.7.1
STEP.8.0
BRUCE-MODULES IN DSC
MOSTLY RAIL
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
LEAKTIGHTNESS 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°2**.**

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.

Road: Road transport is clearly feasible from Bruce [**<52>**, **<53>**, **<27>**and **<54>**]. Public roadways are adequate to support transport from the site. Some strengthening of on-site roadways may be required to support the high volume of transports necessary for this portion of the shipping campaign. Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

Given the volume of used fuel to be transported to the site, use of the road mode would result in a larger number of individual shipments and offers the least potential for a consolidated transport program. The term “consolidated” refers to the physical consolidation of cargo into larger consignments as well as to the coordination of shipments between sites, according to the context.

Creation of two rail road terminals :
Example given Appendix G: Example of the COGEMA LOGISTICS road rail Terminal at Valognes.

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 trailer and rail car.

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 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. Rail car (phase 7 of table paragraph 3.2.9)

The sample rail transportation system is predicated on the following elements:

- The train is dedicated to movement of used fuel under exclusive use conditions;
- Use of depressed center, flat bed car see Appendix A, Figure N° 16;
- Each flat car is loaded with two IFTC/BMs or one DSCTP;
- Each train equipped with locomotive and caboose;
- The locomotive is assumed to have sufficient power to safely and efficiently haul the load.

3.2.3.3. Weather cover for the rail transportation (phase 7 of table paragraph 3.2.9)

- Rolling removable aluminium weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. One man can manually open or close the weather cover which can rolls on a rail fixed on the frame of the rail car.

- 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. The real time tracking system is placed on the two parts (See Appendix H).

3.2.3.4. Frame or support of the Transportation cask for the rail transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the frame of the rail car. This frame is fixed on the frame of the rail car with calculated fixations in the three directions to follow the regulations concerning the accelerations. The weather cover can rolls on a rail fixed on the frame of the rail car. A drip pan is installed under the frame of the rail car 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.

3.2.3.5. Specific equipment for the rail transportation

- GPS antenna (tracking) on the rail car (Appendix H)
- Tools box adapted to the Transportation cask

3.2.3.6. Trailer for the road transportation (phases 6, 10 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 four axles
- One loaded cask per trailer
- 2 drivers and no escort

3.2.3.7. Tractor for the road transportation (phases 6, 10 of table paragraph 3.1.9)

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

3.2.3.8. Weather cover for the road transportation (phases 6, 10 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.

3.2.3.9. 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.

3.2.3.10. 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

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: concerning the site of Bruce shall be developed at the in accordance with the number of transportation and with Section 3.2 of Chapter 3.

- Maintenance Equipment for Rail car: shared facility at the centralised site (see paragraph 3.4 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 for rail.

- 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 3 of table paragraph 3.2.9)

- Gantry Crane:
  One for the pre-shipment of the packaging (see phase 3 of table paragraph 3.2.9) and for loading the Transportation cask on the trailer (see phase 5 of table paragraph 3.2.9).
  One for loading the Transportation cask on the rail car (see phase 7 of table paragraph 3.2.9).
  One for loading the Transportation cask on the trailer (see phase 9 of table paragraph 3.2.9).

- 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 phases 7, 9 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 rail cars and trailers, security, transportation, emergency response:

- Loading of Transportation cask onto the rail car and the trailer, security, transportation as described in phases 5, 7, 10 of table paragraph 3.2.9.

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

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

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).

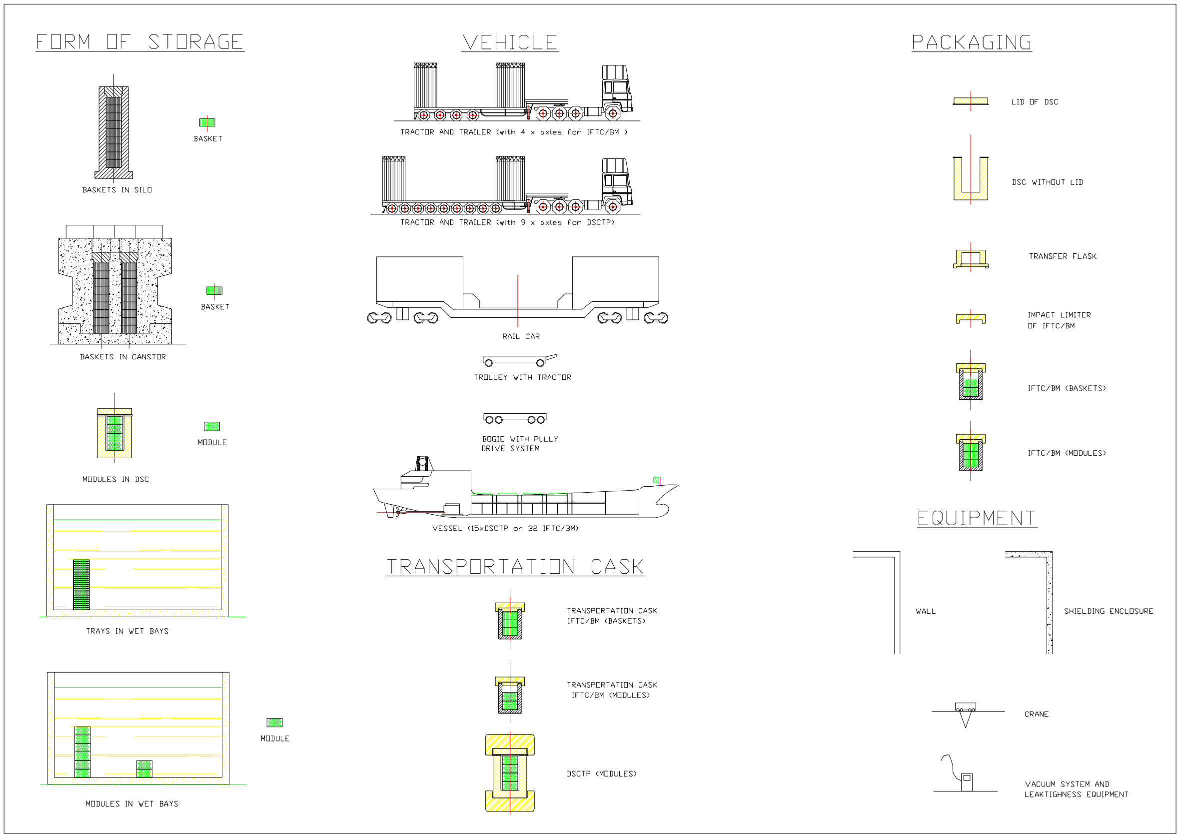
3.2.9. Table : Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° E.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	Unloading of the packaging from the trolley	Gantry crane	60 tons	3.1
			Drainage			3.0, 3.1
			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		
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	Gantry crane	10 tons	
				Lifting beam of 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 trailer	UFTS	Radiological control of the Transportation cask and the trailer	Non contamination, Dose Rate	“Smear test”, Radiameter	5.0, 5.1
			Open the weather cover	Weather cover		

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.2
			Loading the Transportation cask on a trailer	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	
				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. (Appendix A, Figure N°15, **<3>**)	
			Check the condition of the Transportation cask , trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the trailer and of the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	
Phase 6	Road transportation	UFTS	Road transportation of the Transportation cask from the Facility to the Road Rail Terminal			6.0
				Real time tracking	Appendix H	4.0
Phase 7	Road/Rail transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask and the rail car	Non contamination, Dose Rate	“Smear test”, Radiameter	7.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the trailer to the rail car	Gantry Crane	With 1 hoist (of 60 tons for the IFTC/BM or IFTC)	
				Lifting Beam for the Trans-portation cask	To carry of the IFTC/BM (similar to the IFTC, **<3>)**	
				Rail car (Appendix A, Figure 16 **<3>**)	- The train is dedicated to movement of used fuel under exclusive use conditions; - Use of depressed centre, flat bed car; - Each flat car is loaded with two Transportation casks; - Each train equipped with locomotive and caboose; - The locomotive is assumed to have sufficient power to safely and efficiently haul the load.	
			Packaging tie-down on the rail car	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**)	
			Check the condition of the packaging, rail car			
			Fit the transport seals			

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.2
			Close the weather cover of the rail car	Weather cover		
			Radiological control of the rail car and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 8	Rail transportation	UFTS	Rail transportation of the Transportation cask from the road rail terminal to the rail road terminal			8.0
				Real time tracking	Appendix H	
Phase 9	Rail/Road transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask, the rail car and the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	9.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the rail car to the trailer	Gantry Crane	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>)**	
				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	
				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. (Appendix A, Figure N°15, **<3>**)	
			Check the condition of the Transportation cask, trailer			
			Close the weather cover	Weather cover		
			Radiological control of the trailer and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
			Fit the transport seals			
Phase 10	Road transportation	UFTS	Road transportation of the Transportation cask from the rail road terminal to the Centralised Facility			10.0
				Real time Tracking	Appendix H	
Phase 11	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			
Phase 12	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 TRAILER
PHASE 6
ROAD TRANSPORTATION
STEP.4.0
STEP.4.1
STEP.5.0
STEP.5.1
STEP.6.0
PHASE 7
ROAD/RAIL TRANSFER OF THE TRANSPORTATION CASK
STEP.7.0
STEP.7.1
PHASE 8
RAIL TRANSPORTATION
PHASE 9
RAIL/ROAD TRANSFER OF THE TRANSPORTATION CASK
PHASE 10
ROAD TRANSPORTATION
STEP.8.0
STEP.9.0
STEP.10.0
BRUCE-TRAYS IN WET BAYS
MOSTLY RAIL
500276-01a


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

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.

Road: Road transport is clearly feasible from Bruce [**<52>**, **<53>**, **<27>**and **<54>**]. Public roadways are adequate to support transport from the site. Some strengthening of on-site roadways may be required to support the high volume of transports necessary for this portion of the shipping campaign. Such infrastructure improvements would be necessary for road transport, as well as to support transport to a railway or a waterway. Accordingly, such improvements are deemed necessary for the program.

Given the volume of used fuel to be transported to the site, use of the road mode would result in a larger number of individual shipments and offers the least potential for a consolidated transport program. The term “consolidated” refers to the physical consolidation of cargo into larger consignments as well as to the coordination of shipments between sites, according to the context.

Creation of two rail road terminals:

Example given Appendix G: Example of the COGEMA LOGISTICS road rail Terminal at Valognes.

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 rail car.

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. Rail car (phase 8 of table paragraph 3.3.9)

The sample rail transportation system is predicated on the following elements:

- The train is dedicated to movement of used fuel under exclusive use conditions;
- Use of depressed center, flat bed car see Appendix A, Figure N°16
- Each flat car is loaded with two IFTC/BMs or one DSCTP;
- Each train equipped with locomotive and caboose;
- The locomotive is assumed to have sufficient power to safely and efficiently haul the load.

3.3.3.4. Weather cover for the rail transportation (phase 8 of table paragraph 3.3.9)

- Rolling removable aluminium weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. One man can manually open or close the weather cover which can rolls on a rail fixed on the frame of the rail car.

- 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. The real time tracking system is placed on the two parts (See Appendix H).

3.3.3.5. Frame or support of the Transportation cask for the rail transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the frame of the rail car. This frame is fixed on the frame of the rail car with calculated fixations in the three directions to follow the regulations concerning the accelerations. The weather cover can rolls on a rail fixed on the frame of the rail car. A drip pan is installed under the frame of the rail car 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.

3.3.3.6. Specific equipment for the road transportation

- GPS antenna (tracking) on the rail car (Appendix H)
- Tools box adapted to the Transportation cask

3.3.3.7. Specific equipment for the rail transportation

- GPS antenna (tracking) on the rail car (Appendix H)
- Tools box adapted to the Transportation cask

3.3.3.8. Trailer for the road transportation (phases 6, 10 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 four axles
- One loaded cask per trailer
- 2 drivers and no escort

3.3.3.9. Tractor for the road transportation (phases 6, 10 of table paragraph 3.1.9)

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

3.3.3.10. Weather cover for the road transportation (phases 6, 10 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.

3.3.3.11. 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.

3.3.3.12. 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 Rail car: shared facility at the centralised site (see paragraph 3.4 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 IFTC for road but adapted to the accelerations for rail.

- 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 installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 3.3.9)
  One for loading the Transportation cask on the trailer (see phase 6 of table paragraph 3.3.9)
  One for loading the Transportation cask on the rail car (see phase 8 of table paragraph 3.3.9)

- Lifting beam :
  One for the Transfer flask (see phase 3 of table paragraph 3.3.9)
  One for the Transportation cask (see phases 6 and 8 of table paragraph 3.3.9)
  One for the impact limiter of the packaging (see phase 4 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 rail cars, security, transportation, emergency response:

- Loading of the Transportation cask onto the trailer, rail car, security, transportation as described in phases 6, 8, 10 of table paragraph 3.3.9.

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

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

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.

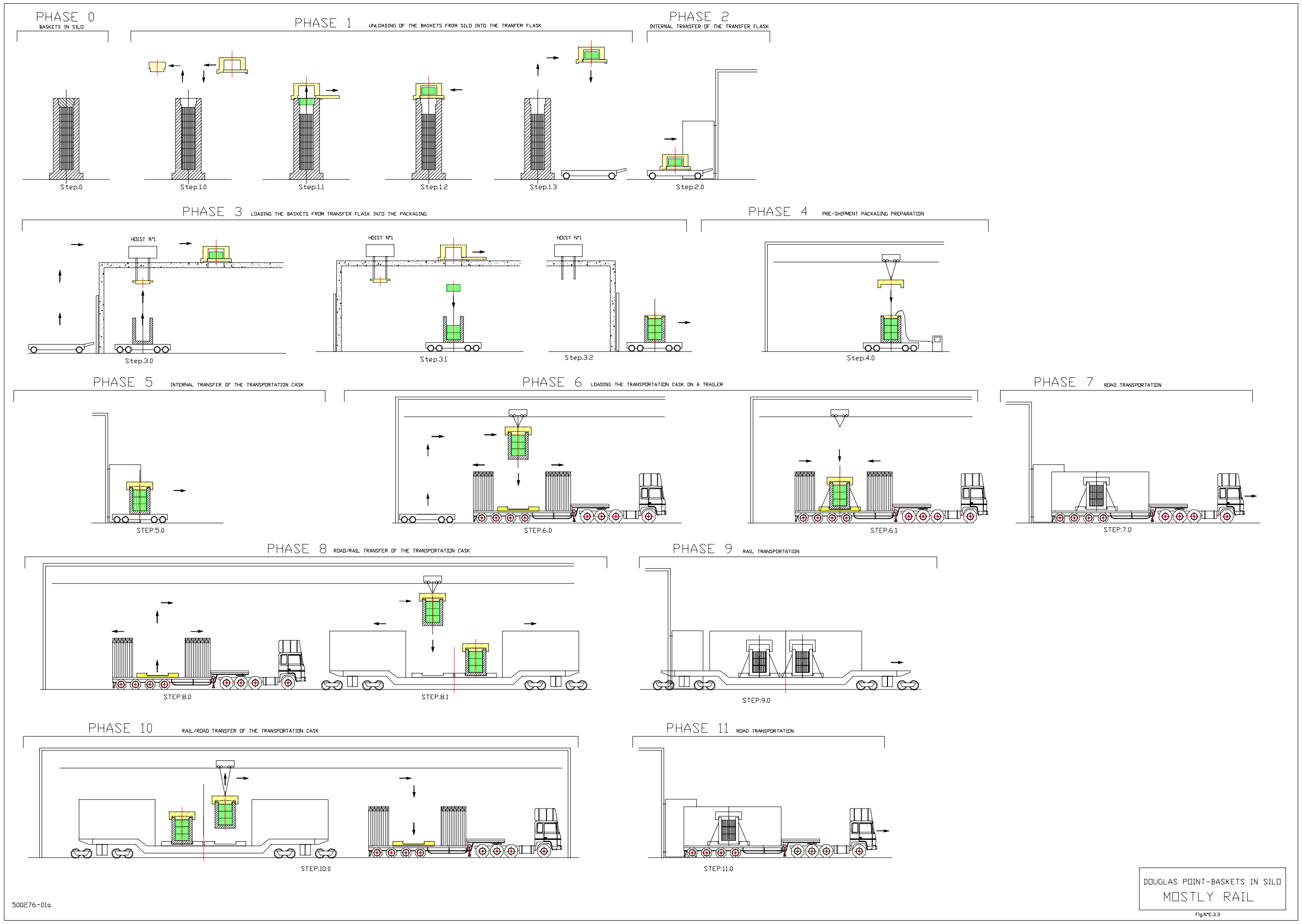
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

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° E.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	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	3.0
				Lifting Beam for Transfer flask		3.0
			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	3.0
			Load the baskets into the packaging			3.1
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 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask and the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	6.0

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.3.3
			Open the weather cover	Weather cover		
			Loading the Transportation cask on a trailer	Gantry Crane	With 1 hoist (of 60 tons for the IFTC/BM)	
				Lifting Beam for the Transportation cask	To carry of the IFTC/BM (similar to the IFTC, **<3>)**	
				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	
				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 (Appendix A, Figure N°15, **<3>**)	
			Check the condition of Transportation cask, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the trailer and the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	
Phase 7	Road transportation	UFTS	Road transportation of the Transportation cask from facility to the road rail terminal			7.0
				Real Time Tracking	Appendix H	
Phase 8	Road/Rail transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask, the rail car	Non contamination, Dose Rate	“Smear test”, Radiameter	8.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the trailer to the rail car	Gantry Crane	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>)**	
				Rail car (Appendix A, Figure N°16 **<3>**)	- The train is dedicated to movement of used fuel under exclusive use conditions; - Use of depressed centre, flat bed car; - Each flat car is loaded with two Transportation casks; - Each train equipped with locomotive and caboose; - The locomotive is assumed to have sufficient power to safely and efficiently haul the load.	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.3.3
			Packaging tie-down on the rail car	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**) but for rail	
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover of the rail car	Weather cover		
			Radiological control of the rail car and the transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	
Phase 9	Rail transportation	UFTS	Rail transportation of the Transportation cask from the road rail terminal to the rail road terminal			9.0
				Real Time Tracking	Appendix H	
Phase 10	Rail/Road transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask, the rail car and the trailer	Non contamination, Dose Rate	“Smear test”, Radiameter	7.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the rail car to the trailer	Gantry Crane	With 2 hoists (of 60 tons for the IFTC/BM)	
				Lifting Beam for Transpor-tation cask	To carry of the IFTC/BM (similar to the IFTC, **<3>)**	
				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 for 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 (Appendix A, Figure N°15, **<3>**)	
			Check the condition of the packaging, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the trailer and the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	
Phase 11	Road transportation	UFTS	Road transportation of the Transportation cask from rail road terminal to the Centralised site			11.0
Phase 12	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the rail car			


PHASE 0
BASKETS IN SILO
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
HOIST N°1
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 TRANSPORTATION CASK
STEP.5.0
PHASE 6
LOADING THE TRANSPORTATION CASK ON A TRAILER
STEP.6.0
STEP.6.1
PHASE 7
ROAD TRANSPORTATION
STEP.7.0
PHASE 8
ROAD/RAIL TRANSFER OF THE TRANSPORTATION CASK
STEP.8.0
STEP.8.1
PHASE 9
RAIL TRANSPORTATION
STEP.9.0
PHASE 10
RAIL/ROAD TRANSFER OF THE TRANSPORTATION CASK
STEP.10.0
PHASE 11
ROAD TRANSPORTATION
STEP.11.0
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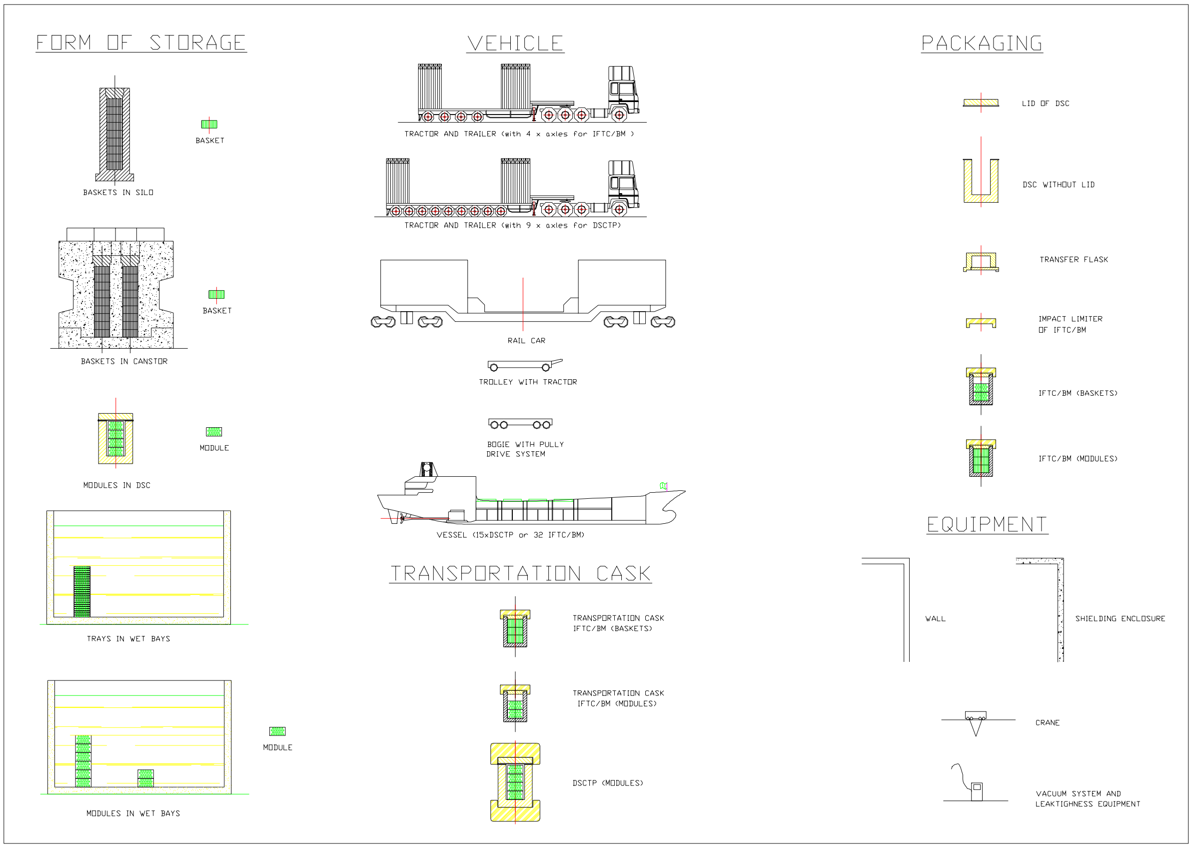
DOUGLAS POINT-BASKETS IN SILO
MOSTLY RAIL
Fig.N°E.3.3

Key:


FORM OF STORAGE
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
BASKET
MODULES IN DSC
MODULE
TRAYS IN WET BAYS
MODULES IN WET BAYS
MODULE
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°2.

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.

***Rail**:* Rail transport is generally feasible from the Pickering site [**<52>**, **<53>**, **<27>**and **<54>**]. The existing rail spur adjacent to the site could be extended closer to the dry cask storage area and the reactor pools. Cask handling equipment, such as suitable cranes, would need to be added to ensure sufficient lift power for loading of the rail cars.

Rail transport offers the ability to consolidate a larger number of casks per shipment than would road transport. Given the volumes involved for Pickering, consolidation has clear merits.

Creation of a rail road terminal:

Example given Appendix G: Example of the COGEMA LOGISTICS road rail Terminal at Valognes.

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 rail car.

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

4.1.3. Transporter (vehicle)

4.1.3.1. Rail car (phase 3 of table paragraph 4.1.9)

The sample rail transportation system is predicated on the following elements:

- The train is dedicated to movement of used fuel under exclusive use conditions;
- Use of depressed center, flat bed car see Appendix A, Figure N°16;
- Each flat car is loaded with two IFTC/BMs or one DSCTP;
- Each train equipped with locomotive and caboose;
- The locomotive is assumed to have sufficient power to safely and efficiently haul the load.

4.1.3.2. Weather cover for the rail transportation (phase 3 of table paragraph 4.1.9)

- Rolling removable aluminium weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. One man can manually open or close the weather cover which can roll on a rail fixed on the frame of the rail car.

- 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. The real time tracking system is placed on the two parts (See Appendix H).

4.1.3.3. Specific equipment for the rail transportation

- GPS antenna (tracking) on the rail car (Appendix H)
- Tools box adapted to the Transportation cask

4.1.3.4. Trailer for the road transportation (phases 5, 6 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 5, 6 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 5, 6 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 Rail Car: shared facility at the centralised site (see paragraph 3.4 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 rail car as described in **<8>**, Appendix A, Figure N° 17.
- DSCTP: See Chapter 2, section 2.4.7.1.3, Figure N° 8 of Appendix A, 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 phase 2 of table paragraph 4.1.9) and one for loading the Transportation cask on the rail car (see phase 3 of table paragraph 4.1.9).
  One for the rail road transfer of the transportation cask (see phase 5 of table paragraph 4.1.9)
- 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 phase 5, 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 rail car, trailer, security, transportation, emergency response:

- Loading of Transportation cask onto the rail car, the trailer security, transportation as described in phases 3, 5 of table paragraph 4.1.9.
- Emergency response plan: see paragraph 9 of Appendix E.
- Real time tracking: see paragraph 9 of Appendix E.

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).

