

Nuclear transport into and from Belgium

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Introduction

Since more than fifty years, activities in Belgium related to the nuclear area have been developed with success. It began with the Research Centre of Mol and its reactors and laboratories, to continue with the construction of Power Plants, Waste treatment installations, fuel production, etc...

Consequently and also due to the central position of Belgium in Europe, more and more nuclear transports have to be executed to, through and from Belgium.

The first part of the presentation will describe the most important flux of nuclear transport.

The second part will give an overview of the SCK procedure for transport of nuclear material. The SCK radiation protection department introduced a document "Model 151" that always is used as key document for internal and external nuclear transports.

A summary is given of the supplementary documents to be completed to arrange a nuclear transport in accordance with the European directives and the national legislation

1. Flux of nuclear transport to and from Belgium

Belgian transport companies are executing a lot of different nuclear transports.

In this presentation we will try to give an overview of the most important transports executed now in Belgium by dividing the transports in 5 categories :

1. Upstream of the fuel cycle.
2. Fresh fuel.
3. Downstream of the fuel cycle.
4. Wastes and dismantling.
5. Research, Laboratories and Medical.

For each category, every flux is described as follows :

1. Country from which the transport is coming.
2. Installation from which the transport is coming.
3. Nuclear material transported.
4. Between (), package used for this transport.

Also transports through Belgium without intervention in Belgium are mentioned in the flow charts.

1.1. Upstream of the fuel cycle (Figure 1)

The materials concerned are U_3O_8 , U_{natural} , U_{depleted} , sodium diuranate, uranium hexafluoride. Most of these transports are only transiting Belgium coming from or going to ore extraction plants, transformation and enrichment installations, fresh fuel production plants.

Anyway, for these transits, transport authorizations and other administrative formalities are to be foreseen.

A lot of those transits are due to the important traffic in the Antwerp port.

1.2. Fresh fuel (Figure 2)

a) UO_2 fuel

Uranium fuel bundles are produced in Belgium by the FBFC facility. UO_2 pellets are imported from other countries and bundles are sent to EDF, Ringhals and Electrabel. Uranium bundles are also imported to Electrabel power plants from France, Sweden, Spain and Germany.

b) MOX fuel

Pu from La Hague and depleted or natural uranium oxide from Germany, France, Sweden and Brazil are imported to BN MOX fabrication plant. The MOX rods are sent from BN Dessel to FBFC and MOX bundles are sent to Germany, Switzerland and Belgium.

c) MTR fuel to BR2 is coming from France.

1.3. Downstream of the fuel cycle (Figure 3)

Spent fuel coming from Belgian power plants are handled as follows :

Doel spent fuel is stored in TN24 storage/transport casks in a building on the site.

Tihange spent fuel is transported for Ti 1, 2 and 3 power plants to a storage pool with the TN17T cask.

Spent fuel coming from the dismantled BR3 plant is stored in 6 Castor casks at Belgoprocess.

BR2 spent fuel is sent to the La Hague reprocessing plant in the TN-MTR cask.

Also spent fuel for the Borssele plant in the Netherlands