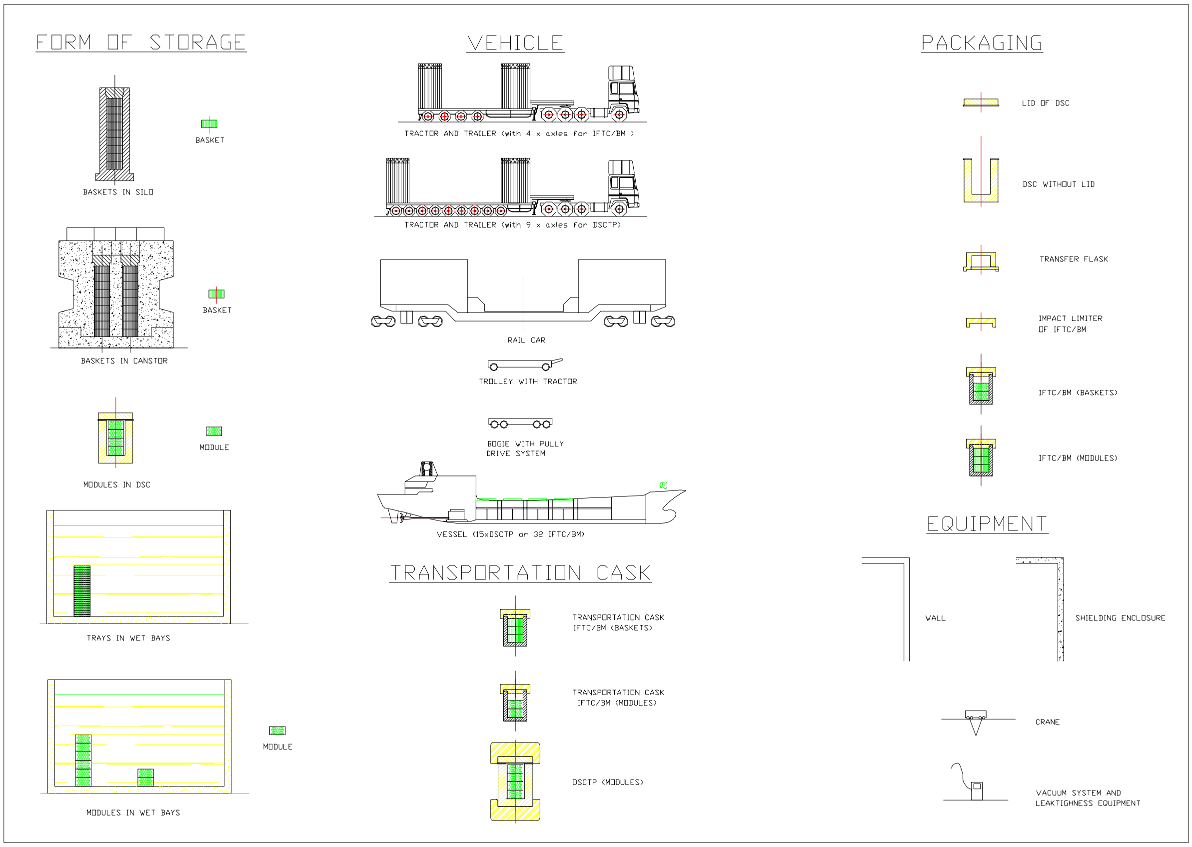
4.1.9. Table: Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° E.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 <10>	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 rail car **<8>**	UFTS	Open the weather cover of the railcar	Rail car (Appendix A, Figures N°16)	• The train is dedicated to movement of used fuel under exclusive use conditions; • Use of depressed center, flat bed car • Each flat car is loaded with one DSCTP; • Each train equipped with locomotive and caboose; • The locomotive is assumed to have sufficient power to safely and efficiently haul the load.	3.0
			Lift package in horizontal position	Gantry crane	120 tons	3.0
			Lower package onto railcar and tiedowns		Appendix A, Figure N°17	3.1
			Package loaded on railcar and tiedowns secured			3.2
			Check the condition of the packaging, rail car			3.2
			Close the weather cover	Weather cover		3.2
			Fit the transport seals			3.2
			Radiological control of the rail car	Non contamination, Dose Rate	“Smear test”, Radiameter	3.2

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.4.1
Phase 4	Rail transportation	UFTS	Rail transportation of the Transportation cask from the site to the rail road terminal			4.0
				Real Time Tacking	Appendix H	4.0
Phase 5	Rail/Road transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask, the rail car and the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	5.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the rail car to the trailer	Gantry Crane	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 trailer and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 6	Road transportation	UFTS	Road transportation of the Transportation cask from the rail road terminal to the Centralised Facility			6.0
				Real time Tracking	Appendix H	
Phase 7	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			
Phase 8	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 THE TRANSPORTATION CASK
Step.2.4
Step.3.0
Step.3.1
Step.3.2
PHASE 4
RAIL TRANSPORTATION
PHASE 5
RAIL / ROAD TRANSFER
Step.4.0
Step.5.0
STEP.5.1
PHASE 6
ROAD TRANSPORTATION
STEP.6.0
PICKERING-MODULES IN DSC
MOSTLY RAIL
Fig.N°E.4.1
500276-01a

Key:


FORM OF STORAGE
BASKETS IN SILO
BASKET
BASKETS IN CASTOR
BASKET
MODULES IN DSC
MODULE
TRAYS IN WET BAYS
MODULES IN WET BAYS
MODULE
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
LEAKTIGHTNESS EQUIPMENT

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

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

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.

Rail: Rail transport is generally feasible from the Pickering site [**<52>**, **<53>**, **<27>**and **<54>**]. The existing rail spur adjacent to the site could be extended closer to the dry cask storage area and the reactor pools. Cask handling equipment, such as suitable cranes, would need to be added to ensure sufficient lift power for loading of the rail cars.

Rail transport offers the ability to consolidate a larger number of casks per shipment than would road transport. Given the volumes involved for Pickering, consolidation has clear merits.

Creation of a rail road terminal:

Example given Appendix G: Example of the COGEMA LOGISTICS road rail Terminal at Valognes.

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 rail car.

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. Rail car (phase 4 of table paragraph 4.2.9)

The sample rail transportation system is predicated on the following elements:

- The train is dedicated to movement of used fuel under exclusive use conditions;
- Use of depressed center, flat bed car see Appendix A, Figure N°16;
- Each flat car is loaded with two IFTC/BMs or one DSCTP;
- Each train equipped with locomotive and caboose;
- The locomotive is assumed to have sufficient power to safely and efficiently haul the load.

4.2.3.3. Weather cover for the rail transportation (phase 4 of table paragraph 4.2.9)

- Rolling removable aluminium weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. One man can manually open or close the weather cover which can rolls on a rail fixed on the frame of the rail car.

- 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. The real time tracking system is placed on the two parts (See Appendix H).

4.2.3.4. Frame or support of the Transportation cask for the rail transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the frame of the rail car. This frame is fixed on the frame of the rail car with calculated fixations in the three directions to follow the regulations concerning the accelerations. The weather cover can rolls on a rail fixed on the frame of the rail car. A drip pan is installed under the frame of the rail car 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.

4.2.3.5. Specific equipment for the rail transportation

- GPS antenna (tracking) on the rail car (Appendix H)
- Tools box adapted to the Transportation cask

4.2.3.6. Trailer for the road transportation (phase 6 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 four axles
- One loaded cask per trailer
- 2 drivers and no escort

4.2.3.7. Tractor for the road transportation (phase 6 of table paragraph 3.1.9)

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

4.2.3.8. Weather cover for the road transportation (phase 6 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.

4.2.3.9. 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.

4.2.3.10. 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

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 Rail car: shared facility at the centralised site (see paragraph 3.4 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.

- 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 rail car (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).

- Lifting beam:
  One for the packaging and Transportation cask (see phases 1 to 4 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 6 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 rail car, trailer, security, transportation, emergency response:

- Loading of the Transportation cask onto the rail car, trailer, security, transportation as described in phases 4, 6 of table paragraph 4.2.9.

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

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

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.

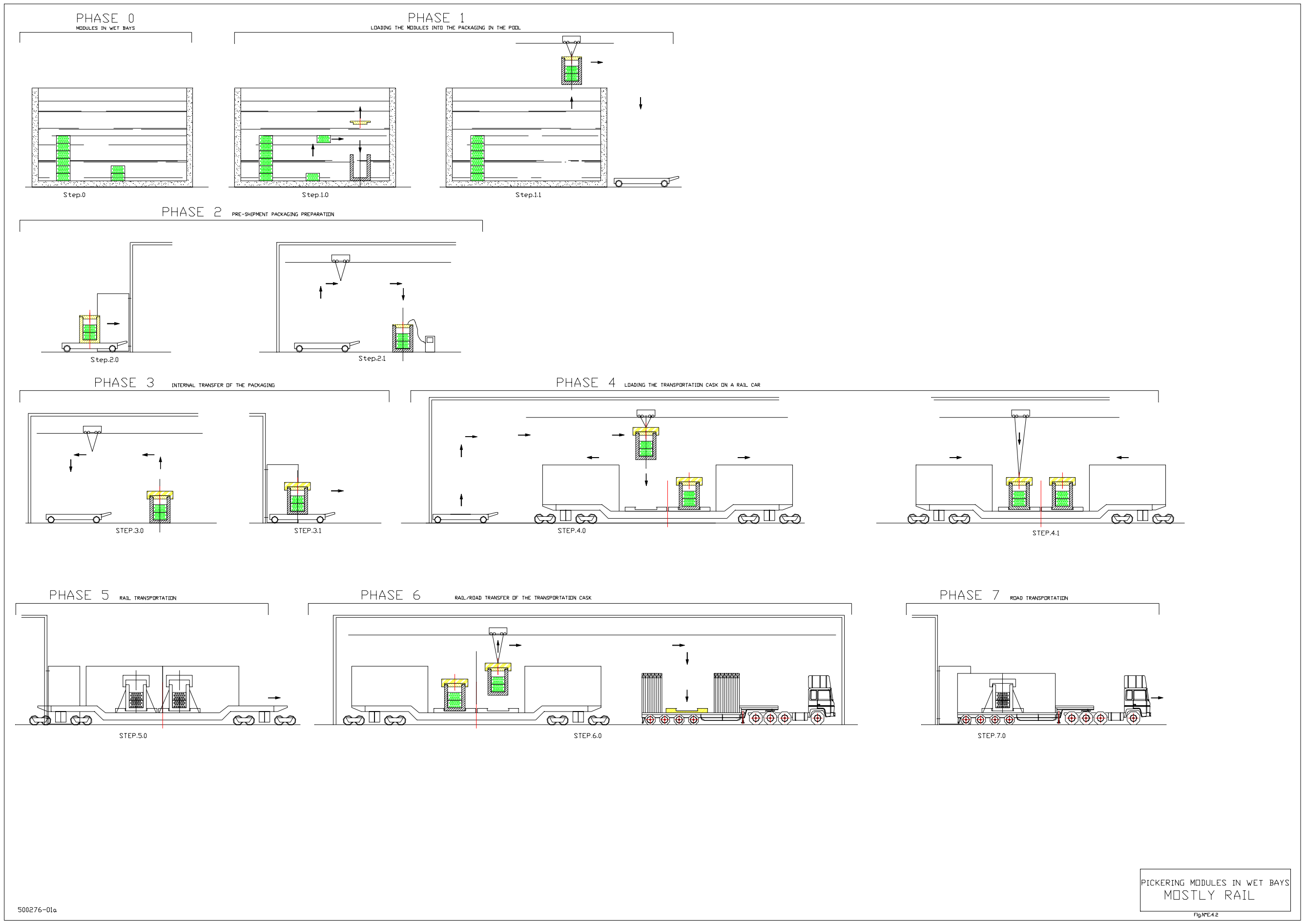
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

4.2.9. Table: Analysis of the operational phases of transport

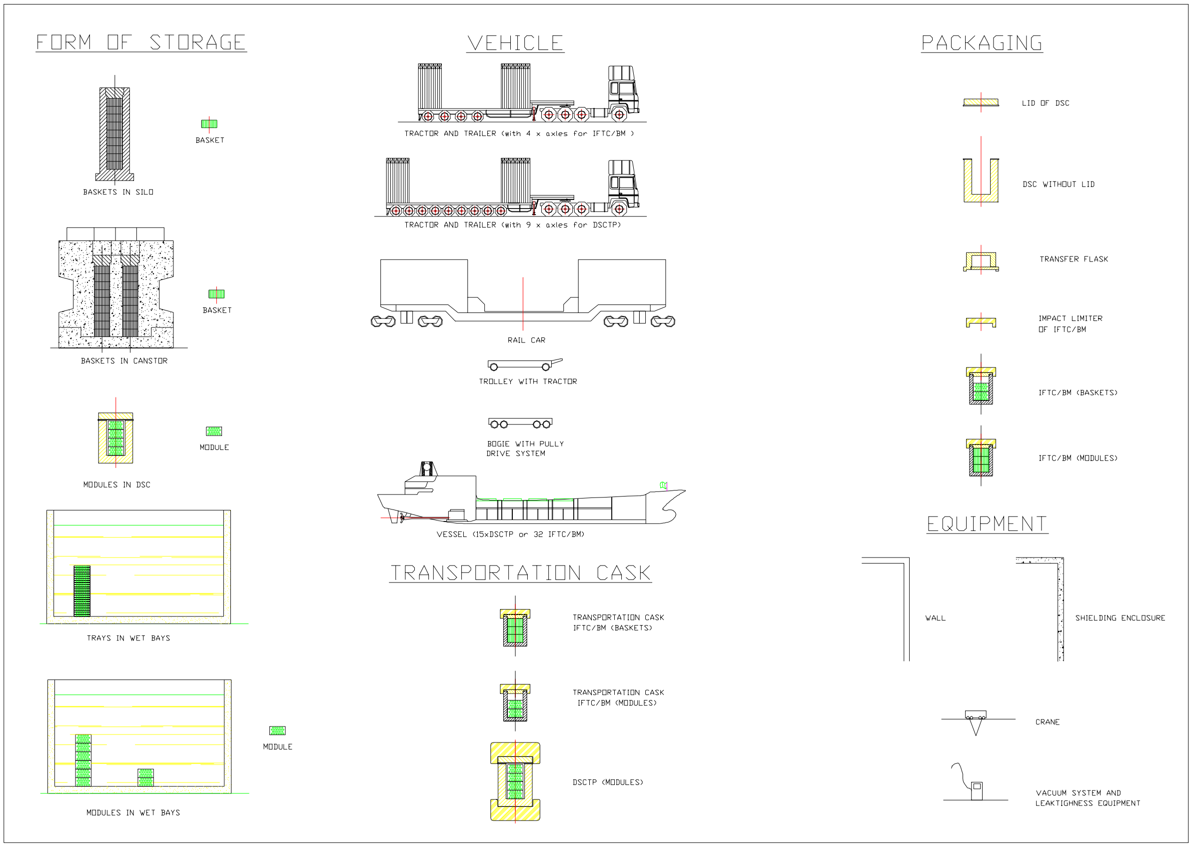
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.4.2
Phase 0	Modules in wet bays	Interim storage	Initial phase			0
Phase 1	Loading the modules into the packaging in the pool	UFTS			Identical than the IFCT in the pool Decontamination 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 2	Pre-shipment packaging preparation	UFTS	Unloading the packaging from the trolley	Gantry crane	60 tons	2.1
			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 equipement		
			Depressurising the cavity	Vacuum circuit		
Phase 3	Internal transfer of the packaging	UFTS	Radiological control of the packaging	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	Lifting beam for 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 rail car	UFTS	Radiological control of the Transportation cask and the rail car	Non contamination, Dose Rate	"Smear test", Radiameter	4.0
			Open the weather cover	Weather cover		4.0
			Loading the Transportation cask on a rail car	Gantry Crane	With 1 hoist (of 60 tons for the IFTC/BM)	4.0
				Lifting Beam for Transportation cask	To carry of the IFTC/BM (similar to the IFTC, **<3>)**	4.0

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.4.2
				Rail car (Appendix A, Figure 16 **<3>**)	- The train is dedicated to movement of used fuel under exclusive use conditions; - Use of depressed centre, flat bed car; - Each flat car is loaded with two Transportation casks; - Each train equipped with locomotive and caboose; - The locomotive is assumed to have sufficient power to safely and efficiently haul the load.	40
			Packaging tie-down on the rail car	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**) but for the rail	4.1
			Check the condition of the Transportation cask , rail car			4.1
			Fit the transport seals			4.1
			Close the weather cover	Weather cover		4.1
			Radiological control of the rail car and the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	4.1
Phase 5	Rail transportation	UFTS	Rail transportation of the Transportation cask from the site to the rail road terminal			5.0
				Real Time Tracking	Appendix H	5.0
Phase 6	Rail/Road transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask, the rail car and the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	6.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the rail car to the trailer	Gantry Crane	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>)**	
				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	
				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 (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° E.4.2
			Close the weather cover	Weather cover		
			Check the condition of the packaging, rail car			
			Radiological control of 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 rail 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			
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 RAIL CAR
STEP.4.0
STEP.4.1
PHASE 5
RAIL TRANSPORTATION
STEP.5.0
PHASE 6
RAIL/ROAD TRANSFER OF THE TRANSPORTATION CASK
STEP.6.0
PHASE 7
ROAD TRANSPORTATION
STEP.7.0
500276-01a
PICKERING MODULES IN WET BAYS
MOSTLY RAIL
Fig.N°E.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°2.

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.

Rail: Rail access exists to the Darlington site [**<52>**, **<53>**, **<27>**and **<54>**]. There is a rail siding relatively close to the proposed site area for Darlington Used Fuel Storage facility. Minor infrastructure improvements would allow extension of the siding directly to the storage facility.

At present, there is no loading capability at the rail siding, nor does Darlington currently possess mobile cranes. Heavy lift capability would need to be added in order to further the rail transport option.

Rail transport offers the ability to consolidate a larger number of casks per shipment than would road transport. Given the volumes involved for Darlington, consolidation has clear merits.

Creation of a rail road terminal:

Example given Appendix G: Example of the COGEMA LOGISTICS road rail Terminal at Valognes.

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 rail car.

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

5.1.3. Transporter (vehicle)

5.1.3.1. Rail car (phase 3 of table paragraph 5.1.9)

The sample rail transportation system is predicated on the following elements:

- The train is dedicated to movement of used fuel under exclusive use conditions;
- Use of depressed center, flat bed car see Appendix A, Figure N°16;
- Each flat car is loaded with two IFTC/BMs or one DSCTP;
- Each train equipped with locomotive and caboose;
- The locomotive is assumed to have sufficient power to safely and efficiently haul the load.

5.1.3.2. Weather cover for the rail transportation (phase 3 of table paragraph 5.1.9)

- Rolling removable aluminium weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. One man can manually open or close the weather cover which can rolls on a rail fixed on the frame of the rail car.

- 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. The real time tracking system is placed on the two parts (See Appendix H).

5.1.3.3. Specific equipment for the rail transportation

- GPS antenna (tracking) on the rail car (Appendix H)
- Tools box adapted to the Transportation cask

5.1.3.4. Trailer for the road transportation (phases 5, 6 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 5, 6 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 5, 6 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 Rail car: shared facility at the centralised site (see paragraph 3.4 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 rail car as described in **<8>**, Appendix A, Figure N° 17.

- DSCTP: See Chapter 2, section 2.4.7.1.3, Figure N° 8 of Appendix A, 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 phase 2 of table paragraph 5.1.9) and one for loading the Transportation cask on the rail car (see phase 3 of table paragraph 5.1.9).
  One for the rail road transfer of the transportation cask (see phase 5 of table paragraph 5.1.9)

- 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 phase 5 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 rail car, trailer, security, transportation, emergency response:

- Loading of Transportation cask onto the rail car, the trailer security, transportation as described in phases 3, 5 of table paragraph 5.1.9.

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

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

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).

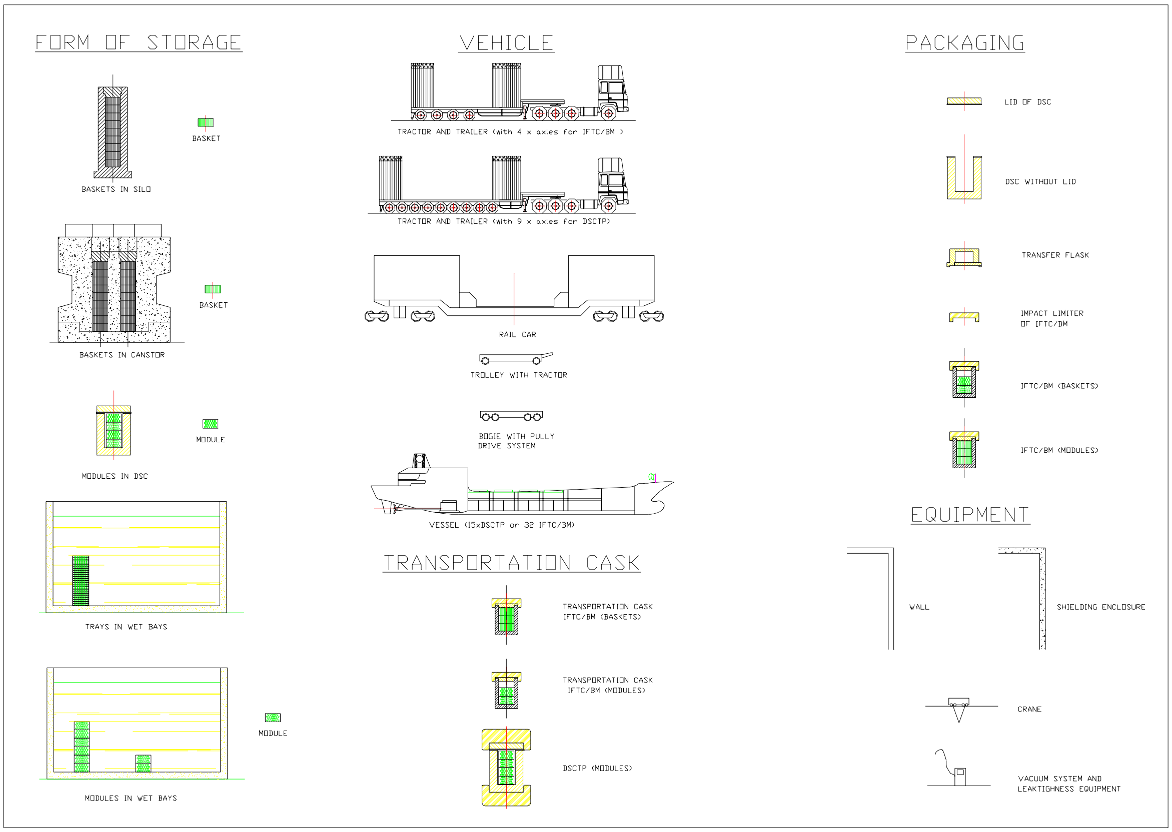
5.1.9. Table : Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° E.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 rail car **<8>**	UFTS	Open the weather cover of the railcar	Rail car (Appendix A, Figures N°16)	• The train is dedicated to movement of used fuel under exclusive use conditions; • Use of depressed center, flat bed car • Each flat car is loaded with one DSCTP; • Each train equipped with locomotive and caboose; • The locomotive is assumed to have sufficient power to safely and efficiently haul the load.	
			Lift package in horizontal position	Gantry crane	120 tons	3.0
			Lower package onto railcar and tiedowns		Appendix A, Figure N°17	3.1
			Package loaded on railcar and tiedowns secured			3.2
			Check the condition of the packaging, rail car			
			Close the weather cover	Weather cover		3.2
			Fit the transport seals			3.2

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.5.1
			Radiological control of the rail car	Non contamination, Dose Rate	"Smear test", Radiameter	3.2
Phase 4	Rail transportation	UFTS	Rail transportation of the Transportation cask from the site to the rail road terminal			4.0
				Real Time Tacking	Appendix H	4.0
Phase 5	Rail/Road transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask, the rail car and the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	5.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the rail car to the trailer	Gantry Crane	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 trailer and of the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 6	Road transportation	UFTS	Road transportation of the Transportation cask from the rail road terminal to the Centralised Facility			6.0
				Real time Tracking	Appendix H	
Phase 7	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the trailer			
Phase 8	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 THE TRANSPORTATION CASK
Step.2.4
Step.3.0
Step.3.1
Step.3.2
PHASE 4 RAIL TRANSPORTATION
PHASE 5 RAIL / ROAD TRANSFER
Step.4.0
Step.5.0
STEP.5.1
PHASE 6 ROAD TRANSPORTATION
STEP.6.0
DARLINGTON-MODULES IN DSC
MOSTLY RAIL
500276-01a

Key:


FORM OF STORAGE
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
BASKET
MODULES IN DSC
MODULE
TRAYS IN WET BAYS
MODULES IN WET BAYS
MODULE
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° 2.

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.

Rail: Rail access exists to the Darlington site [**<52>**, **<53>**, **<27>**and **<54>**]. There is a rail siding relatively close to the proposed site area for Darlington Used Fuel Storage facility. Minor infrastructure improvements would allow extension of the siding directly to the storage facility.

At present, there is no loading capability at the rail siding, nor does Darlington currently possess mobile cranes. Heavy lift capability would need to be added in order to further the rail transport option.

Rail transport offers the ability to consolidate a larger number of casks per shipment than would road transport. Given the volumes involved for Darlington, consolidation has clear merits.

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 rail car.

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. Rail car (phase 4 of table paragraph 5.2.9)

The sample rail transportation system is predicated on the following elements:

- The train is dedicated to movement of used fuel under exclusive use conditions;
- Use of depressed center, flat bed car see Appendix A, Figure N°16;
- Each flat car is loaded with two IFTC/BMs or one DSCTP;
- Each train equipped with locomotive and caboose;
- The locomotive is assumed to have sufficient power to safely and efficiently haul the load.

5.2.3.3. Weather cover for the rail transportation (phase 4 of table paragraph 5.2.9)

- Rolling removable aluminium weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. One man can manually open or close the weather cover which can rolls on a rail fixed on the frame of the rail car.

- 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. The real time tracking system is placed on the two parts (See Appendix H).

5.2.3.4. Frame or support of the Transportation cask for the rail transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the frame of the rail car. This frame is fixed on the frame of the rail car with calculated fixations in the three directions to follow the regulations concerning the accelerations. The weather cover can rolls on a rail fixed on the frame of the rail car. A drip pan is installed under the frame of the rail car 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.

5.2.3.5. Specific equipment for the rail transportation

- GPS antenna (tracking) on the rail car (Appendix H)
- Tools box adapted to the Transportation cask

5.2.3.6. Trailer for the road transportation (phase 6 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 four axles
- One loaded cask per trailer
- 2 drivers and no escort

5.2.3.7. Tractor for the road transportation (phase 6 of table paragraph 3.1.9)

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

5.2.3.8. Weather cover for the road transportation (phase 6 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.

5.2.3.9. 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.

5.2.3.10. 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

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 Rail car: shared facility at the centralised site (see paragraph 3.4 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.

- 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:

- 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 rail car (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).

- Lifting beam:
  One for the packaging and Transportation cask (see phases 1 to 4 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 6 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 rail car, trailer, security, transportation, emergency response:

- Loading of the Transportation cask onto the rail car, trailer, security, transportation as described in phases 4, 6 of table paragraph 5.2.9.

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

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

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° E.5.2
Phase 0	Modules in wet bays	Interim storage	Initial phase			0
Phase 1	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 2	Pre-shipment packaging preparation	UFTS	Unloading the packaging from the trolley	Gantry crane	60 tons	
			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 equipement		
			Depressurising the cavity	Vacuum circuit		
Phase 3	Internal transfer of the packaging	UFTS	Radiological control of the packaging	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	Lifting beam of the impact limiter		
			Loading of the full Transportation cask on the vehicle			
			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 rail car	UFTS	Radiological control of the Transportation cask and the rail car	Non contamination, Dose Rate	“Smear test”, Radiameter	4.0
			Open the weather cover	Weather cover		4.0
			Loading the Transportation cask on a rail car	Gantry Crane	With 1 hoist (of 60 tons for the IFTC/BM)	4.0
				Lifting Beam for the Transportation cask	To carry of the IFTC/BM (similar to the IFTC, **<3>)**	4.0

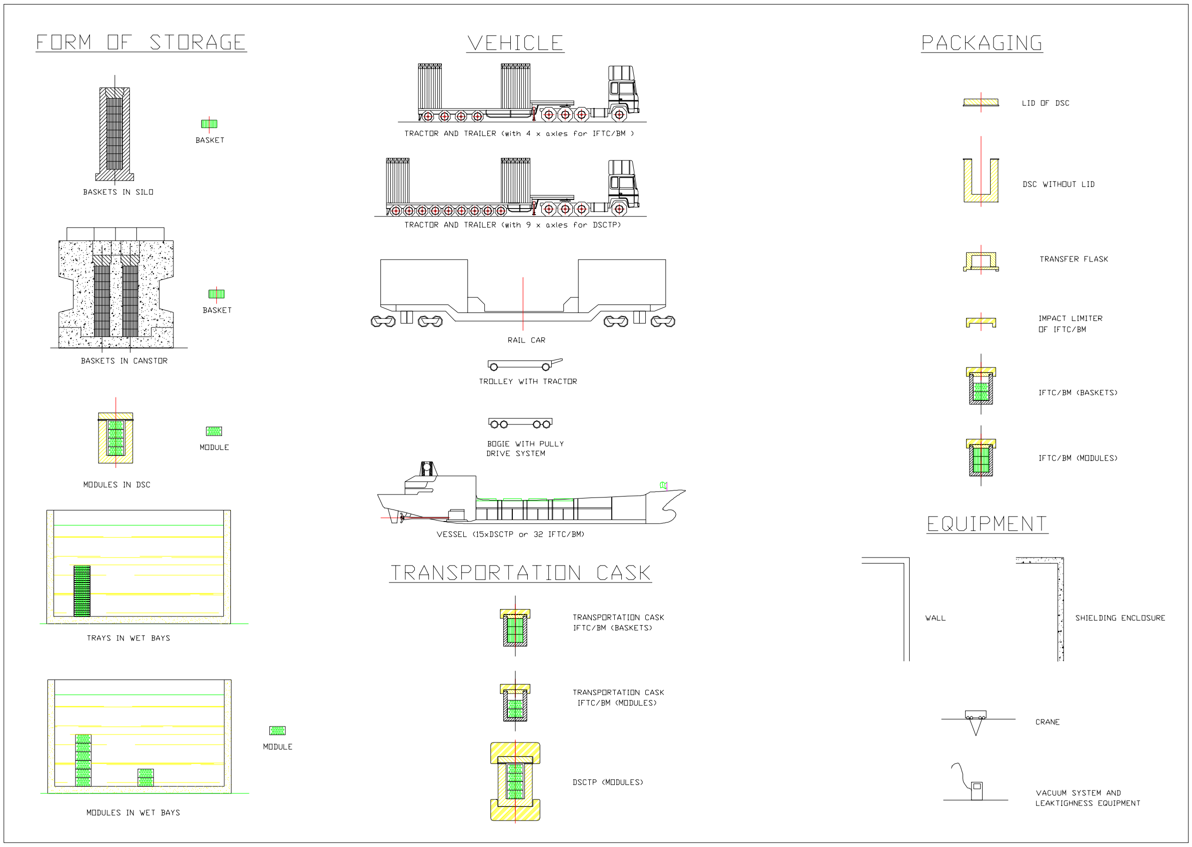
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.5.2
				Rail car (Appendix A, Figure 16 **<3>**)	- The train is dedicated to movement of used fuel under exclusive use conditions; - Use of depressed centre, flat bed car; - Each flat car is loaded with two Transportation casks; - Each train equipped with locomotive and caboose; - The locomotive is assumed to have sufficient power to safely and efficiently haul the load.	40
			Packaging tie-down on the rail car	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**)	4.1
			Check the condition of the Transportation cask, rail car			4.1
			Fit the transport seals			4.1
			Close the weather cover	Weather cover		4.1
			Radiological control of the rail car and the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	4.1
Phase 5	Rail transportation	UFTS	Rail transportation of the Transportation cask from the site to the rail road terminal			5.0
				Real Time Tracking	Appendix H	5.0
Phase 6	Rail/Road transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask, the rail car and the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	6.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the rail car to the trailer	Gantry Crane	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>)**	
				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	
				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 (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° E.5.2
			Close the weather cover	Weather cover		
			Check the condition of the packaging, rail car			
			Radiological control of 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 rail 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			
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
STEP.3.0
STEP.3.1
PHASE 4
LOADING THE TRANSPORTATION CASK ON A RAIL CAR
STEP.4.0
STEP.4.1
PHASE 5
RAIL TRANSPORTATION
STEP.5.0
PHASE 6
RAIL/ROAD TRANSFER OF THE TRANSPORTATION CASK
STEP.6.0
PHASE 7
ROAD TRANSPORTATION
STEP.7.0
500276-01a
DARLINGTON MODULES IN WET BAYS
MOSTLY RAIL

Fig.N°E.5.2

Key:


FORM OF STORAGE
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
BASKET
MODULES IN DSC
MODULE
TRAYS IN WET BAYS
MODULES IN WET BAYS
MODULE
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°2.

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.

Rail: The Point Lepreau site does not have a rail siding. The closest rail into the nearby city of Saint Johns is privately owned. More significantly, however, the line crosses into the State of Maine in the United States before crossing back into Canadian territory [**<52>**, **<53>**, **<27>**and **<54>**]. While transit through the United States is technically feasible, the moderate benefits presented by rail transport may not justify the international shipment.

The next closest rail line is in Moncton, roughly 150 km away. The infrastructure improvements would be most significant for this mode. In this case, road transport from the reactor site to the railhead would be necessary; transfer from the road to rail mode would be required, necessitating a transfer facility equipped with suitable cranes and handling equipment.

It is also noted that a large portion of the rail line runs along St. Lawrence Seaway and passes through the same populated regions as do the parallel road and waterway systems. Rail transport, therefore, does not provide any significant benefits (i.e., shorter routes, avoidance of population centers, etc.) as compared with road or water transport.

Creation of two rail road terminals:

Example given Appendix G: Example of the COGEMA LOGISTICS road rail Terminal at Valognes.

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 trailer.

See phases 3, 4, 5 of paragraph 6.9 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. Trailer for the road transportation (phases 6, 8 of table paragraph 6.9)

- 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

6.3.4. Tractor for the road transportation (phases 6, 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.

6.3.5. Weather cover for the road transportation (phases 6, 10 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 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.

6.3.6. 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.

6.3.7. 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

6.3.8. Rail car (phase 8 of table paragraph 6.9)

The sample rail transportation system is predicated on the following elements:

- The train is dedicated to movement of used fuel under exclusive use conditions;
- Use of depressed center, flat bed car see Appendix A, Figure N°13;
- Each flat car is loaded with two IFTC/BM or one DSCTP;
- Each train equipped with locomotive and caboose;
- The locomotive is assumed to have sufficient power to safely and efficiently haul the load.

6.3.9. Weather cover for the rail transportation (phase 6 of table paragraph 6.9)

- Rolling removable aluminium weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. One man can manually open or close the weather cover which can rolls on a rail fixed on the frame of the rail car.

- 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. The real time tracking system is placed on the two parts (See Appendix H).

6.3.10. Frame or support of the Transportation cask for the rail transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the frame of the rail car. This frame is fixed on the frame of the rail car with calculated fixations in the three directions to follow the regulations concerning the accelerations. The weather cover can rolls on a rail fixed on the frame of the rail car. A drip pan is installed under the frame of the rail car 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.

6.3.11. Specific equipment for the road transportation

- GPS antenna (tracking) on the rail car (Appendix H)
- 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).

- Maintenance equipment for Rail car: shared facility at the centralised site as developed in paragraph 3.4 of Chapter 3.

6.5. Casks

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

- Tie-down: similar to the IFTC for road but adapted to the accelerations for rail.

- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 6 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 installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 6.9)
  One for loading the Transportation cask on the trailer (see phase 6 of table paragraph 6.9)
  One for loading the Transportation cask on the rail car (see phase 8 of table paragraph 6.9)

- Lifting beam :
  One for the Transfer flask (see phase 3 of table paragraph 6.9)
  One for the Transportation cask (see phases 6, 8 of table paragraph 6.9)
  One for the impact limiter of the packaging (see phase 4 of table paragraph 6.9)

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

6.7. UFTS Transportation system operation

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

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

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

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

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

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).

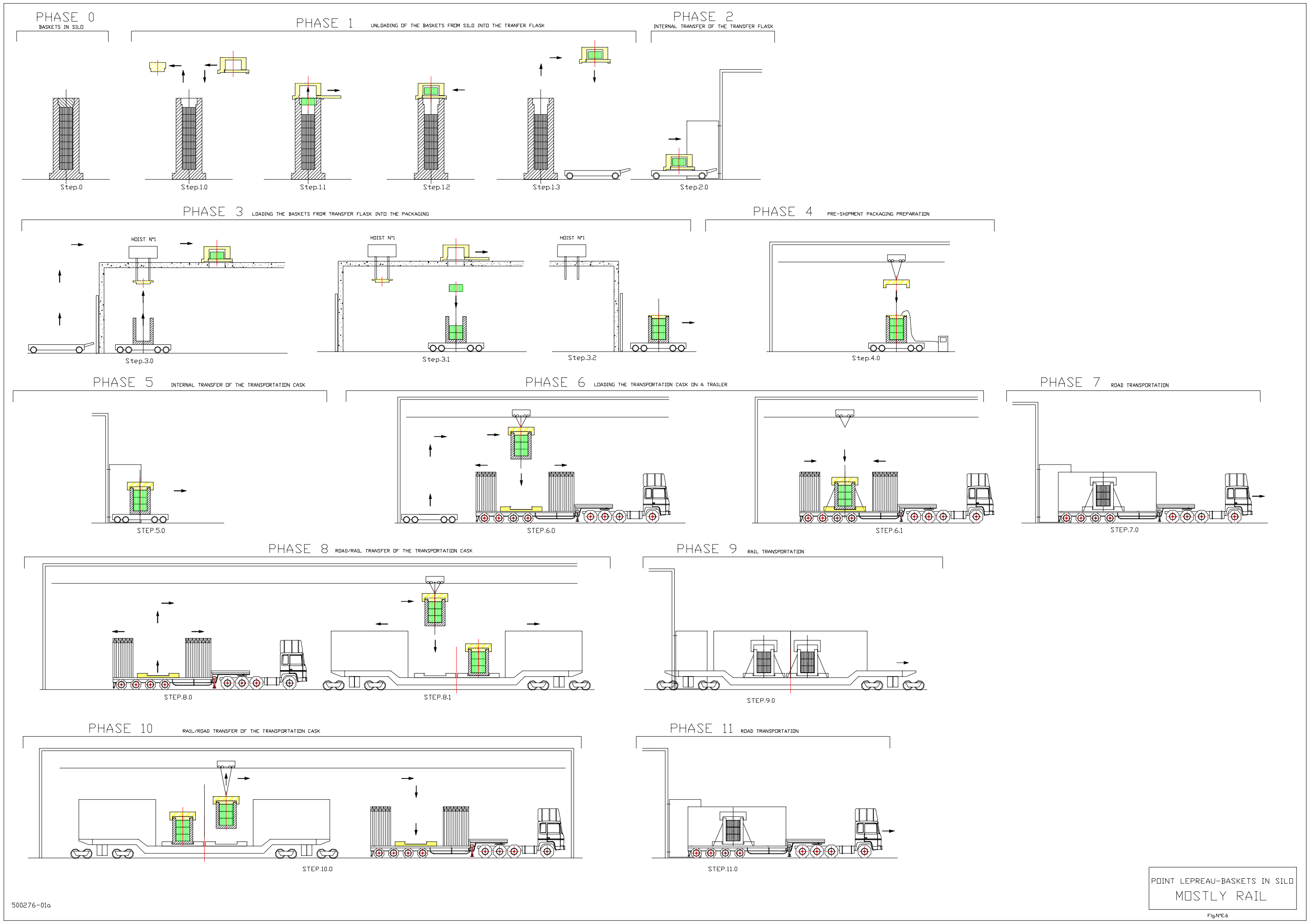
6.9. Table: Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° E.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	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	3.0
				Lifting Beam for Transfer flask		3.0
			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	3.0
			Load the baskets into the packaging			3.1
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 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 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask and the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	6.0
			Open the weather cover	Weather cover		

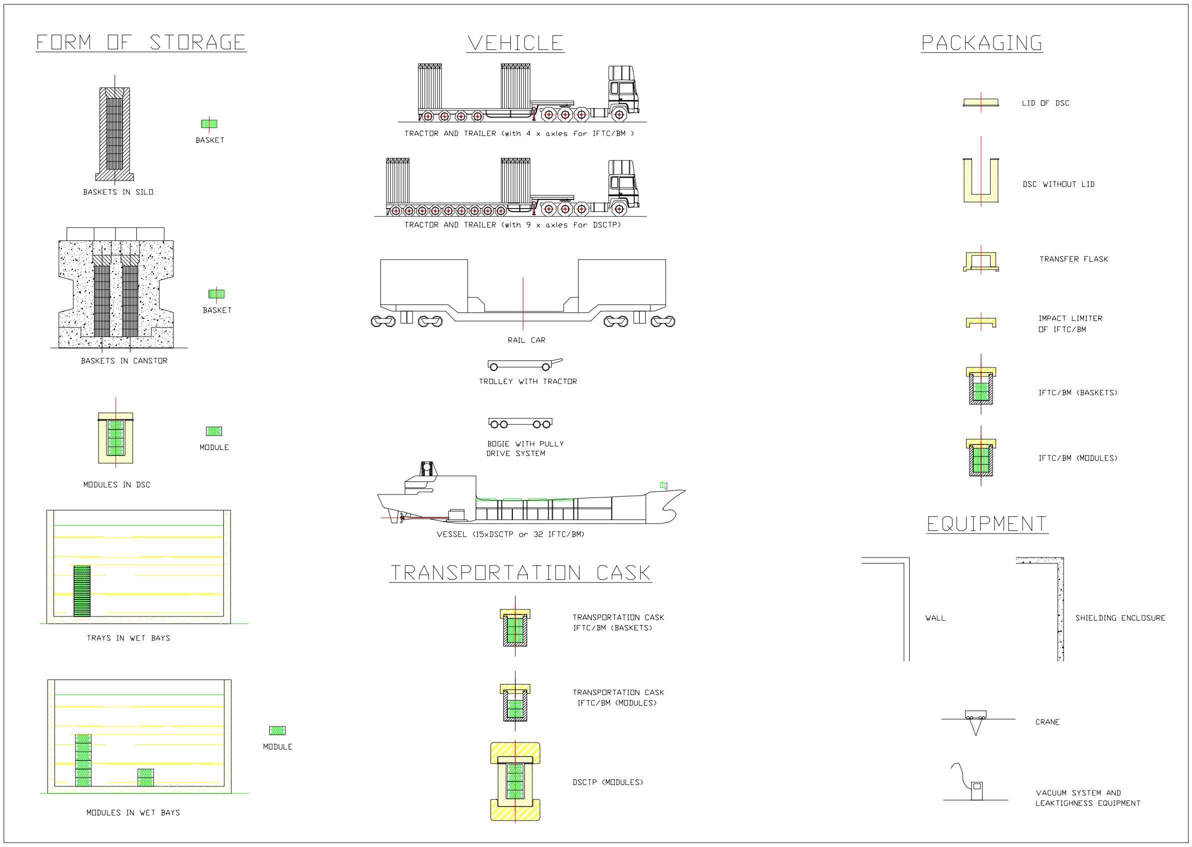
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.6
			Loading the Transportation cask on a trailer	Gantry Crane	With 1 hoists (of 60 tons for the IFTC/BM)	
				Lifting Beam for the Trans-portation cask	To carry of the IFTC/BM (similar to the IFTC, **<3>)**	
				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	
				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 (Appendix A, Figure N°15, **<3>**)	
			Check the condition of Transportation cask, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the trailer and the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	
Phase 7	Road transportation	UFTS	Road transportation of the Transportation cask from facility to the road rail terminal			7.0
				Real Time Tracking	Appendix H	
Phase 8	Road/Rail transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask, the rail car	Non contamination, Dose Rate	“Smear test”, Radiameter	8.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the trailer to the rail car	Gantry Crane	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>)**	
				Rail car (Appendix A, Figure N°16 **<3>**)	- The train is dedicated to movement of used fuel under exclusive use conditions; - Use of depressed centre, flat bed car; **-** Each flat car is loaded with two Transportation casks; - Each train equipped with locomotive and caboose; - The locomotive is assumed to have sufficient power to safely and efficiently haul the load.	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.6
			Packaging tie-down on the rail car	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**) but for rail	
			Check the condition of the packaging, rail car			
			Fit the transport seals			
			Close the weather cover of the rail car	Weather cover		
			Radiological control of the rail car and the transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 9	Rail transportation	UFTS	Rail transportation of the Transportation cask from the road rail terminal to the rail road terminal			9.0
				Real Time Tracking	Appendix H	
Phase 10	Rail/Road transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask, the rail car and the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	7.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the rail car to the trailer	Gantry Crane	With 2 hoists (of 60 tons for the IFTC/BM)	
				Lifting Beam for Transportation cask	To carry of the IFTC/BM (similar to the IFTC, **<3>)**	
				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 for 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 (Appendix A, Figure N°15, **<3>**)	
			Check the condition of the packaging, trailer			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the trailer and 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° E.6
Phase 11	Road transportation	UFTS	Road transportation of the Transportation cask from rail road terminal to the Centralised site			11.0
Phase 12	Unloading of the Transportation cask	DGR/CES	Unloading of the Transportation cask from the rail car			


PHASE 0
BASKETS IN SILO
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
HOIST N°1
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 TRANSPORTATION CASK
STEP.5.0
PHASE 6
LOADING THE TRANSPORTATION CASK ON A TRAILER
STEP.6.0
STEP.6.1
PHASE 7
ROAD TRANSPORTATION
STEP.7.0
PHASE 8
ROAD/RAIL TRANSFER OF THE TRANSPORTATION CASK
STEP.8.0
STEP.8.1
PHASE 9
RAIL TRANSPORTATION
STEP.9.0
PHASE 10
RAIL/ROAD TRANSFER OF THE TRANSPORTATION CASK
STEP.10.0
PHASE 11
ROAD TRANSPORTATION
STEP.11.0
500276-01a
POINT LEPREAU-BASKETS IN SILO
MOSTLY RAIL
Fig.N°E.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° 2 .

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)

Conceptual design of trailer and tractors (phase 6 of table paragraph 7.9)

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).

7.3.3. Trailer for the road transportation (phase 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

7.3.4. 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.

7.3.5. 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 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.

7.3.6. 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.

7.3.7. 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 installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 7.9)
  One for loading the Transportation 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 Transportation 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 3.7 of Chapter 3).

7.7. UFTS Transportation system operation

Loading of packages onto the trailers, 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

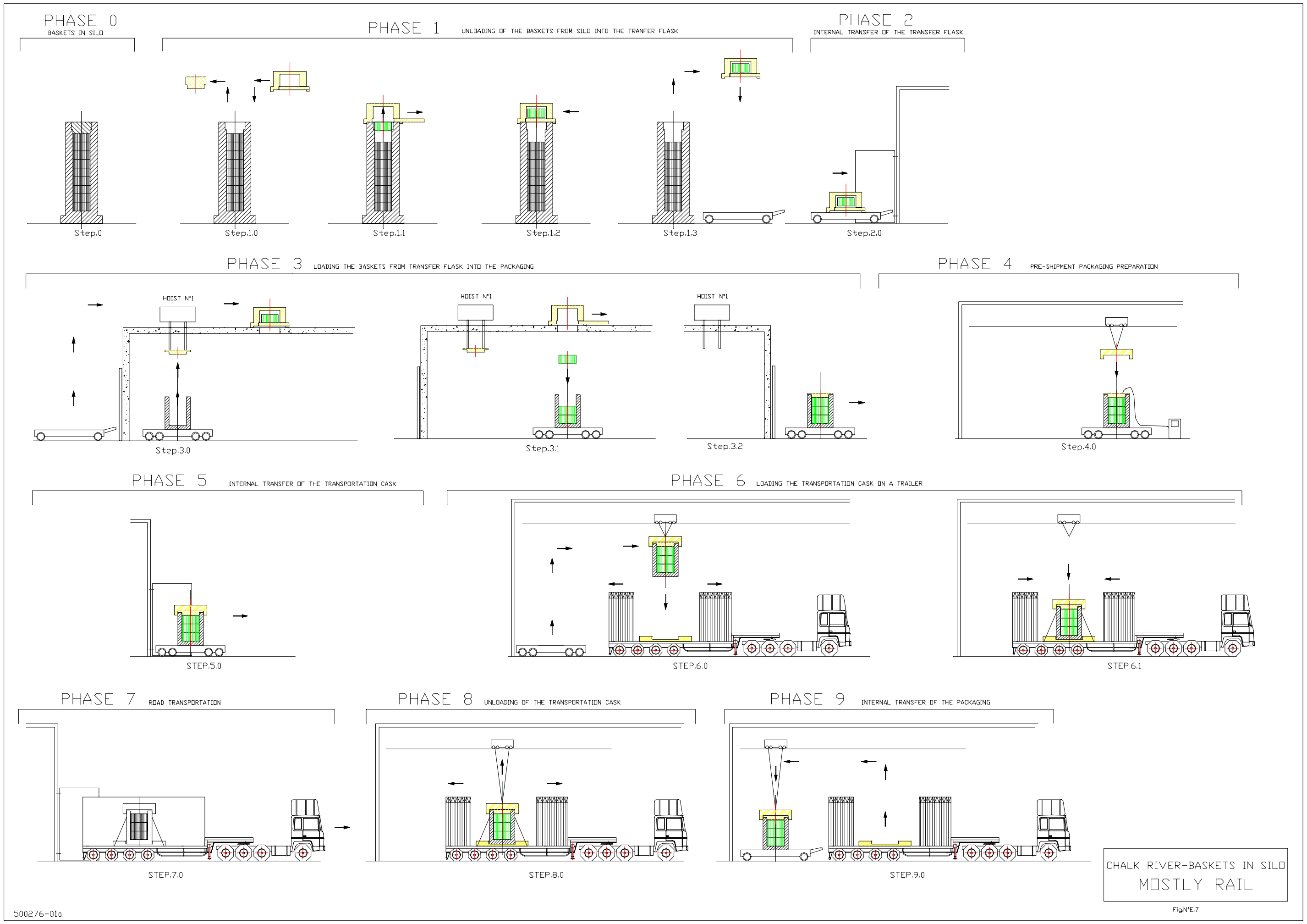
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

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 3.7 of Chapter 3).

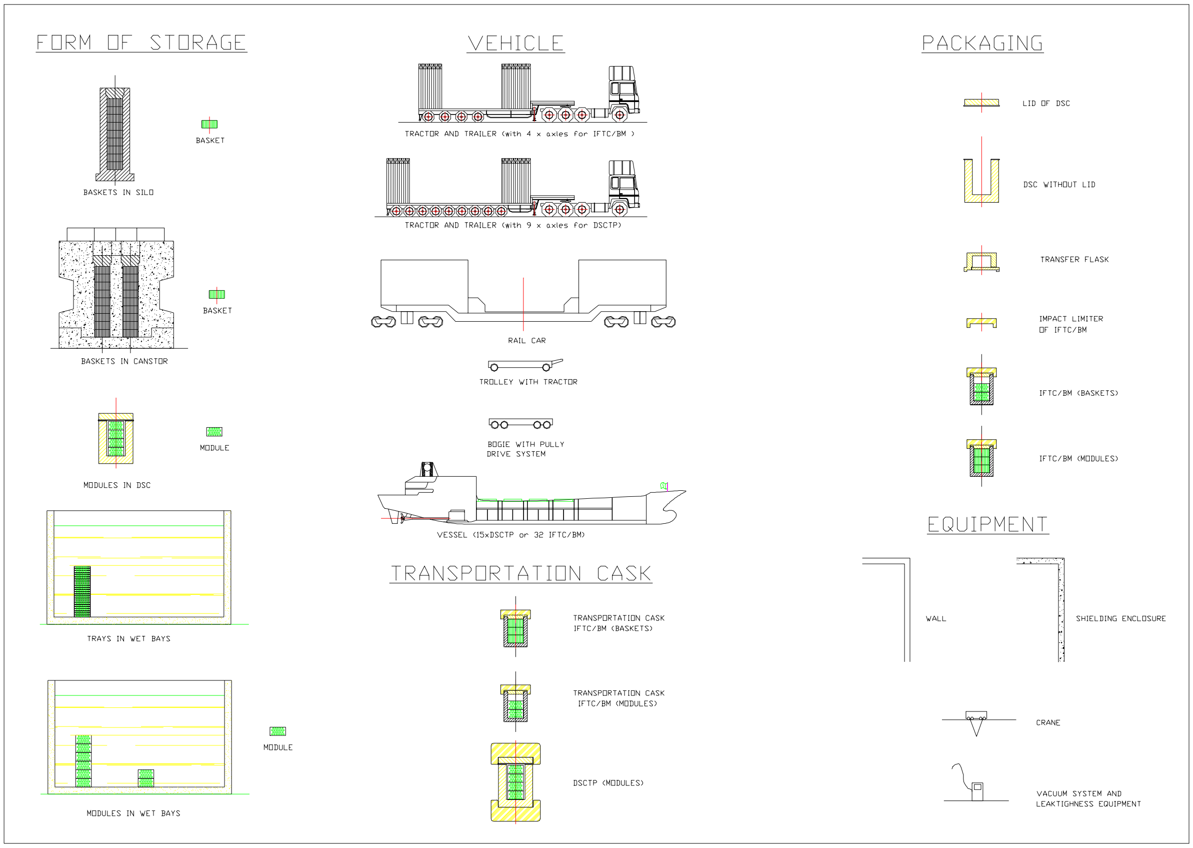
7.9. Table : Analysis of the operational phases of transport

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.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 a gantry crane , 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	3.0
				Lifting Beam for Transfer flask		3.0
			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	3.0
			Load the baskets into the packaging			3.1
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		
			Depressuring the cavity	Vacuum circuit		
			Installing the impact limiter	Lifting beam for the impact limiter		
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 trolley	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° E.7
Phase 6	Loading the Transportation cask on a trailer	UFTS	Radiological control of the Transportation cask and 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 hoists (of 60 tons for the IFTC/BM)	6.0
				Lifting Beam for the Transportation cask	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 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 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				9.0
Phase 10	Unloading the baskets from the Transportation cask	DGR/CES				
Phase 11	Storage of the baskets on 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
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 RAIL
500276-01a
Fig.N°E.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° 2.

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.

Rail: Rail transport from the Gentilly sites is possible [**<52>**, **<53>**, **<56>**, **<58>**, **<54>**, and **<57>**]. There is no operating rail line into the facility. It would therefore be necessary to either extend the line to Gentilly (the site map indicates a rail line just outside the one kilometer exclusion zone) or to transport loaded casks from the site by road to the rail line where it would also be necessary to construct the necessary transfer and loading station (including equipping the site with necessary lift power).

The volumes of used fuel to be transferred from the Gentilly site could benefit from the consolidation opportunities presented by rail.

Creation of a rail road terminal:

Example given Appendix G: Example of the COGEMA LOGISTICS road rail Terminal at Valognes.

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 trailer.

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. 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 or air ride suspension to cushion the load
- Trailer equipped with four axles

- One loaded cask per trailer
- 2 drivers and no escort

8.1.3.4. 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.

8.1.3.5. 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.

8.1.3.6. 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.

8.1.3.7. 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

8.1.3.8. Rail car (phase 6 of table paragraph 8.1.9)

The sample rail transportation system is predicated on the following elements:

- The train is dedicated to movement of used fuel under exclusive use conditions;
- Use of depressed center, flat bed car see Appendix A, Figure N°13;
- Each flat car is loaded with two IFTC/BMs or one DSCTP;
- Each train equipped with locomotive and caboose;
- The locomotive is assumed to have sufficient power to safely and efficiently haul the load.

8.1.3.9. Weather cover for the rail transportation (phase 6 of table paragraph 8.1.9)

- Rolling removable aluminium weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. One man can manually open or close the weather cover which can roll on a rail fixed on the frame of the rail car.

- 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. The real time tracking system is placed on the two parts (See Appendix H).

8.1.3.10. Frame or support of the Transportation cask for the rail transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the frame of the rail car. This frame is fixed on the frame of the rail car with calculated fixations in the three directions to follow the regulations concerning the accelerations. The weather cover can rolls on a rail fixed on the frame of the rail car. A drip pan is installed under the frame of the rail car 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.

8.1.3.11. Specific equipment for the road transportation

- GPS antenna (tracking) on the rail car (Appendix H)
- 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).

- Maintenance equipment for Rail car: shared facility at the centralised site (see paragraph 3.4 of Chapter 3).

8.1.5. Casks

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

- Tie-down: similar to the IFTC.

- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 5 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 installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 8.1.9)
  One for loading the Transportation cask on the rail car (see phase 6 of table paragraph 8.1.9)
  One for loading the Transportation cask on the tariler (see phase 8 of table paragraph 8.1.9)

- Lifting beam :
  One for the Transfer flask (see phase 3 of table paragraph 8.1.9)
  One for the Transportation cask (see phase 6 of table paragraph 8.1.9)
  One for the impact limiter of the packaging (see phase 4 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 rail car, trailer, security, transportation, emergency response:

- Loading of the Transportation cask onto the rail car, security, transportation as described in phase 6 of table paragraph 8.1.9.

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

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

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

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.

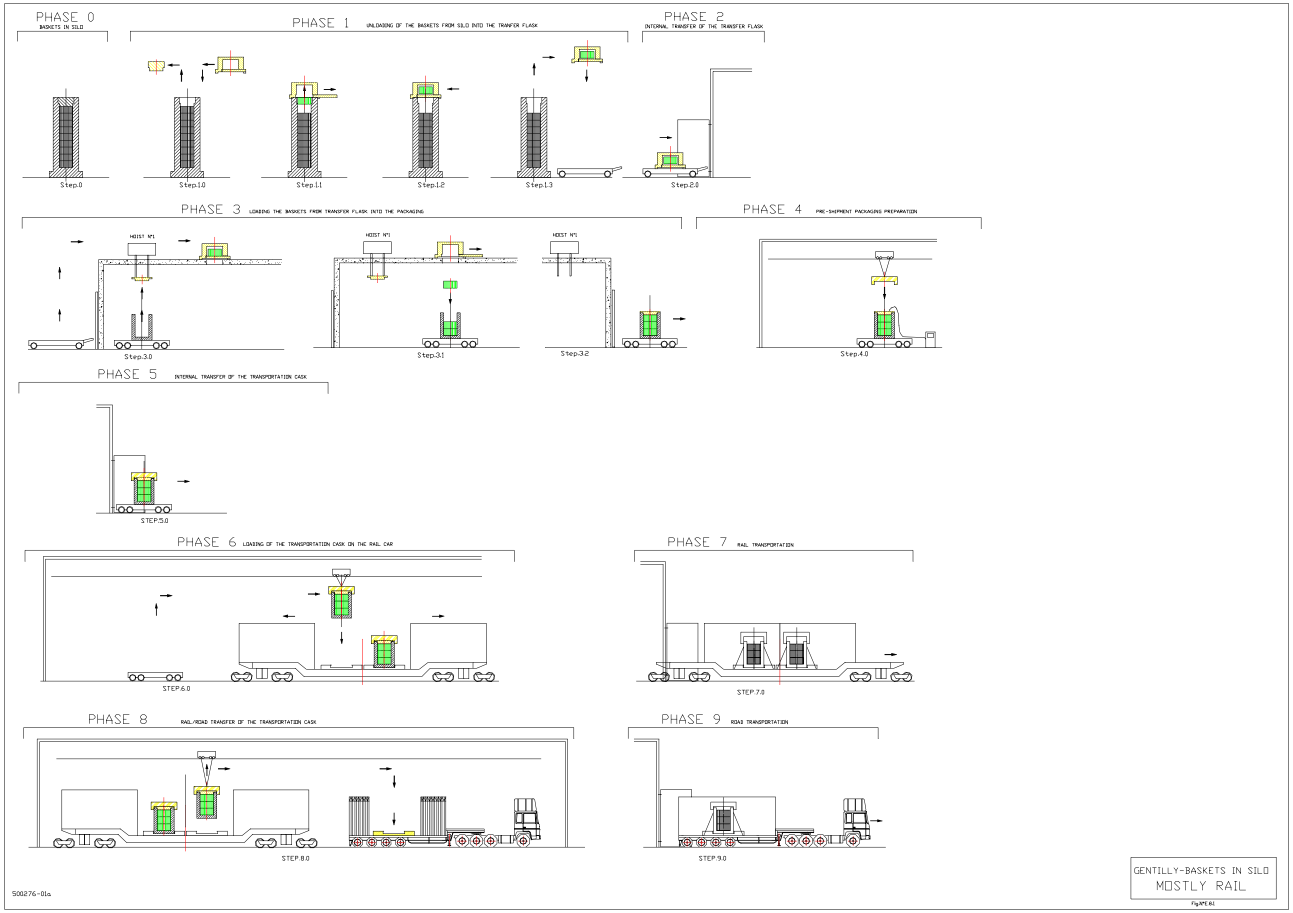
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2. of Chapter 3).

8.1.9. Table : Analysis of the operational phases of transport

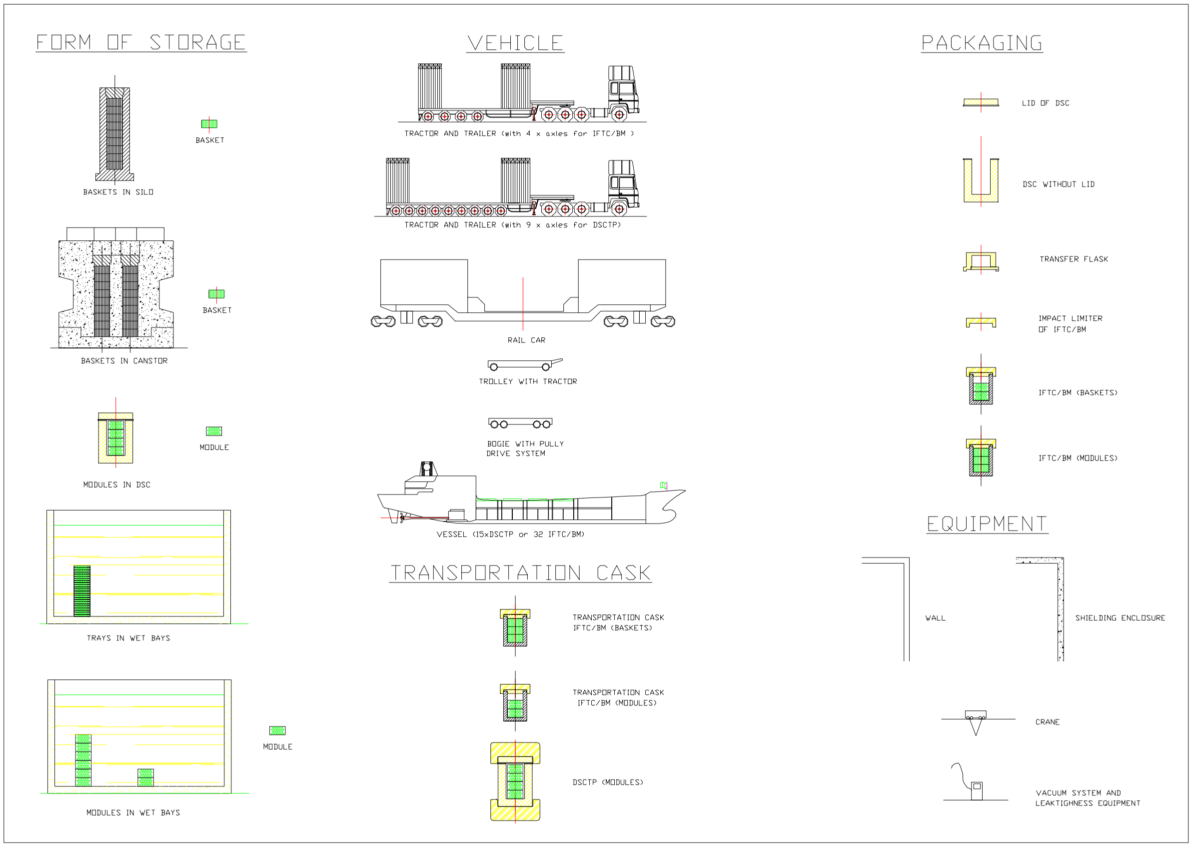
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.8.1
Phase 0	Baskets in Silo	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 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	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 Transfer flask		3.0
			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	3.0
			Load the baskets into the packaging			3.1
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	Lifting beam of 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 vehicle	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 Transportation cask the 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° E.8.1
Phase 6	Loading the Transportation cask on a rail car	UFTS	Radiological control of the Transportation cask and the rail car	Non contamination, Dose Rate	"Smear test", Radiameter	6.0
			Open the weather cover	Weather cover		
			Loading the Transportation cask on a rail car	Gantry Crane	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>)**	
				Rail car (Appendix A, Figure 16 **<3>**)	- The train is dedicated to movement of used fuel under exclusive use conditions; - Use of depressed centre, flat bed car; - Each flat car is loaded with two Transportation casks; - Each train equipped with locomotive and caboose; - The locomotive is assumed to have sufficient power to safely and efficiently haul the load.	
			Packaging tie-down on the rail car	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**)	
			Check the condition of the Transportation cask , rail car			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the rail car and the Transportation cask	Non contamination, Dose Rate	"Smear test", Radiameter	
Phase 7	Rail transportation	UFTS	Rail transportation of the Transportation cask from the site to the rail road terminal			7.0
				Real Time Tracking	Appendix H	
Phase 8	Rail/Road transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask, the rail car and the trailer	Non contamination, Dose Rate	"Smear test", Radiameter	8.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the rail car to the trailer	Gantry Crane	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>)**	
				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	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.8.1
				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 (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			
			Radiological control of 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 rail 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
HOIST N°1
HOIST N°1
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 TRANSPORTATION CASK
STEP.5.0
PHASE 6
LOADING OF THE TRANSPORTATION CASK ON THE RAIL CAR
STEP.6.0
PHASE 7
RAIL TRANSPORTATION
STEP.7.0
PHASE 8
RAIL/ROAD TRANSFER OF THE TRANSPORTATION CASK
STEP.8.0
PHASE 9
ROAD TRANSPORTATION
STEP.9.0
500276-01a
GENTILLY-BASKETS IN SILO
MOSTLY RAIL
Fig.N°E.8.1

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° 2.

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.

Rail: Rail transport from the Gentilly sites is possible [**<52>**, **<53>**, **<56>**, **<58>**, **<54>**, and **<57>**]. There is no operating rail line into the facility. It would therefore be necessary to either extend the line to Gentilly (the site map indicates a rail line just outside the one kilometer exclusion zone) or to transport loaded casks from the site by road to the rail line where it would also be necessary to construct the necessary transfer and loading station (including equipping the site with necessary lift power).

The volumes of used fuel to be transferred from the Gentilly site could benefit from the consolidation opportunities presented by rail.

Creation of a rail road terminal:

Example given Appendix G: Example of the COGEMA LOGISTICS road rail Terminal at Valognes.

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 trailer.

See phases 3, 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 paragraph 8.2.9).

8.2.3.3. Trailer for the road transportation (phase 8 of table paragraph 8.2.9)

- 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

8.2.3.4. Tractor for the road transportation (phase 8 of table paragraph 8.2.9)

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

8.2.3.5. Weather cover for the road transportation (phase 8 of table paragraph 8.2.9)

- 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.

8.2.3.6. 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.

8.2.3.7. 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

8.2.3.8. Rail car (phase 6 of table paragraph 8.2.9)

The sample rail transportation system is predicated on the following elements:

- The train is dedicated to movement of used fuel under exclusive use conditions;
- Use of depressed center, flat bed car see Appendix A, Figure N° 13;
- Each flat car is loaded with two IFTC/BMs or one DSCTP;
- Each train equipped with locomotive and caboose;
- The locomotive is assumed to have sufficient power to safely and efficiently haul the load.

8.2.3.9. Weather cover for the rail transportation (phase 6 of table paragraph 8.2.9)

- Rolling removable aluminium weather cover in order to protect the Transportation cask from rain and to not have a publicly Transportation cask. One man can manually open or close the weather cover which can rolls on a rail fixed on the frame of the rail car.

- 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. The real time tracking system is placed on the two parts (See Appendix H).

8.2.3.10. Frame or support of the Transportation cask for the rail transportation

Specific frame to fix the Transportation cask and to have an evenly distributed load on the frame of the rail car. This frame is fixed on the frame of the rail car with calculated fixations in the three directions to follow the regulations concerning the accelerations. The weather cover can rolls on a rail fixed on the frame of the rail car. A drip pan is installed under the frame of the rail car 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.

8.2.3.11. Specific equipment for the road transportation

- GPS antenna (tracking) on the rail car (Appendix H)
- 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).

- Maintenance equipment for Rail car: shared facility at the centralised site (see paragraph 3.4 of Chapter 3).

8.2.5. Casks

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

- Tie-down: similar to the IFTC.

- IFTC/BM: See chapter 2, section 2.4.7.1.3, Figure N° 5 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 8.2.9)

- Gantry Crane :
  One for installing the Transfer flask on the top of the hot cell (see phase 3 of table paragraph 8.2.9)
  One for loading the Transportation cask on the rail car (see phase 6 of table paragraph 8.2.9)
  One for loading the Transportation cask on the trailer (see phase 8 of table paragraph 8.2.9)

- Lifting beam :
  One for the Transfer flask (see phase 3 of table paragraph 8.2.9)
  One for the Transportation cask (see phase 6 of table paragraph 8.2.9)
  One for the impact limiter of the packaging (see phase 4 of table paragraph 8.2.9)

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

8.2.7. UFTS Transportation system operation

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

- Loading of packaging onto the rail car, security, transportation as described in phases 6 of table paragraph 8.2.9.

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

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

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

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.

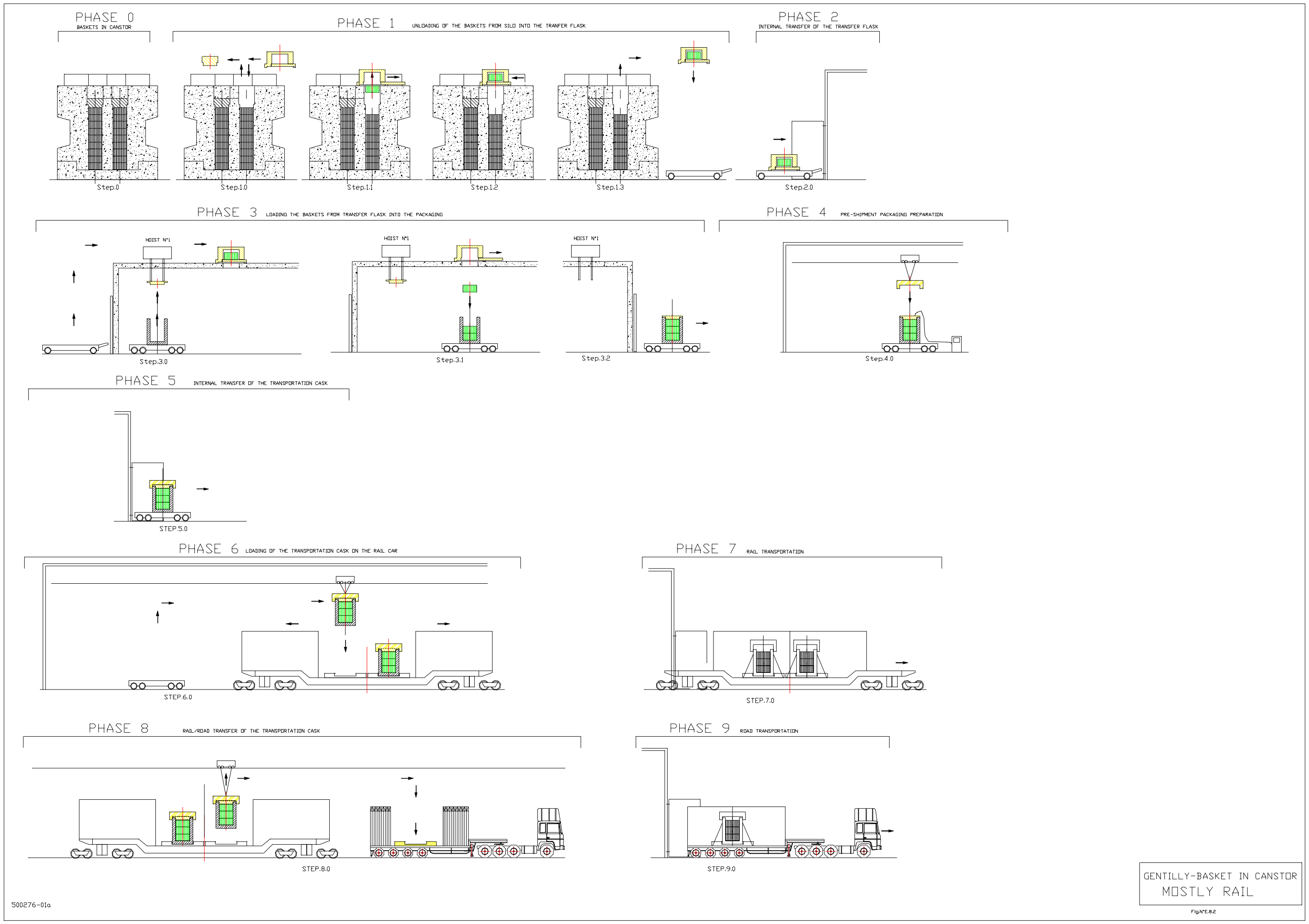
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

8.2.9. Table : Analysis of the operational phases of transport

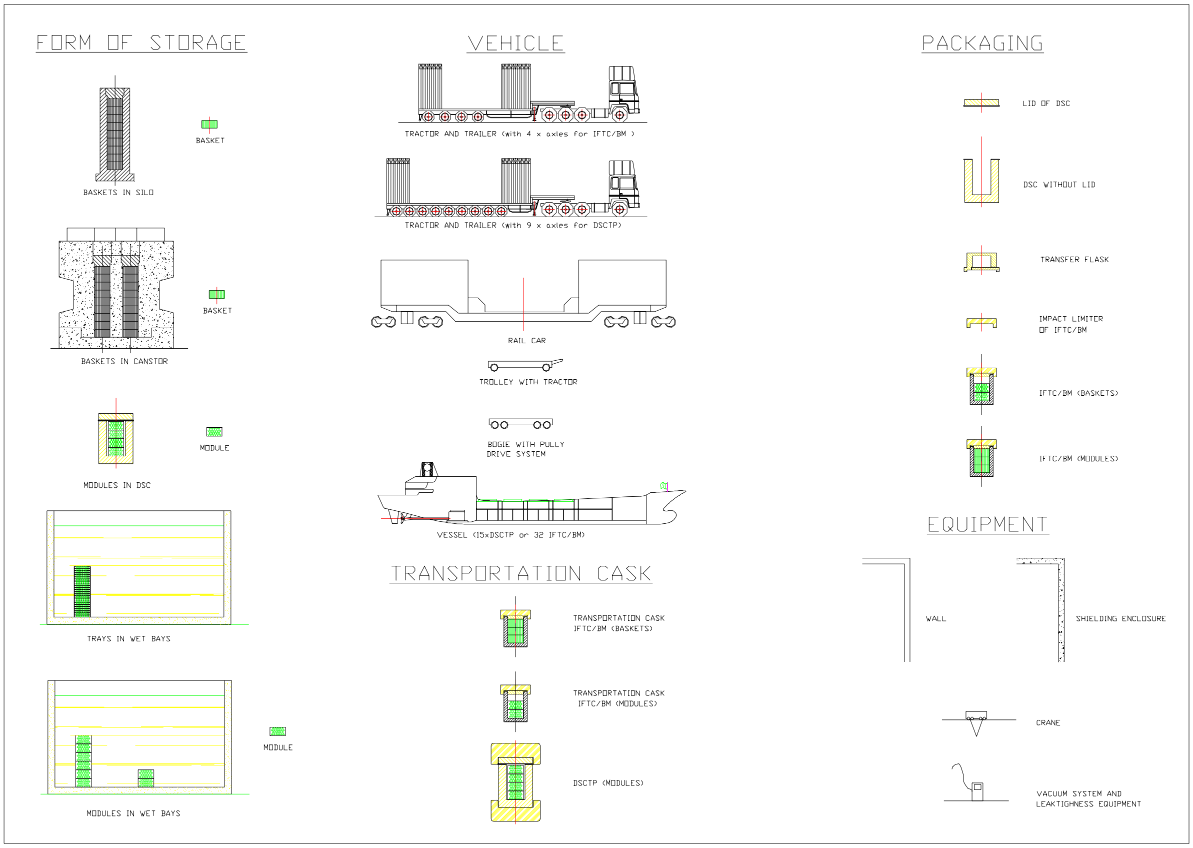
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.8.2
Phase 0	Baskets in Canstor	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 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	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	3.0
				Lifting Beam for Transfer flask		3.0
			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	3.0
			Load the baskets into the packaging			3.1
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	Lifting beam of 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 vehicle	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 Transportation cask the 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° E.8.2
Phase 6	Loading the Transportation cask on a rail car	UFTS	Radiological control of the Transportation cask and the rail car	Non contamination, Dose Rate	“Smear test”, Radiameter	6.0
			Open the weather cover	Weather cover		
			Loading the Transportation cask on a rail car	Gantry Crane	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>)**	
				Rail car (Appendix A, Figure 16 **<3>**)	- The train is dedicated to movement of used fuel under exclusive use conditions; - Use of depressed centre, flat bed car; - Each flat car is loaded with two Transportation casks; - Each train equipped with locomotive and caboose; - The locomotive is assumed to have sufficient power to safely and efficiently haul the load.	
			Packaging tie-down on the rail car	Tie down	Similar to the Tie down of the IFTC (Appendix A, Figure N°15, **<3>**)	
			Check the condition of the Transportation cask , rail car			
			Fit the transport seals			
			Close the weather cover	Weather cover		
			Radiological control of the rail car and the Transportation cask	Non contamination, Dose Rate	“Smear test”, Radiameter	
Phase 7	Rail transportation	UFTS	Rail transportation of the Transportation cask from the site to the rail road terminal			7.0
				Real Time Tracking	Appendix H	
Phase 8	Rail/Road transfer of the Transportation cask	UFTS	Radiological control of the Transportation cask, the rail car and the trailer	Non contamination, Dose Rate	“Smear test”, Radiameter	8.0
			Open the weather covers of the trailer and of the rail car	Weather covers		
			Loading the packaging from the rail car to the trailer	Gantry Crane	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>)**	
				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	

PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° E.8.2
				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 (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			
			Radiological control of 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 rail 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
HOIST N°1
Step.3.1
HOIST N°1
Step.3.2
PHASE 4
PRE-SHIPMENT PACKAGING PREPARATION
Step.4.0
PHASE 5
INTERNAL TRANSFER OF THE TRANSPORTATION CASK
STEP.5.0
PHASE 6
LOADING OF THE TRANSPORTATION CASK ON THE RAIL CAR
STEP.6.0
PHASE 7
RAIL TRANSPORTATION
STEP.7.0
PHASE 8
RAIL/ROAD TRANSFER OF THE TRANSPORTATION CASK
STEP.8.0
PHASE 9
ROAD TRANSPORTATION
STEP.9.0
500276-01a
GENTILLY-BASKET IN CANSTOR
MOSTLY RAIL
FigN°E.8.2

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

9. CENTRALISED SITE

Quantity of bundles to transport from 2035 to 2064: see Appendix A, Table N° 2.

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/CES 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).
- Maintenance equipment for rail cars: shared facility at the centralised site (see paragraph 3.4 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.

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

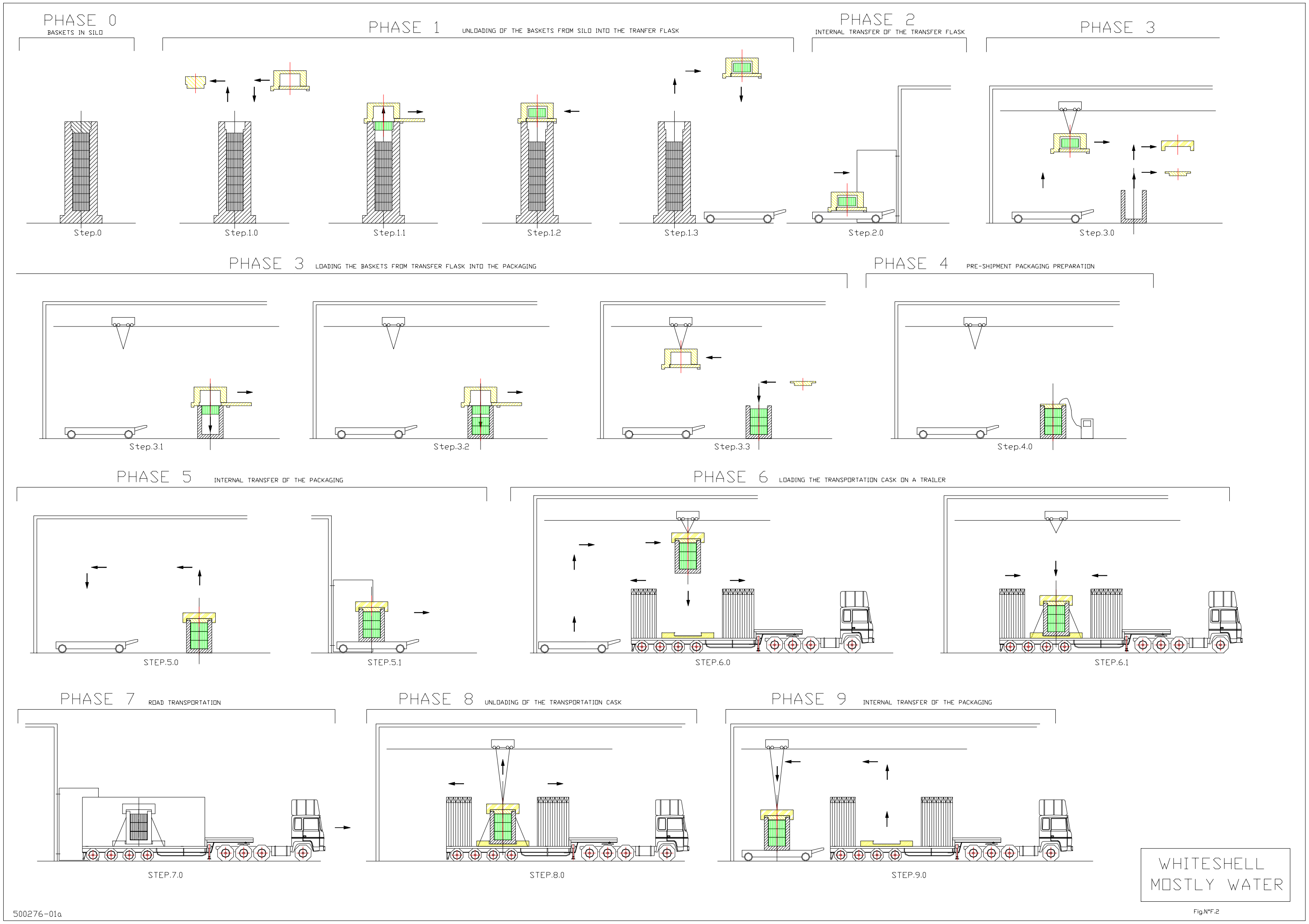
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.2
Phase 0	Baskets in Silo	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 2	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

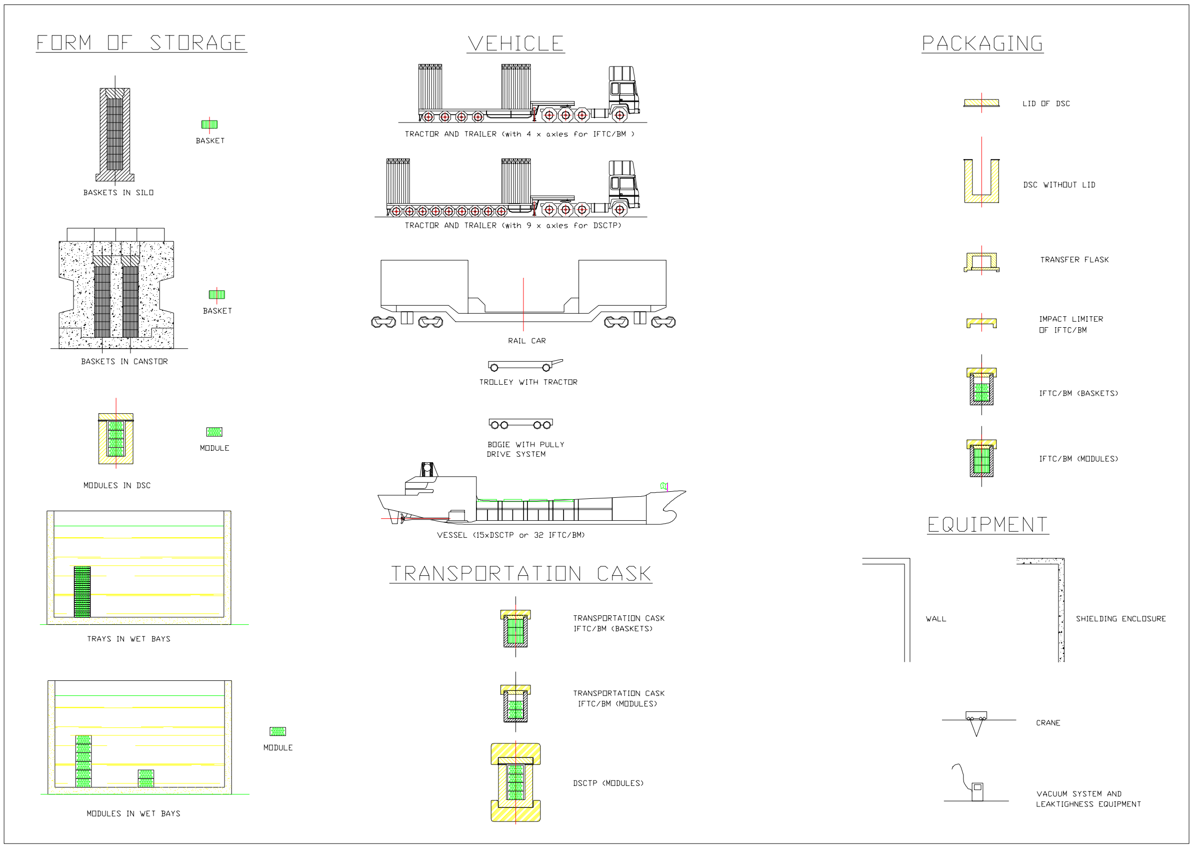
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.2
Cont'd Phase 7	Road transportation	UFTS	Road transportation of the Transportation cask from the Facility to the Centralised Facility			7.0
				Real time tracking	Appendix H	7.0
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
Fig.N°F.2
500276-01a

Key:


FORM OF STORAGE
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
BASKET
MODULES IN DSC
MODULE
TRAYS IN WET BAYS
MODULES IN WET BAYS
MODULE
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).

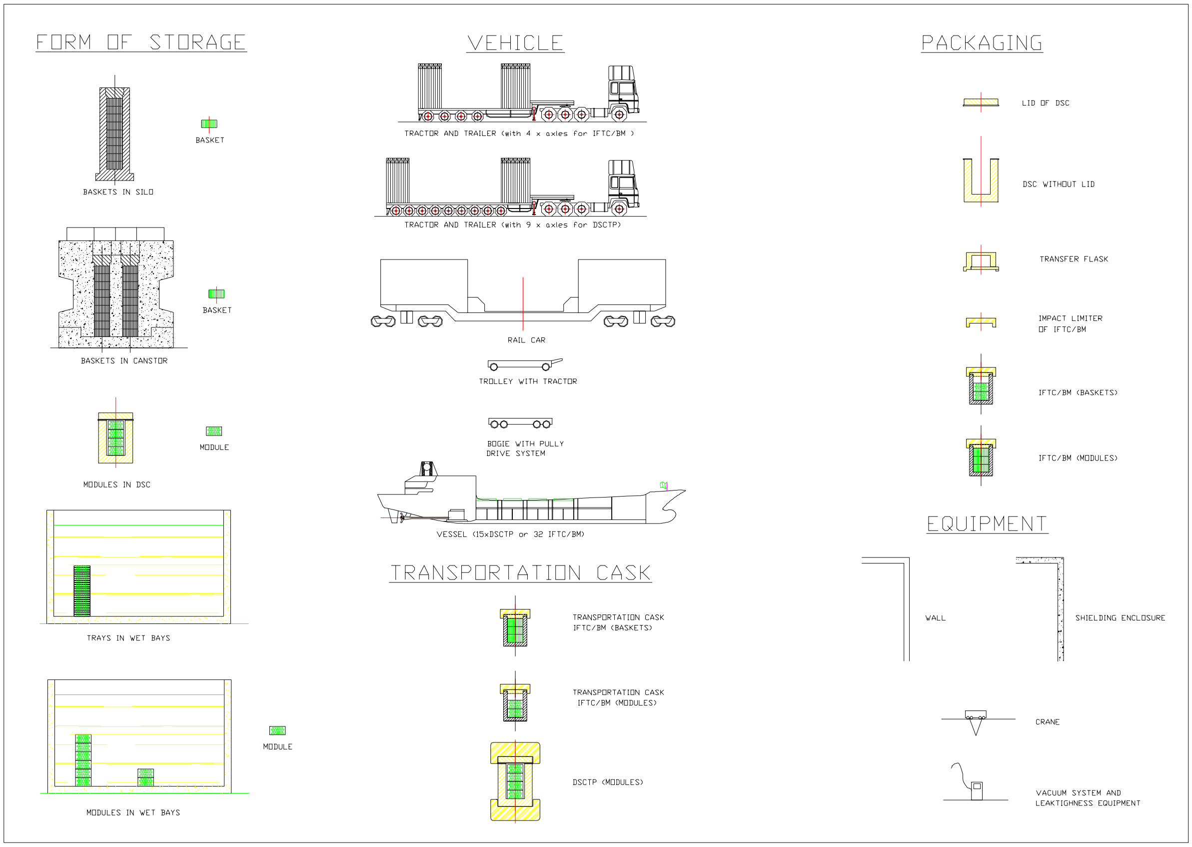
3.1.9. Table: Analysis of the operational phases of transport

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
Fig.N°F.31
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.

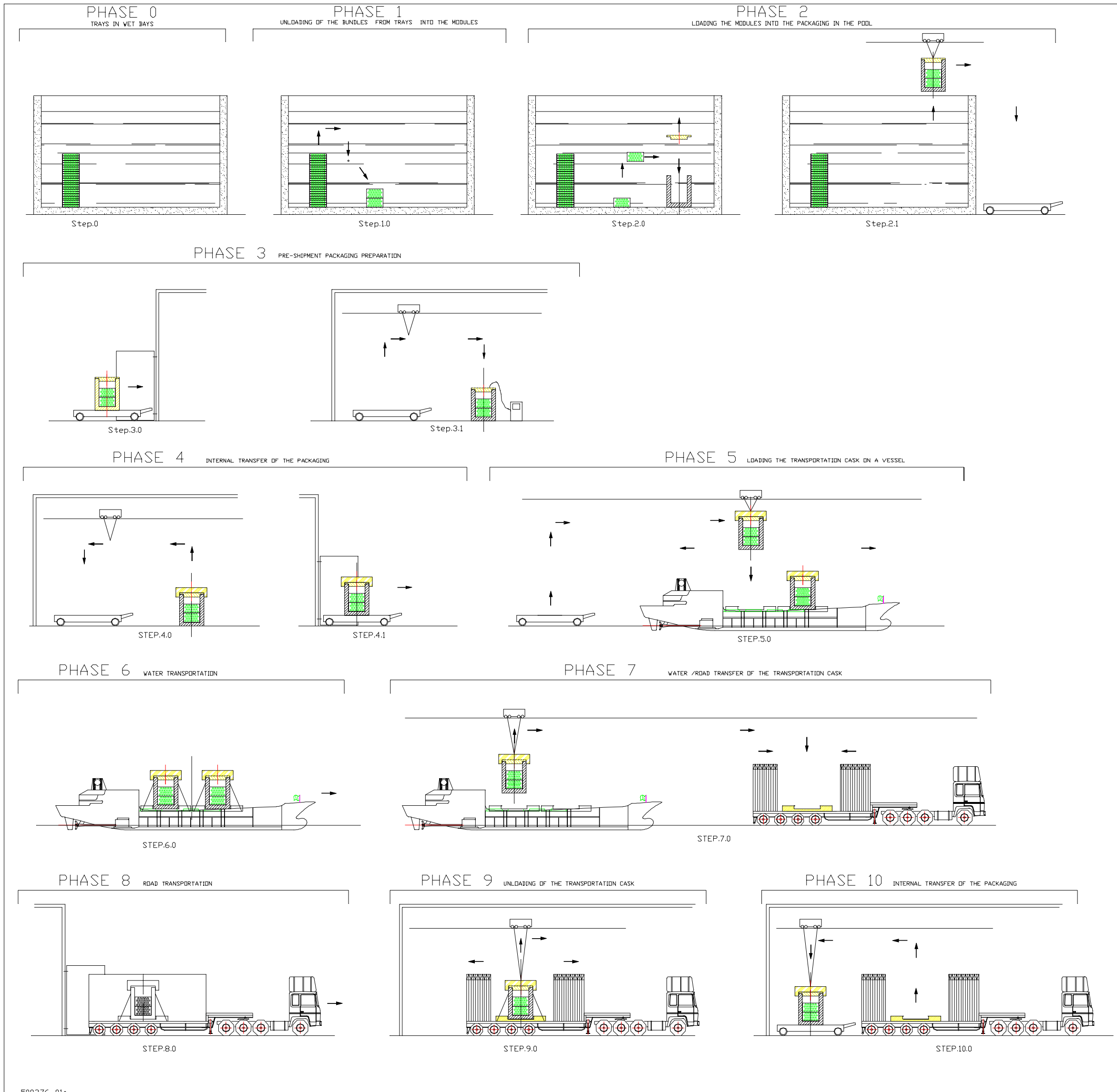
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

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	

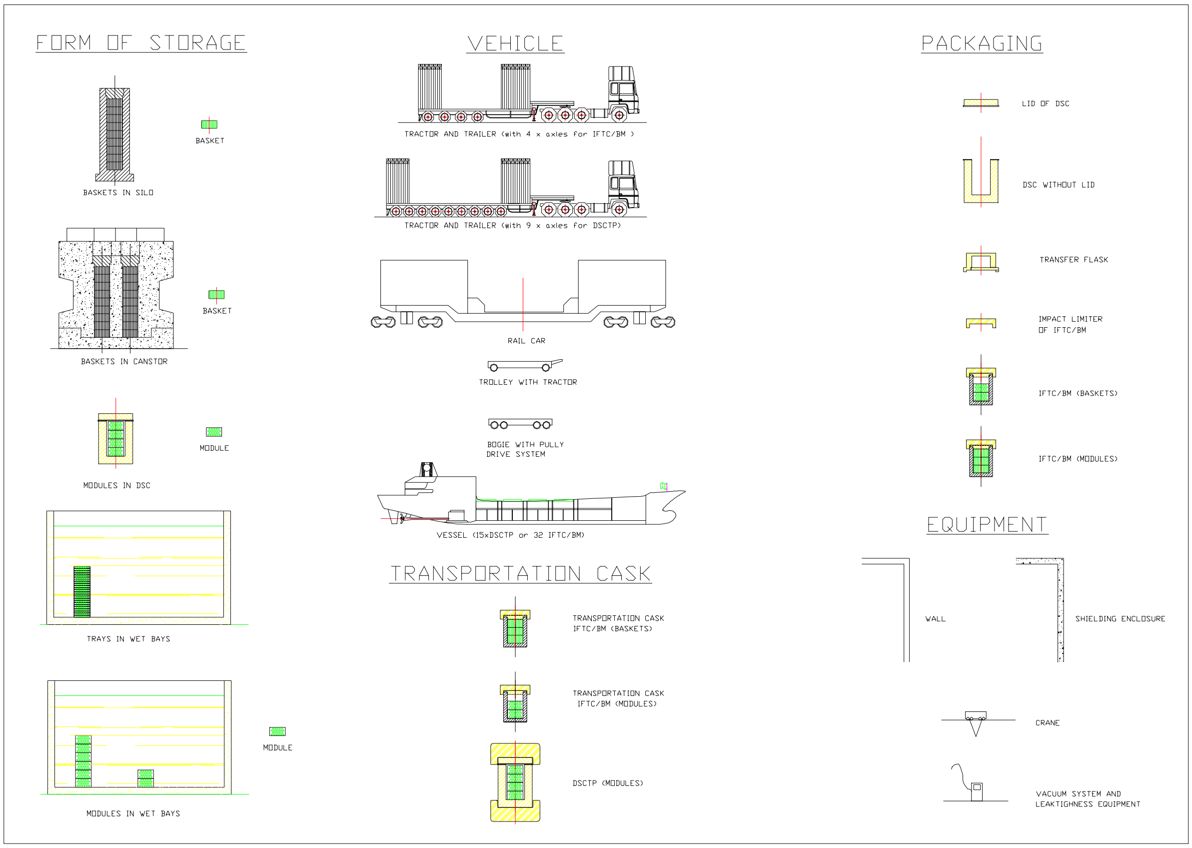
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.3.2
Phase 8	Road transportation	UFTS	Road transportation of the Transportation cask from the water road terminal to the Centralised Facility			8.0
				Real time Tracking	Appendix 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				



BRUCE-TRAYS IN WET BAYS
MOSTLY WATER

Fig.N°F.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.

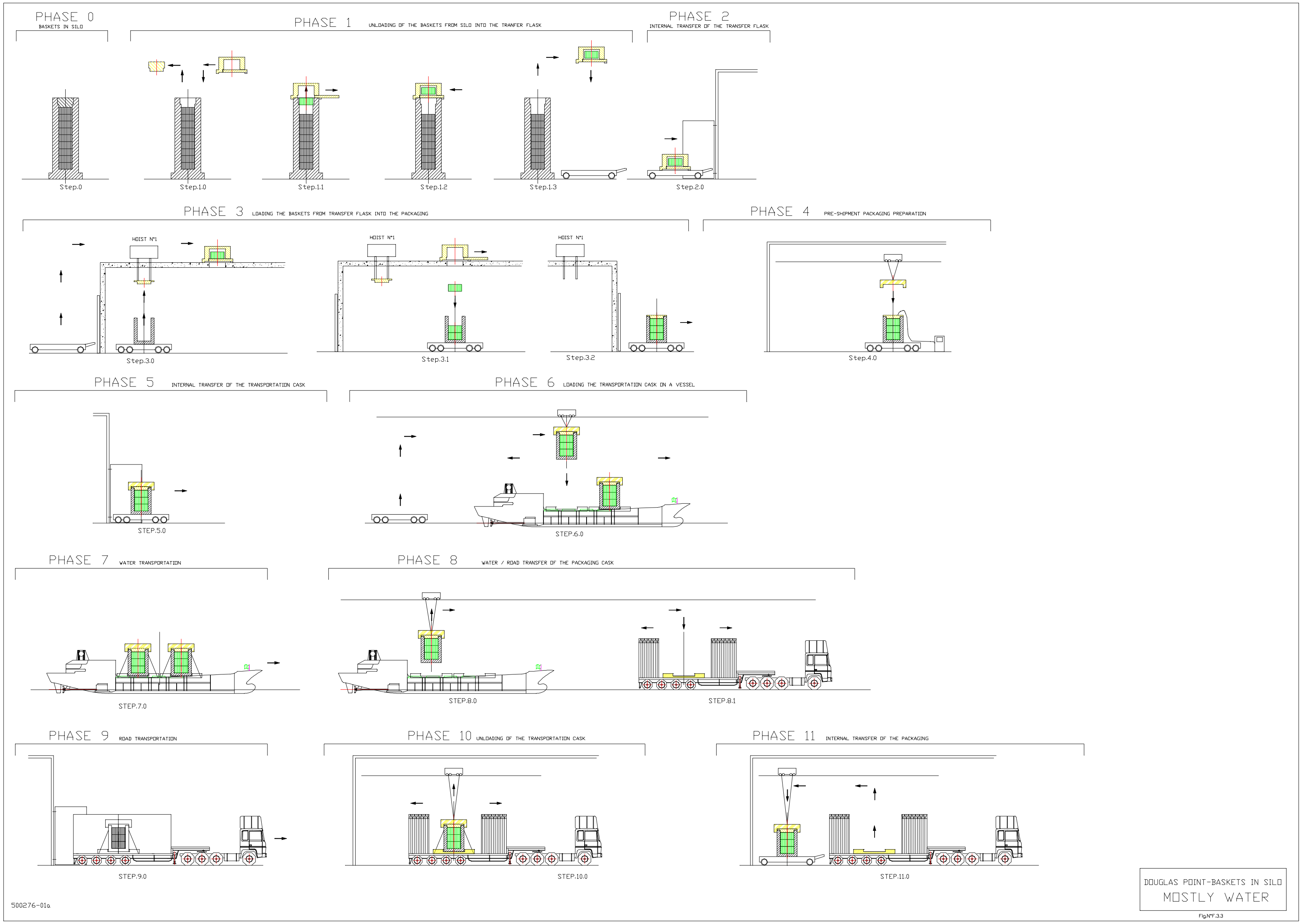
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

3.3.9. Table : Analysis of the operational phases of transport

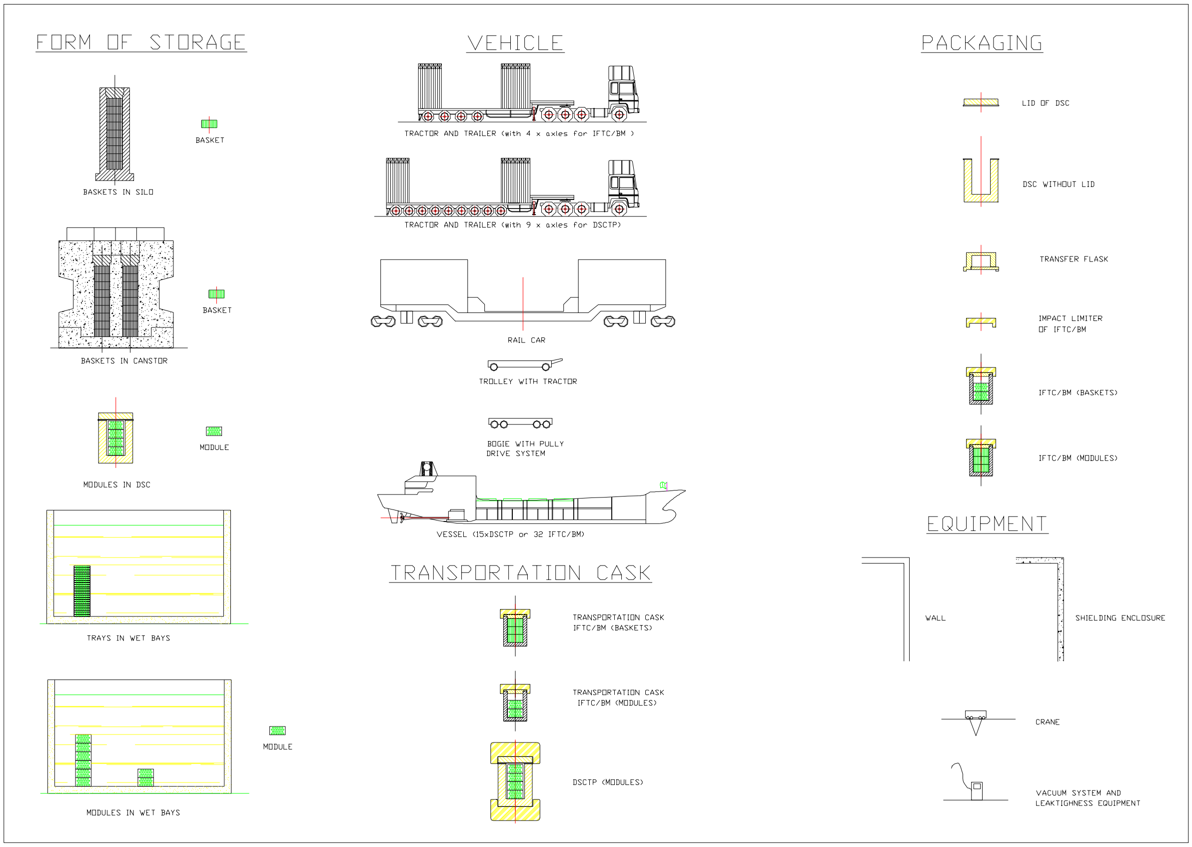
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.3.3
Phase 0	Baskets in Silo	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 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°F.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).

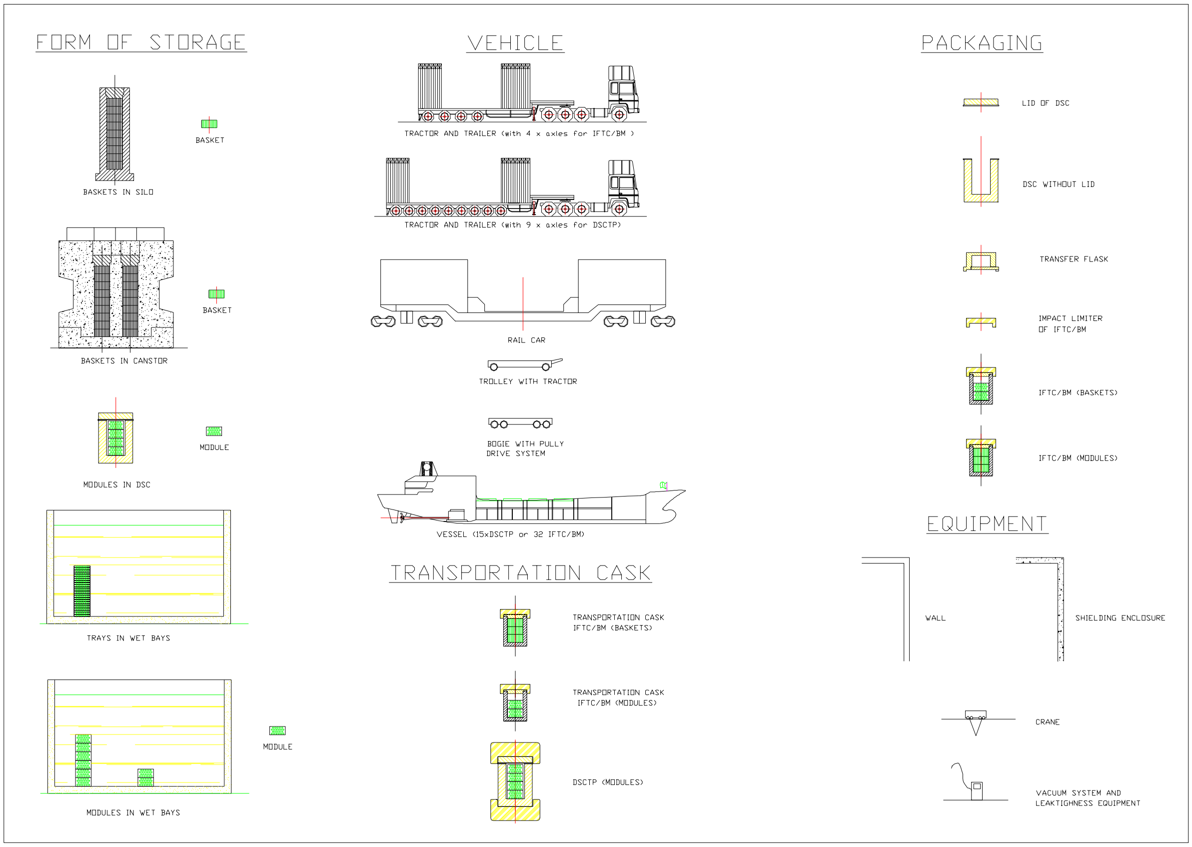
4.1.9. Table: Analysis of the operational phases of transport

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
Fig.N°F.4.1
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.

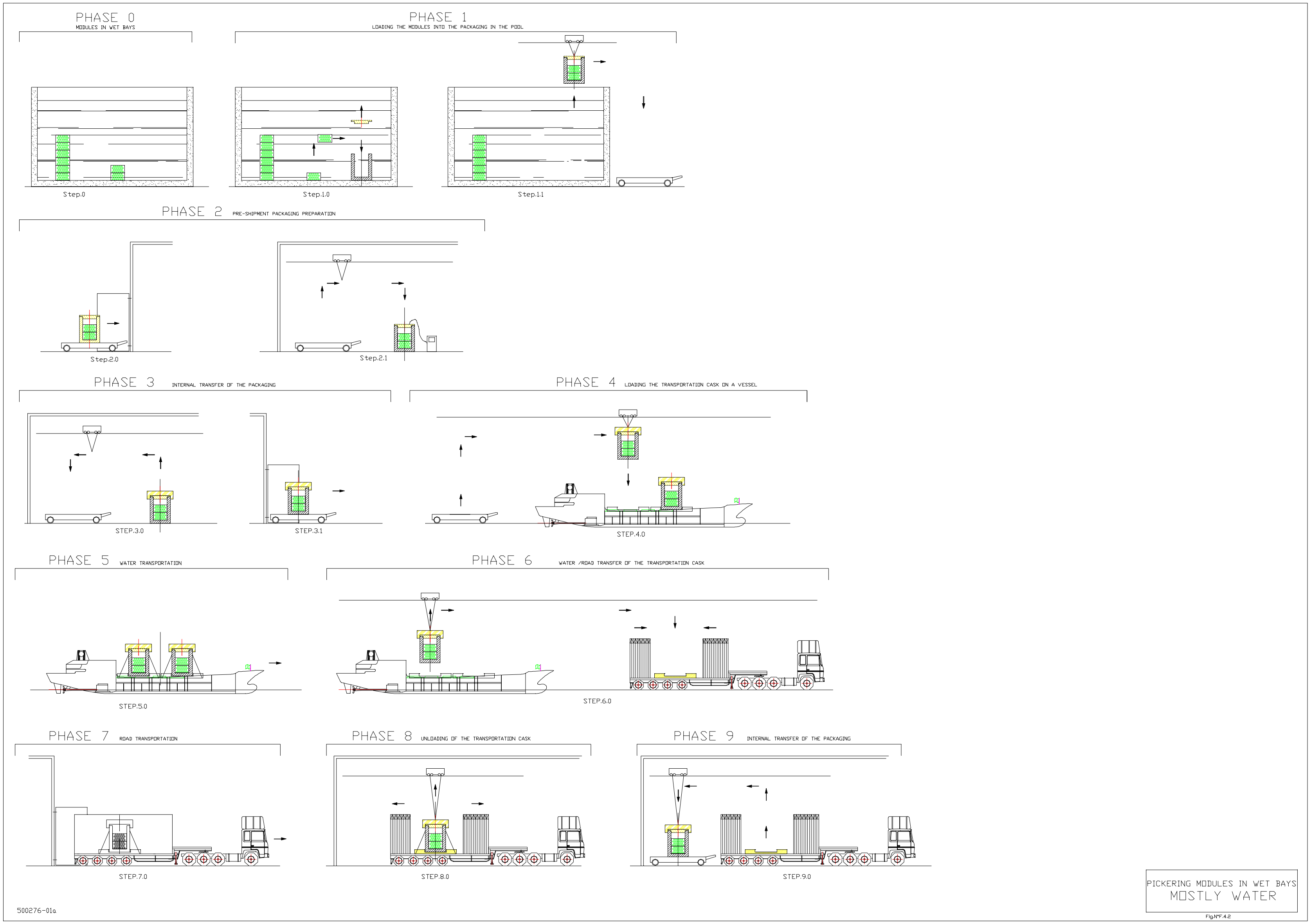
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

4.2.9. Table: Analysis of the operational phases of transport

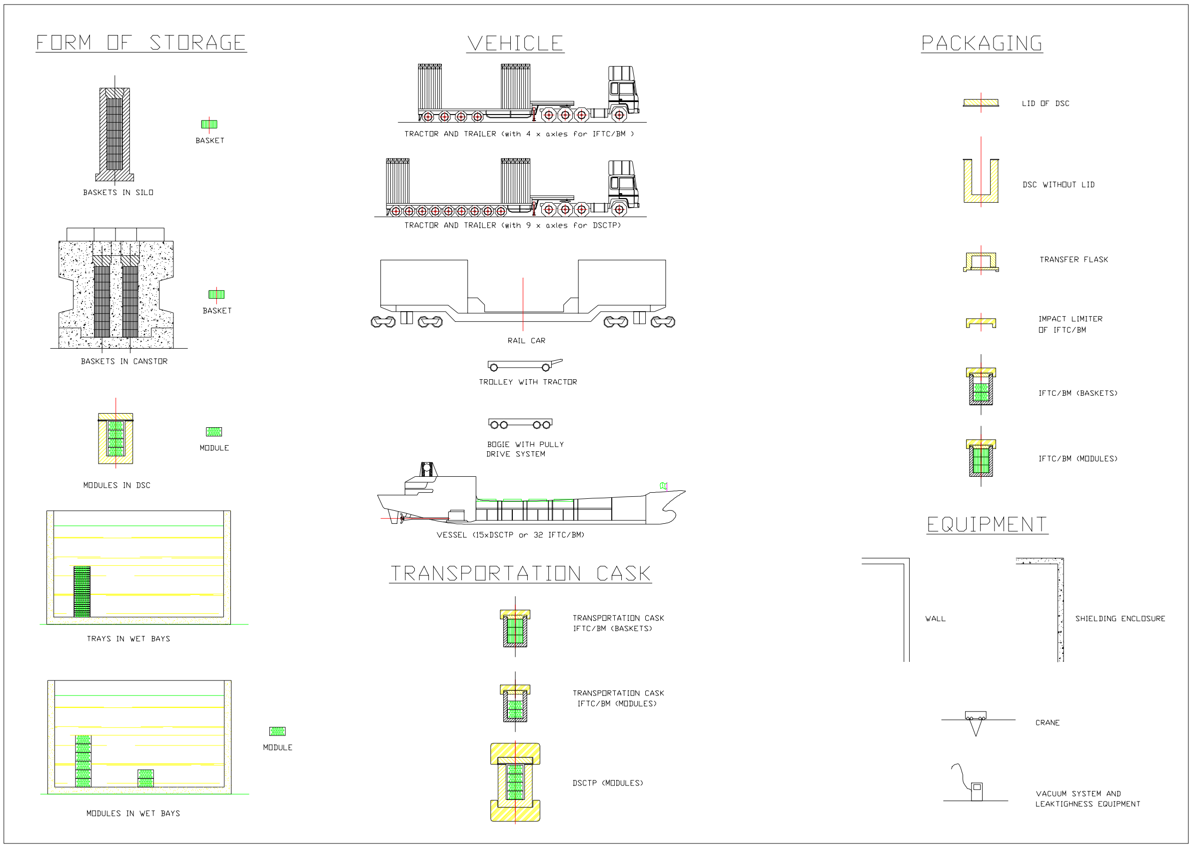
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F.4.2
Phase 0	Modules in wet bays	Interim storage	Initial phase			0
Phase 1	Loading the modules into the packaging in the pool	Interim UFTS	Loading the modules into the packaging 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
Fig.N°F.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).

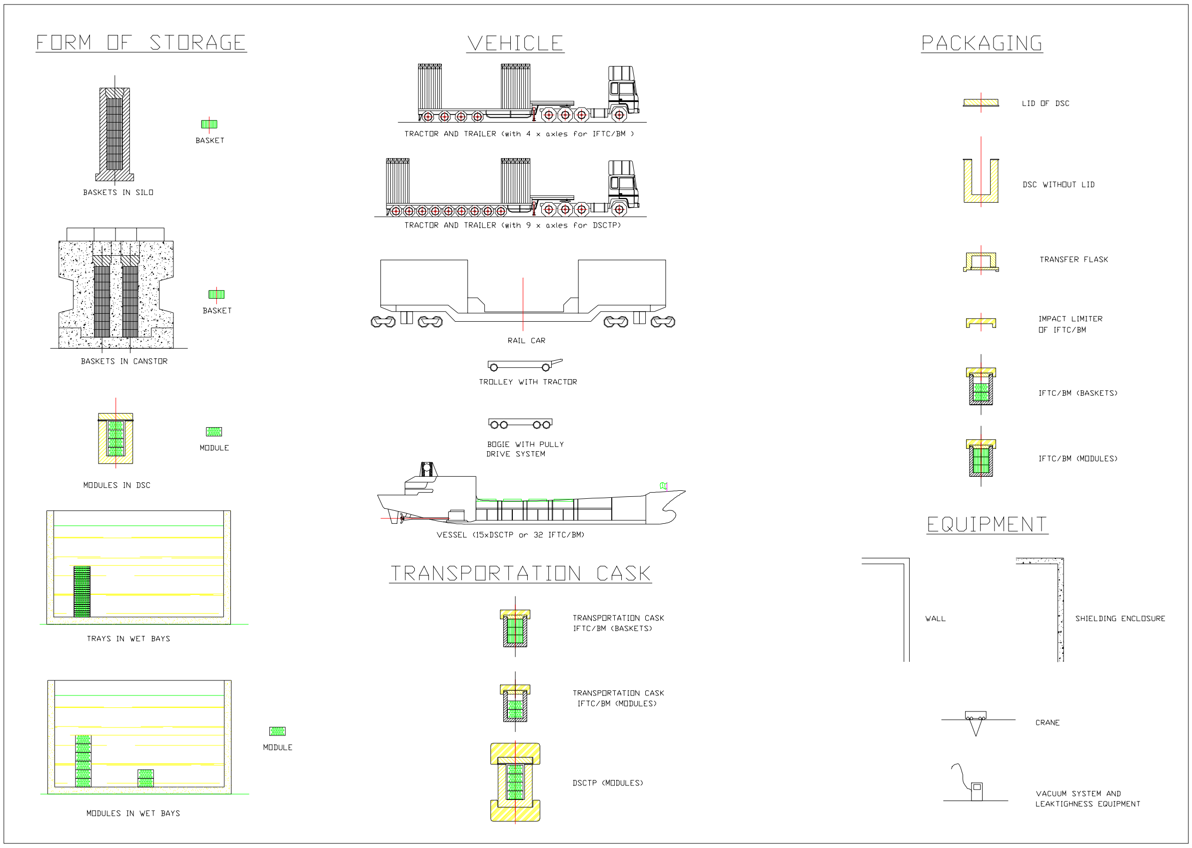
5.1.9. Table: Analysis of the operational phases of transport

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
Step.0
PHASE 1
INTERNAL TRANSFER OF DSC
Step.1.0
PHASE 2 PRE-SHIPMENT
Step.2.0
Step.2.1
Step.2.2
Step.2.3
PHASE 2
Step.2.4
PHASE 3 LOADING OF THE TRANSPORTATION CASK TO A VEHICLE
Step.3.0
PHASE 4 LOADING THE TRANSPORTATION CASK ON A VESSEL
Step.4.0
Step.4.1
PHASE 5 WATER TRANSPORTATION
Step.5.0
PHASE 6 WATER / ROAD TRANSFER OF THE TRANSPORTATION CASK
Step.6.0
Step.6.1
PHASE 7 ROAD TRANSPORTATION
Step.7.0
PHASE 8 UNLOADING OF THE TRANSPORTATION CASK
Step.8.0
DARLINGTON-MODULES IN DSC
MOSTLY WATER
Fig.N°F.51
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

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

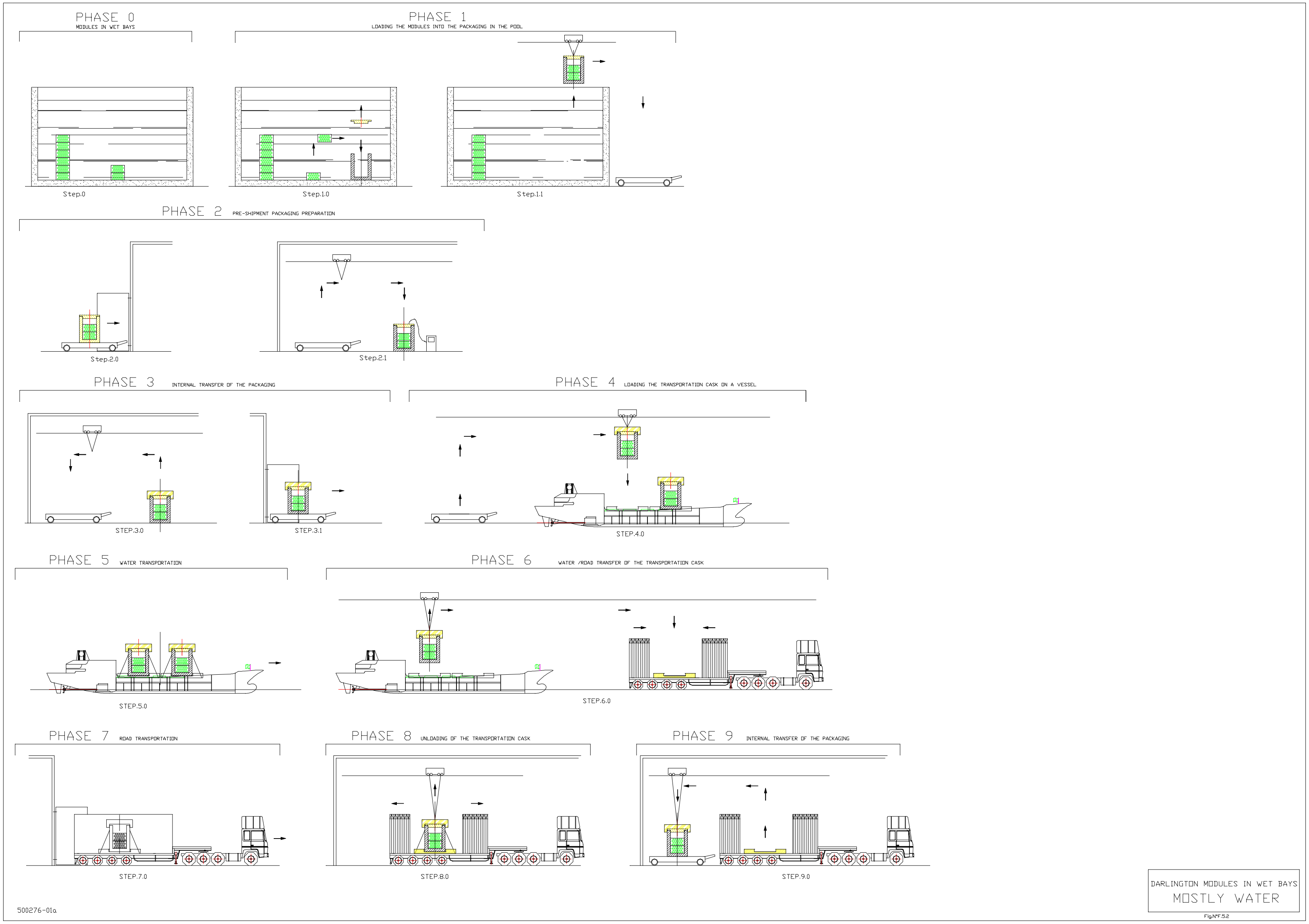
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

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).

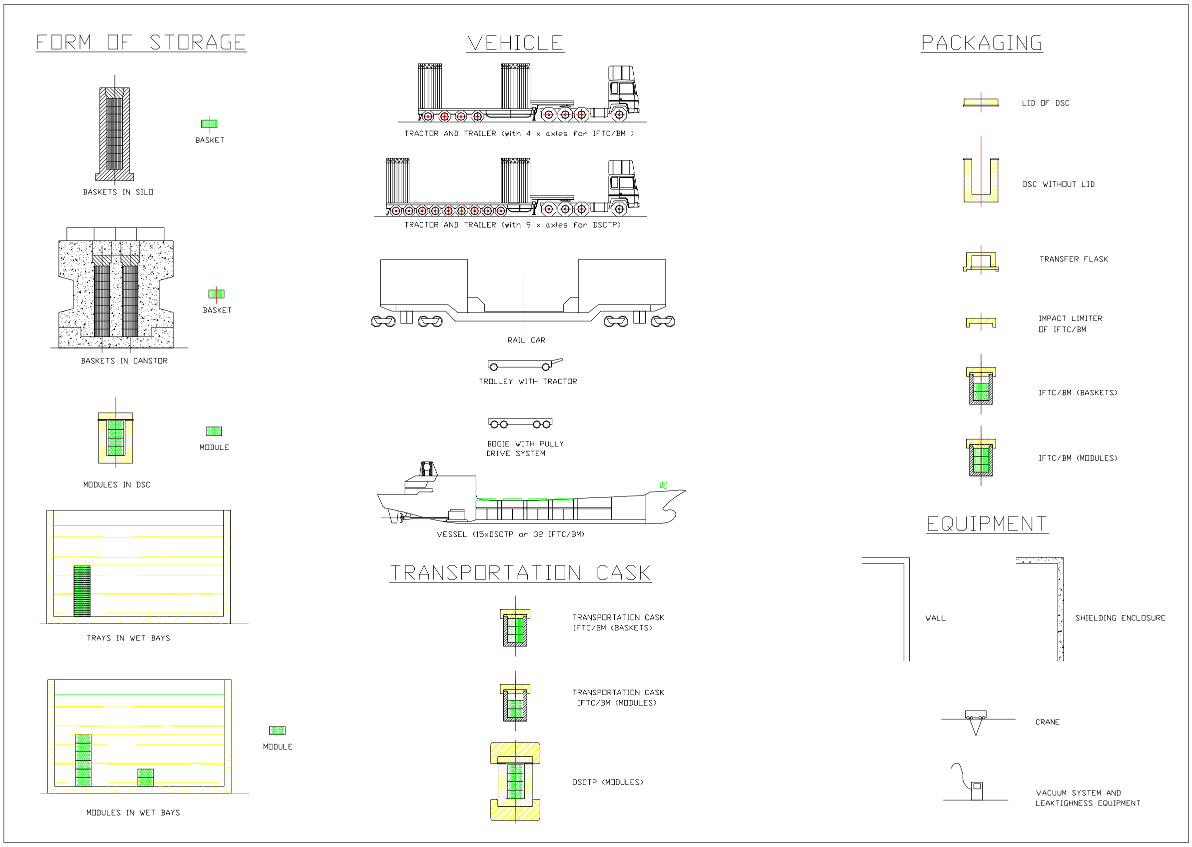
5.2.9. Table: Analysis of the operational phases of transport

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 Transpor-tation 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>**)	
			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
500276-01a
DARLINGTON MODULES IN WET BAYS
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

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

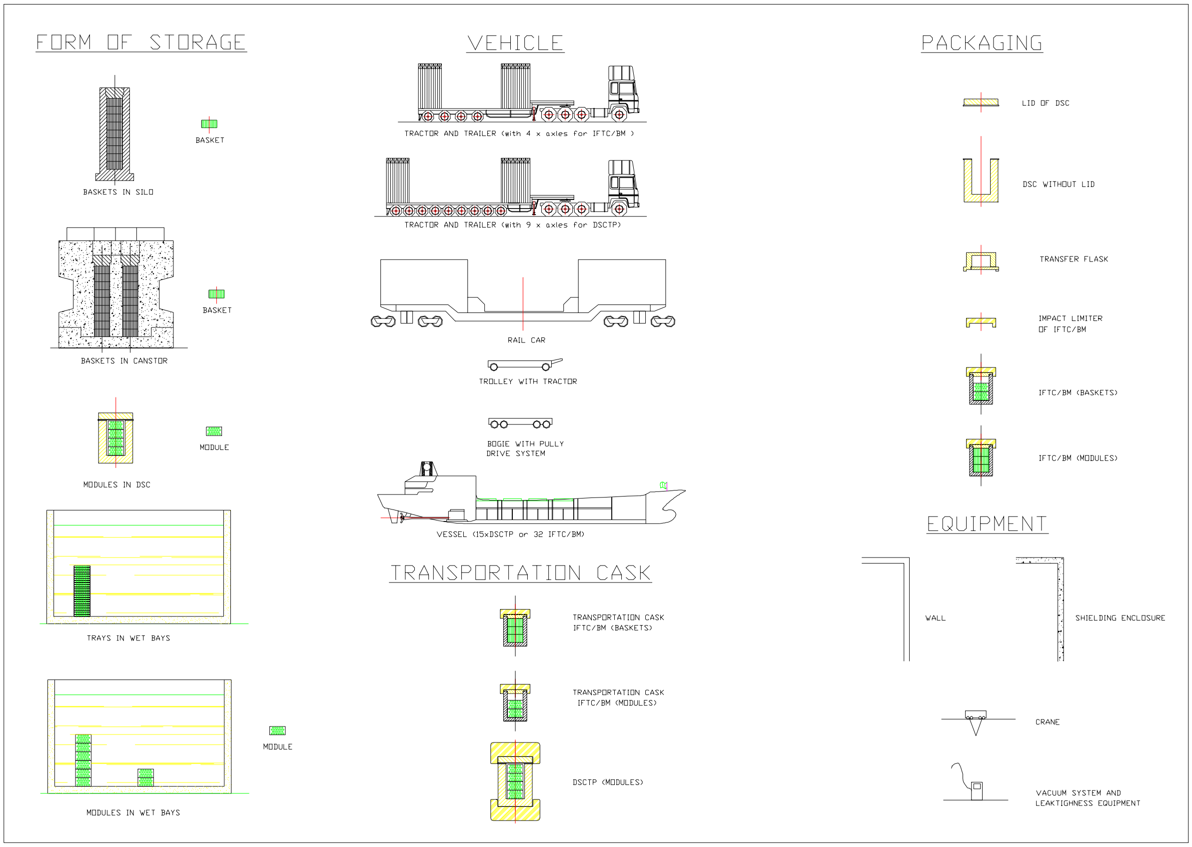
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG N° F.6
Phase 0	Baskets in Silo	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 2	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
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
500276-01a
POINT LEPREAU-BASKETS IN SILO
MOSTLY WATER
Fig.N°F.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

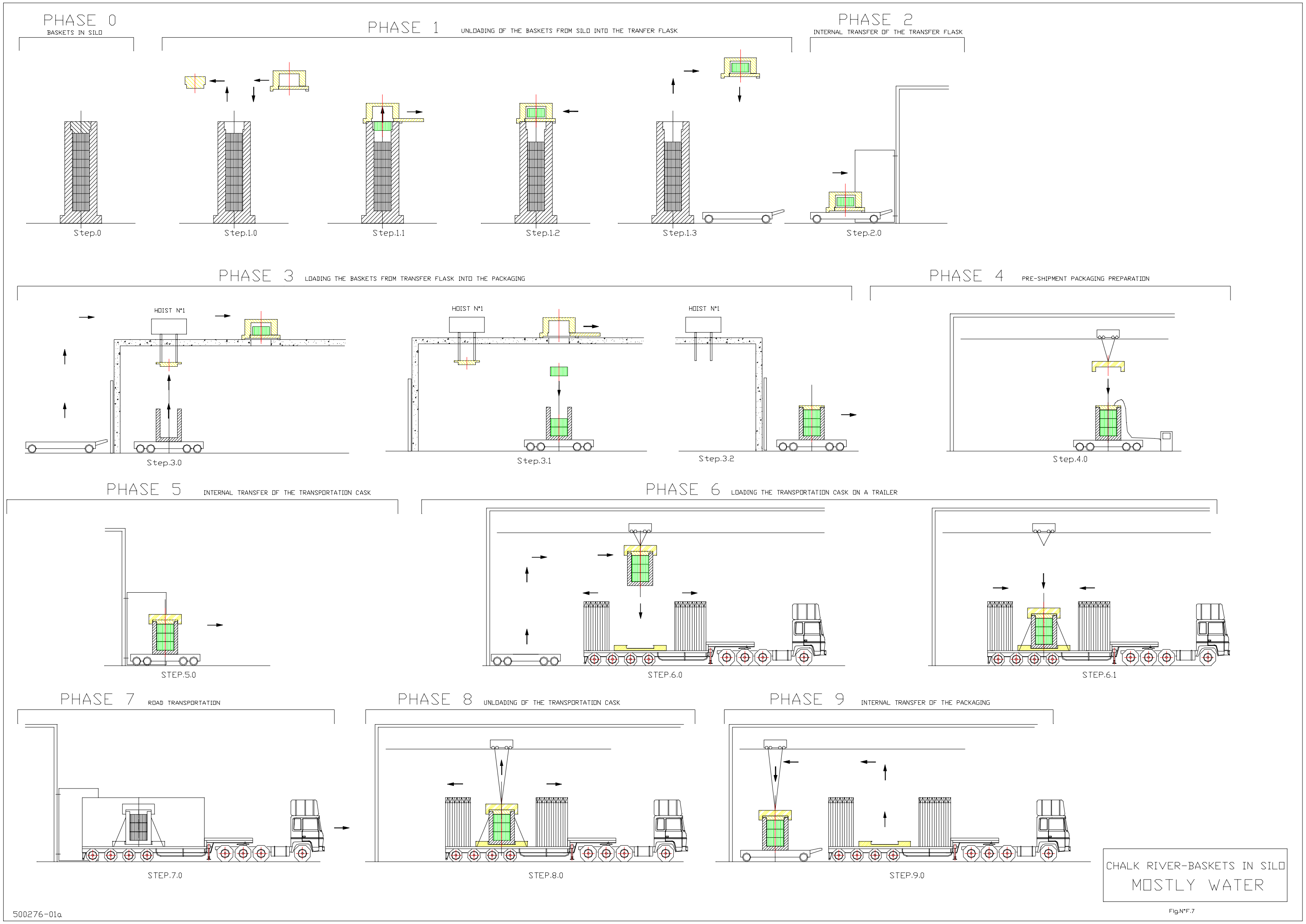
Where possible the equipment would be salvaged and decontaminated for sale and the remainder would be sent to a disposal facility.

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).

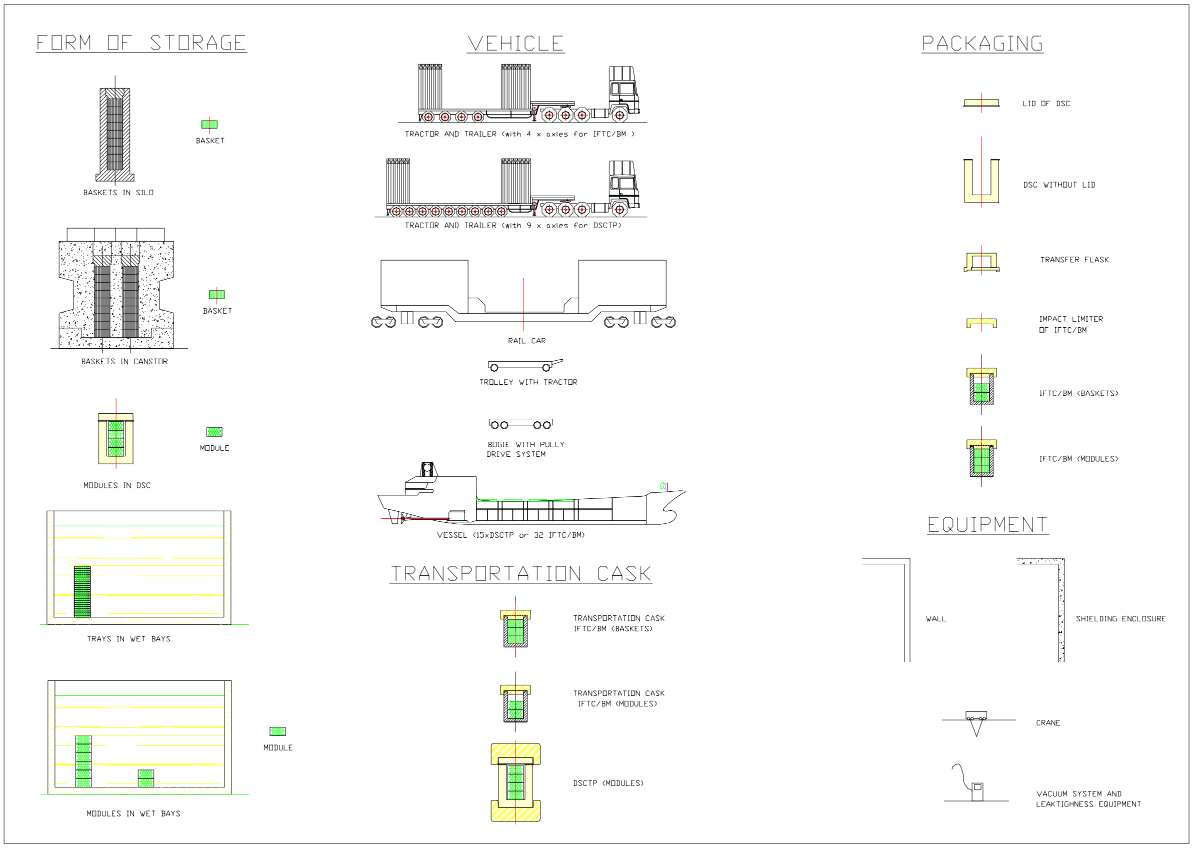
7.9. Table: Analysis of the operational phases of transport

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
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
Fig.N°F.7
500276-01a

Key:


FORM OF STORAGE
BASKETS IN SILO
BASKET
BASKETS IN CANSTOR
BASKET
MODULES IN DSC
MODULE
TRAYS IN WET BAYS
MODULES IN WET BAYS
MODULE
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.

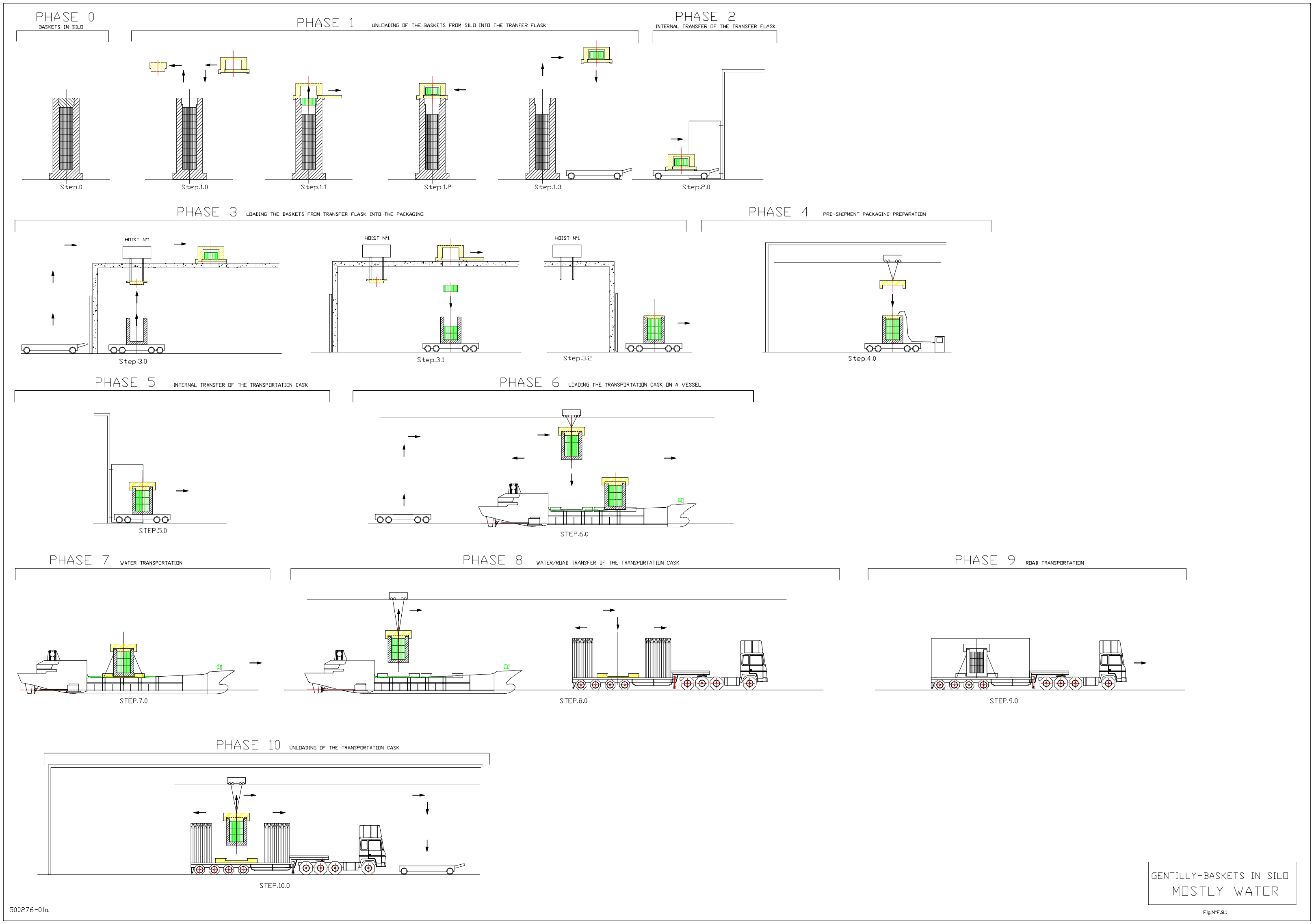
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

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
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
HOIST N°1
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 TRANSPORTATION CASK
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
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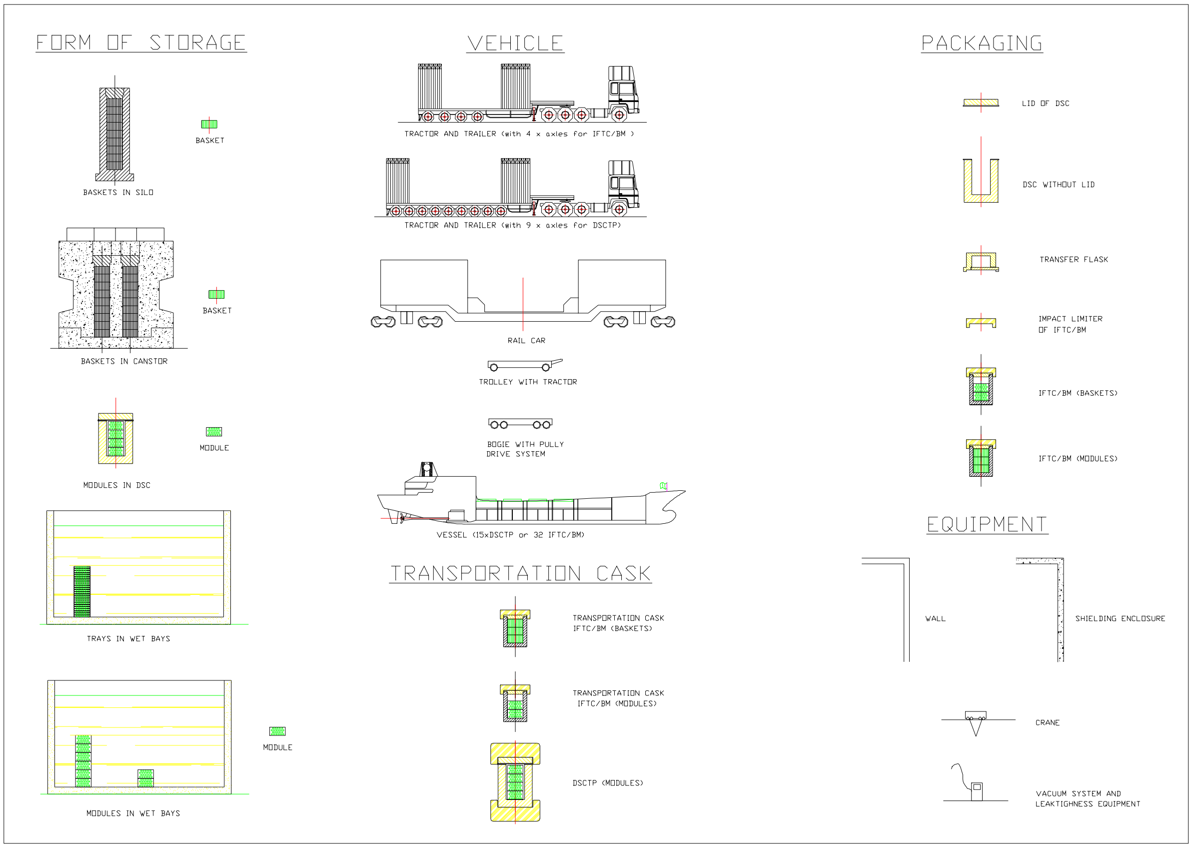
GENTILLY-BASKETS IN SILO
MOSTLY WATER
Fig.N°F.81

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.

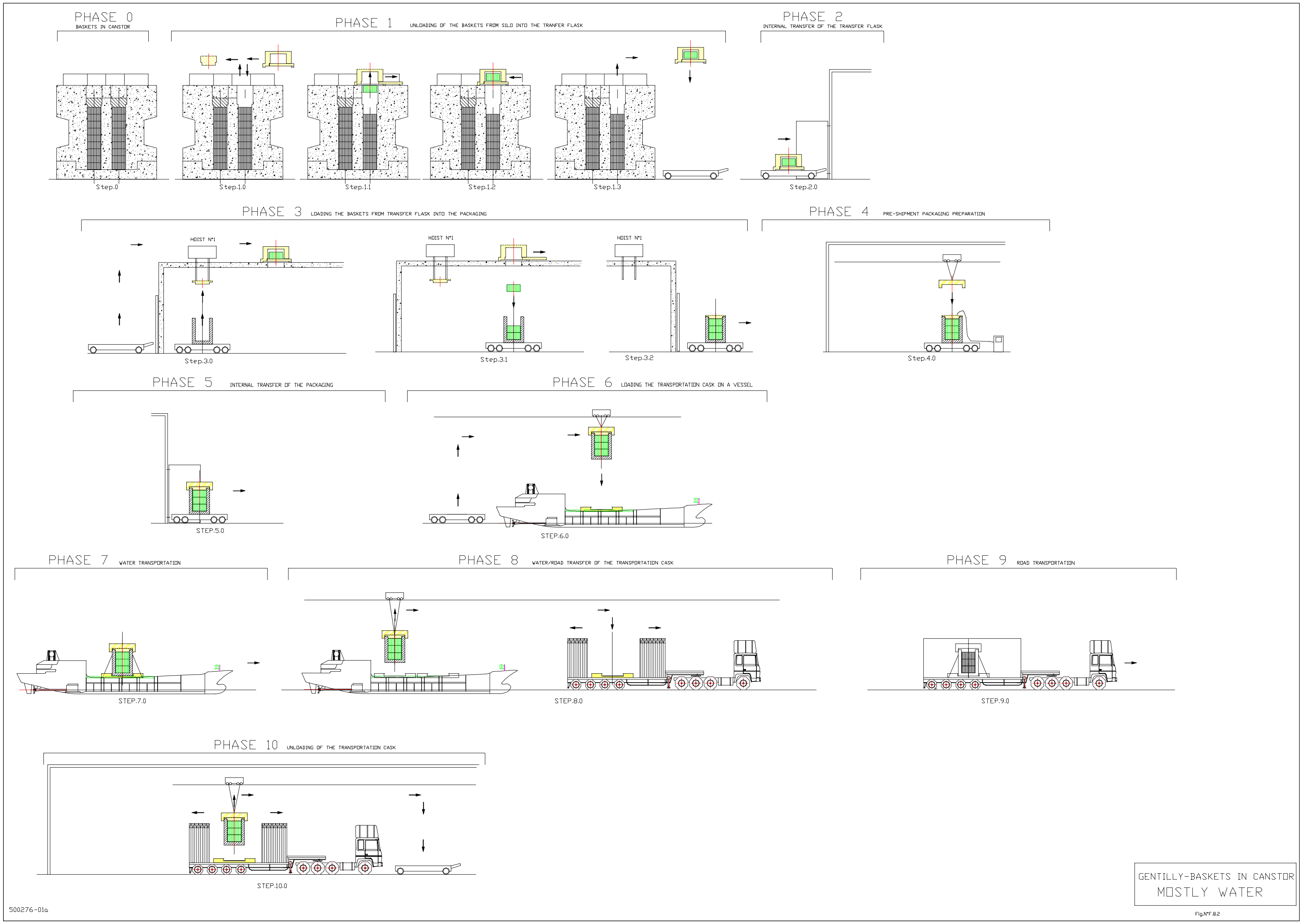
Some of the decontaminated equipment can be decontaminated on the current storage site and some of them can be decontaminated at the Centralised Facility in order to avoid the transportation of contaminated equipment (see paragraph 3.2 of Chapter 3).

8.2.9. Table: Analysis of the operational phases of transport

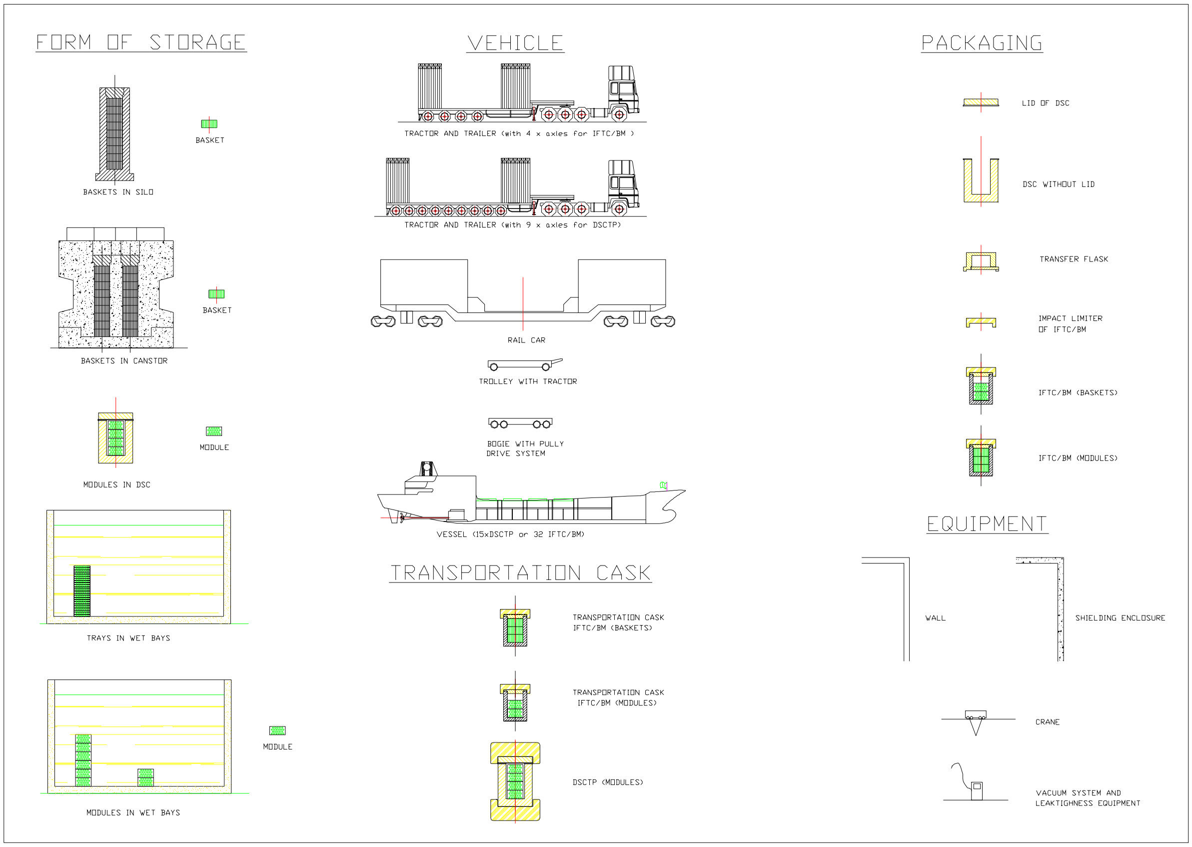
PHASE	DESIGNATION	STUDIED IN	DESCRIPTION OF PHASE	COMPONENTS	DESCRIPTION OF COMPONENTS	N° STEP IN SEQUENCE DIAGRAM FIG. N° F. 8.2
Phase 0	Baskets in Canstor	Interim storage	Initial phase			0
Phase 1	Unloading of the baskets from the Silo into the transfer flask	Interim storage				1.0, 1.1, 1.2, 1.3
Phase 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
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 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
500276-01a
GENTILLY-BASKETS IN CANSTOR
MOSTLY WATER
Fig.N°F.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:

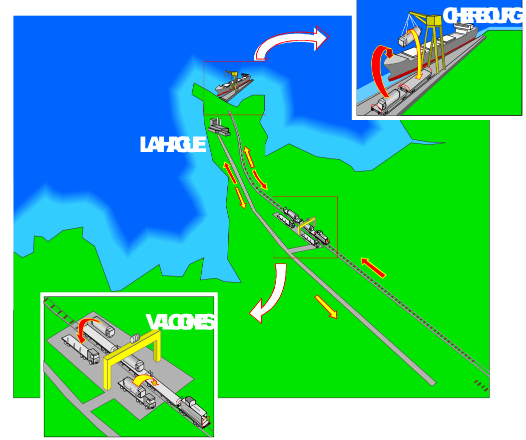
As described in chapter 4 of D#5 an Emergency response plan for transportation, is needed.
The crisis cell will be located in a specially built crisis room at the Centralised Facility fully equipped with communication means (Vehicles tracking system, telephones, telefax, teleconference system,...) and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



The COGEMA LOGISTICS Railroad Terminal at Valognes

October 2002

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Introduction

- The railway terminal in the town of Valognes is 40 kilometers from COGEMA-La Hague plant
- Built in 1982, the Valognes railway terminal is the rail-to-load transfer point for casks of nuclear materials
- Casks of spent fuel from French, Asian and European power plants arrive at the terminal by train in transportation casks that have been secured to specialized wagons
- On arrival at Valognes, COGEMA monitors the casks and the wagons for contamination
- The casks are then off-loaded onto trucks and transported to COGEMA-La Hague plant

Description of the Terminal

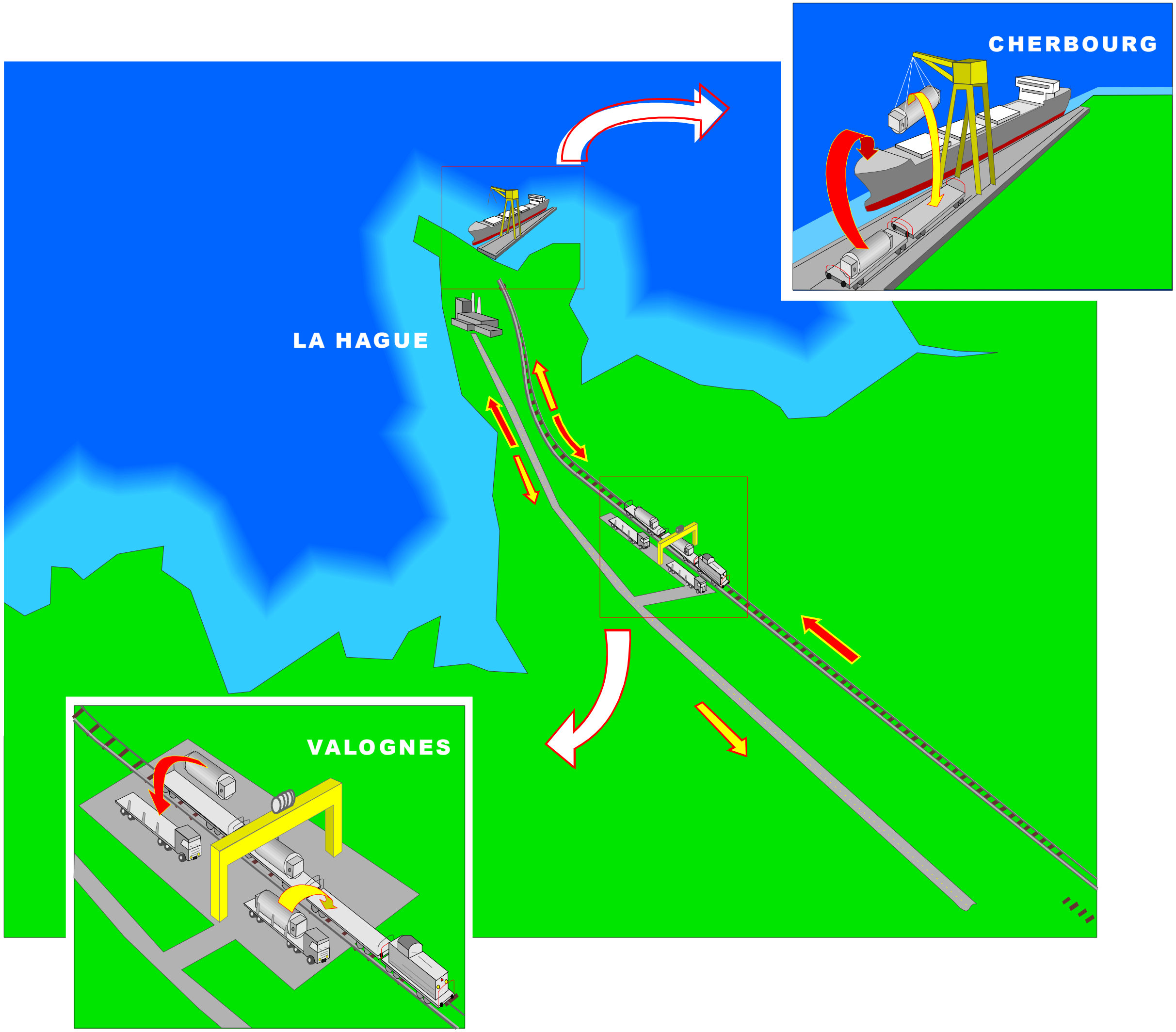
- The terminal is owned by COGEMA LOGISTICS
- the 4.5-hectare terminal, includes 1,400 m² of covered area
- The six tracks at the site each have a specific purpose, with three used for graveyards and three for loading and unloading of wagons and highway trailers using two bridge cranes
- About 15 people work at the site, including security personnel posted at site entrances. Security personnel are in direct contact with the Valognes police station and with the Local Security Patrol for COGEMA-La Hague site

Description of the Terminal

> Rail traffic inside the terminal is managed with 12 rail switches, as is wagon transfer to various site facilities:

- the A facility, a 600 m² covered area, where transportation casks are monitored, wagons and highway trailers are inspected and rail/road transfer are conducted using gantry crane
- the B tunnel where casks and wagons are monitored for contamination and cleaned if necessary
- the C facility, a 420 m² facility, where wagons (equipment replacement) and handling cranes are serviced
- the D facility, a 135 m² facility, where wagons and LR65 tanks used to transport uranyl nitrate are monitored

COGEMA LOGISTICS railway terminal at Valognes, Manche (France)



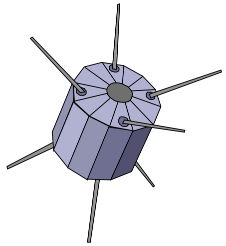
COGEMA LOGISTICS Railway Terminal at Valognes, Manche (France)

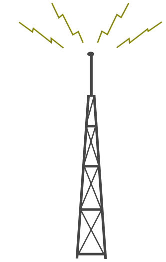
Spent Fuel Cask unloading at Cherbourg Port

Road Transport between Valognes and COGEMA-La Hague

Specialized Wagon

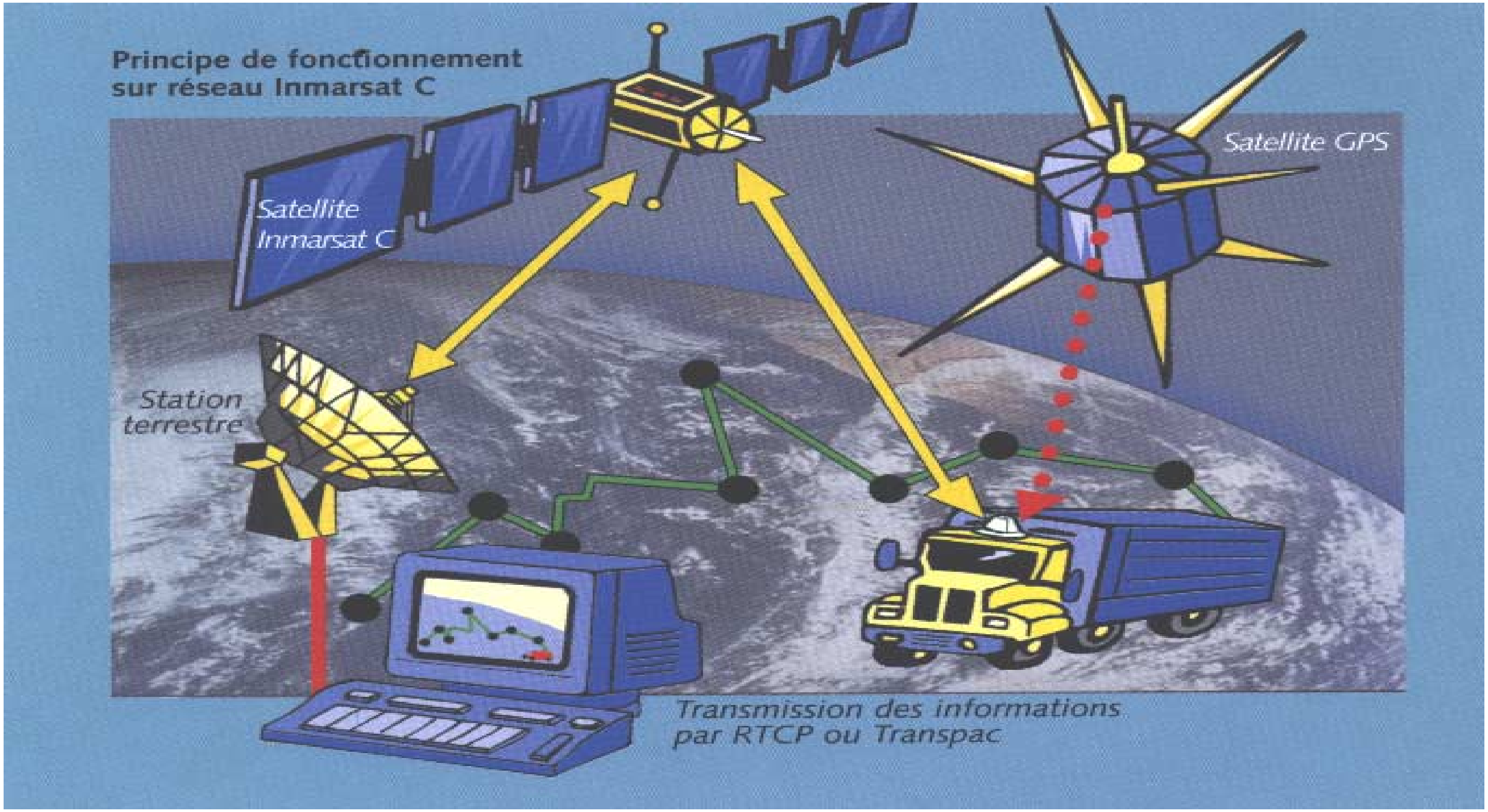
Spent Fuel Cask unloading at Valognes





THE REAL TIME TRACKING SYSTEM

PRINCIPLE OF REAL TIME TRACKING WITH INMARSAT C NETWORK



Informations transmitted in real time

> **From vehicles to the tracking room**

- GPS Position
- Hour of the position
- Direction (Cap)
- Speed
- Alarms :
  - vehicle stopped
  - exceeding the limited speed
  - driver in difficulties
  - battery default
  - canopy open
  - ...

Informations transmitted in real time

> **From the tracking room to the vehicles**

- Sending a ponctual request position
- Modification of the frequency of transmitting
- Request of transmission of all positions and alarms recorded on the module on board every 45 s

Tracking fittings on vehicles

> The module on board the vehicles including :

- An Inmarsat C transmitter / receiver
- or a GSM transmitter / receiver
  (same as cellular phone mobile)

Communication function

- a GPS card included in the Inmarsat C transmitter / receiver

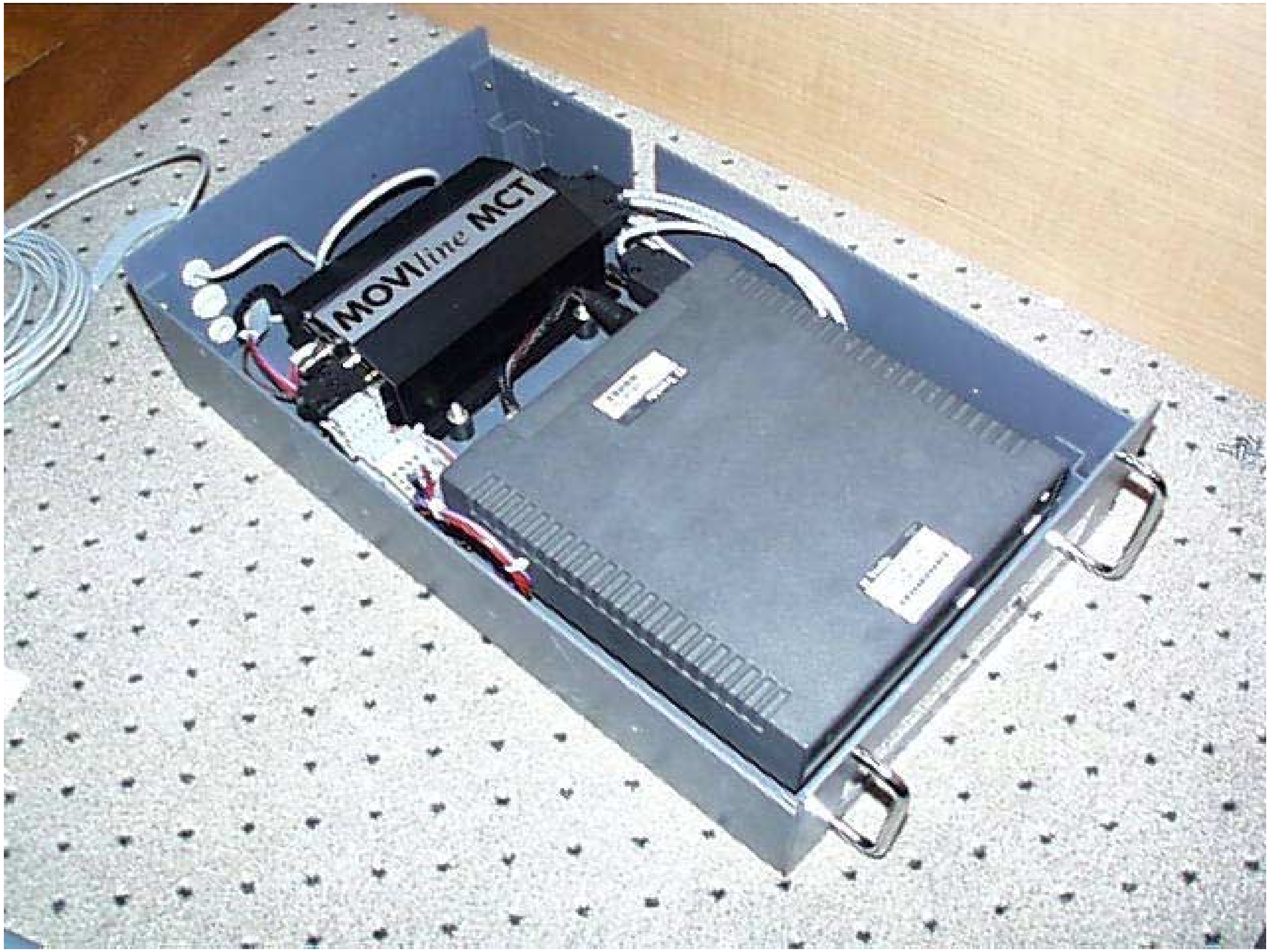
Localisation function

- a PC card

Management of the on board software
Analog inputs and Digital I/O ports
Local Data acquisition (positions, alarms)

Tracking fittings on vehicles

Road on board system



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Tracking fittings on vehicles

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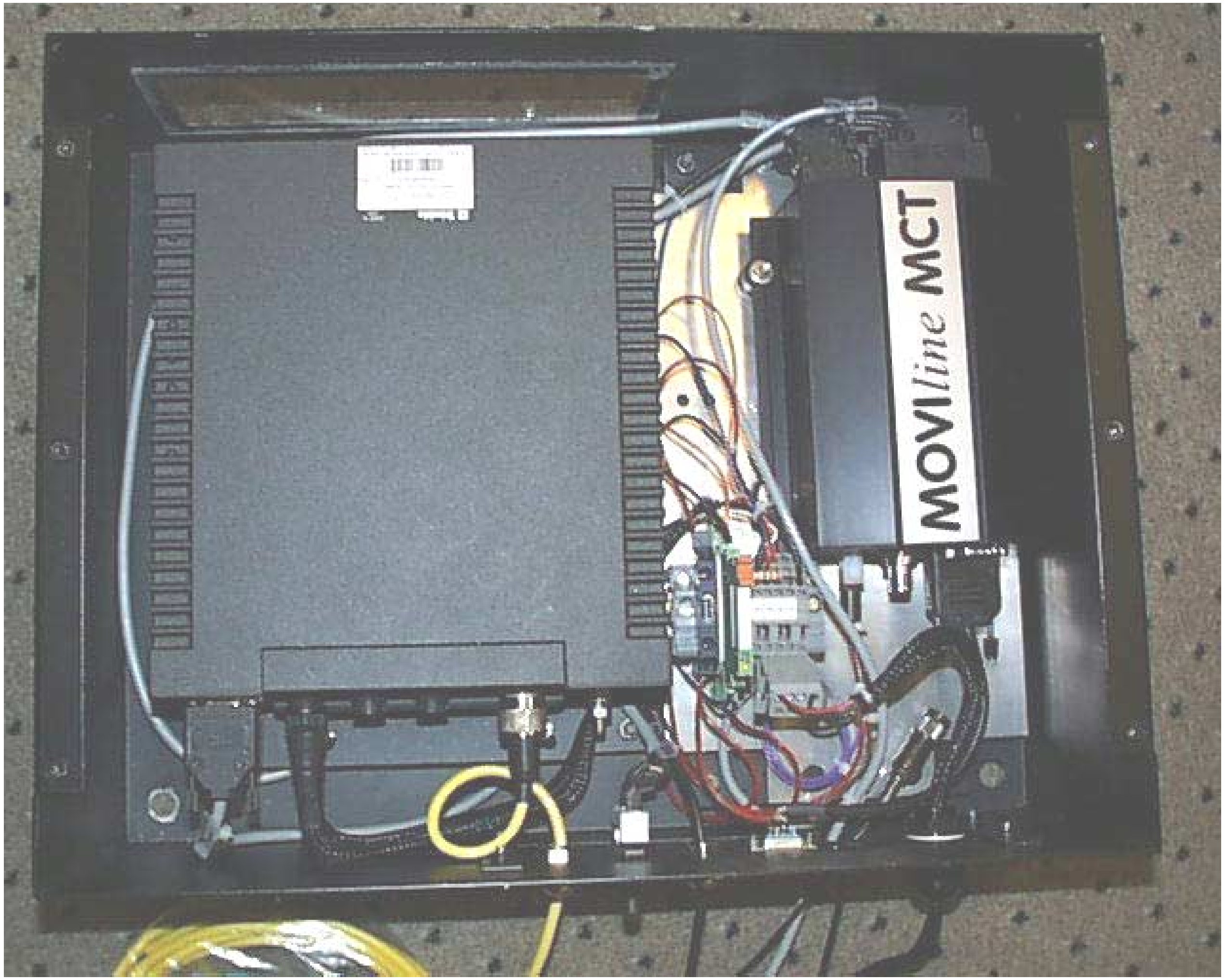
Tracking fittings on vehicles

Tracking fittings on vehicles

Rail on board system



Tracking fittings on vehicles

Inmarsat C transmitter / receiver

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Tracking fittings on vehicles

Specific tracking fittings for Q7 wagons

Tracking fittings on vehicles

> **Designed to be**

- Not easily noticeable
- Free from operational constraints

> **The electrical supply system**

- 4 solars panels
- 4 wind propellers
- 4 batteries

The energy produced by the solar panels and by the wind propellers is stored in the batteries to be later released to the module on board.

Tracking fittings on vehicles

Fitting on the wagon cover (canopy)

The picture shows :

- ***The solar panels***
- ***The Inmarsat C antenna***
- ***The GPS antenna***
- ***Wind propellers***

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Tracking fittings on vehicles

Fitting on the wagon cover (canopy)

The picture shows :

> ***Wind propeller seen from inside the canopy***

Tracking fittings on vehicles

Ship tracking

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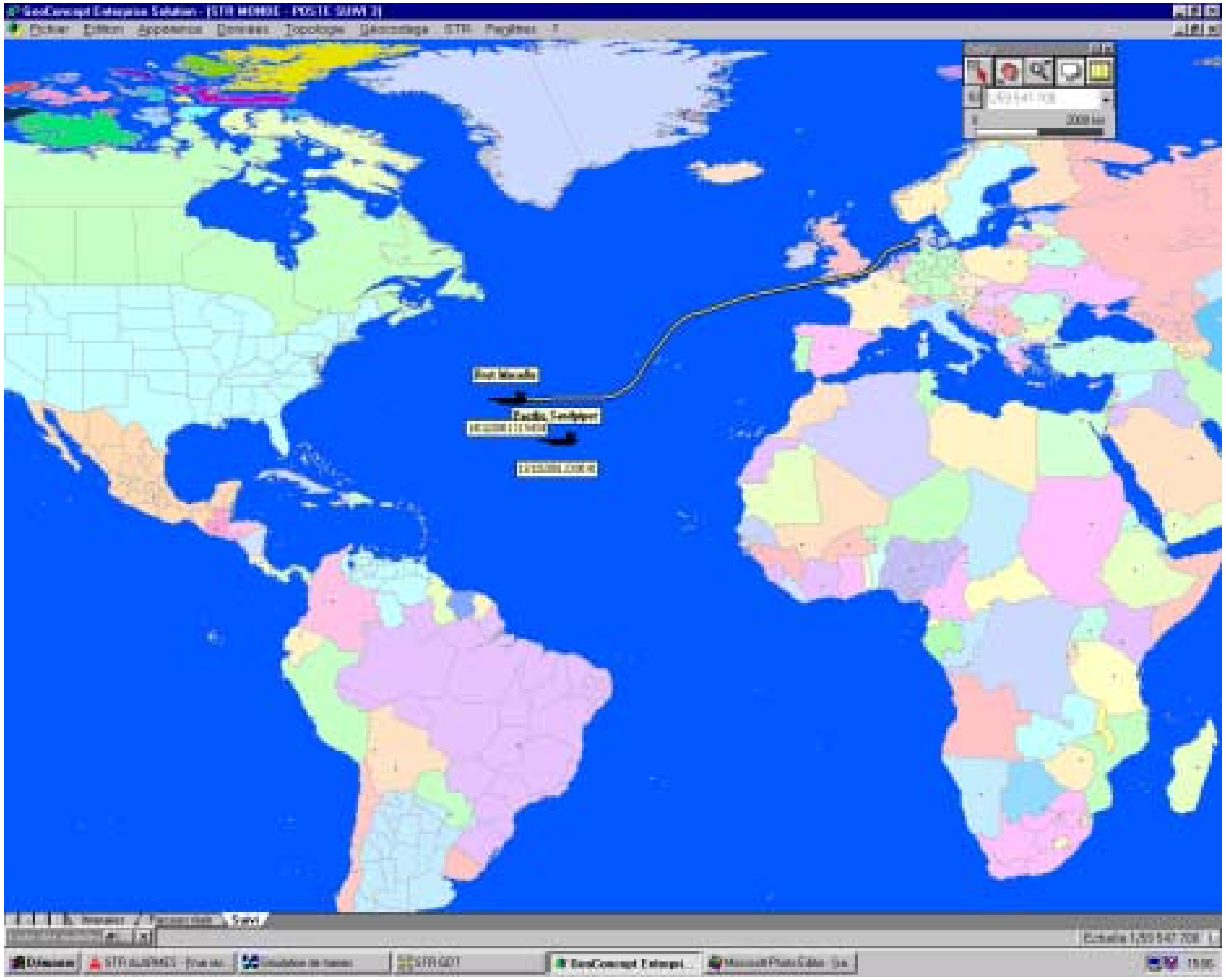
Tracking software

Ship tracking



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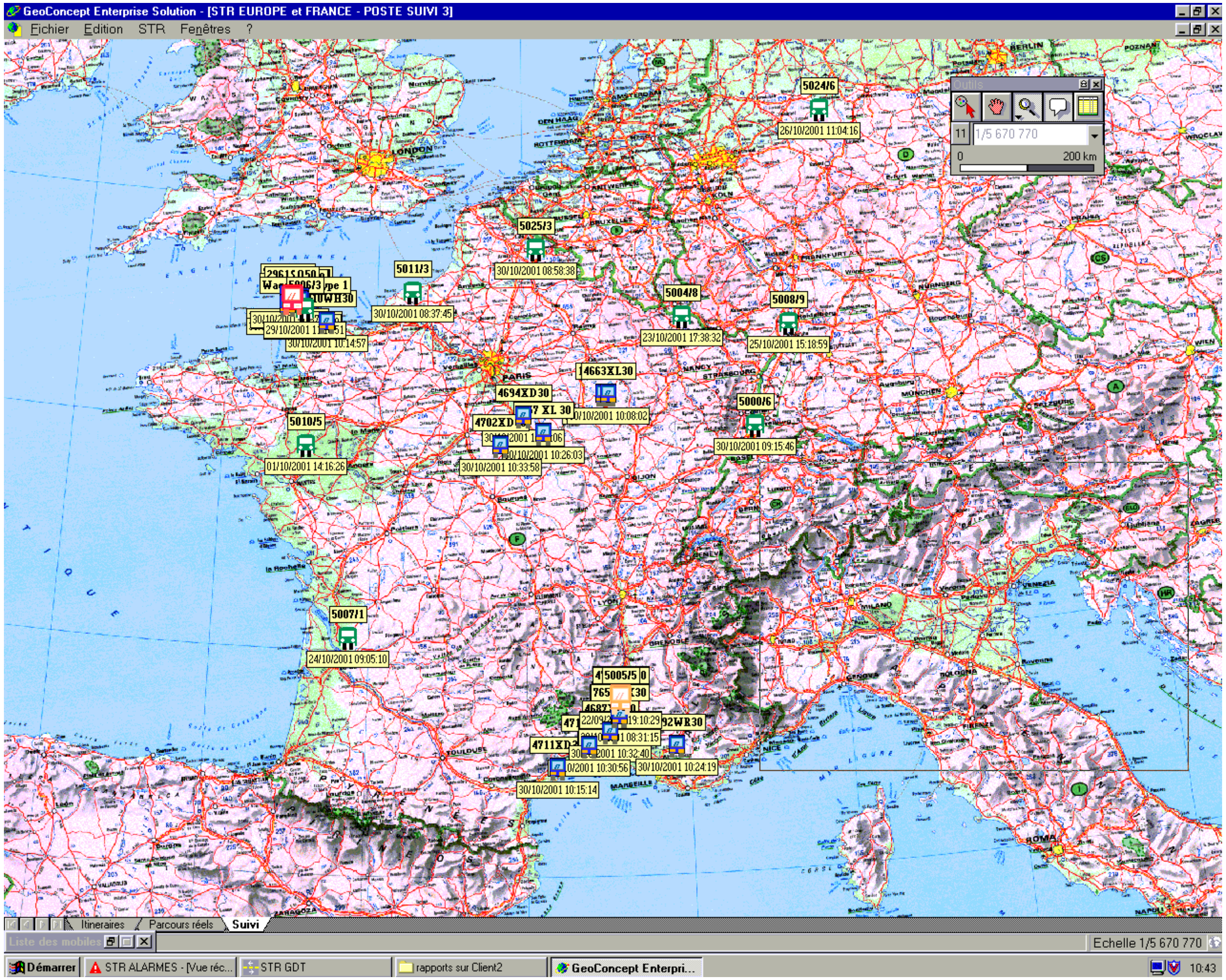
Tracking software

Map



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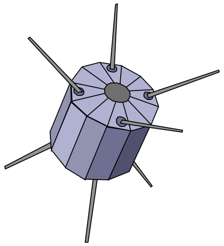

End...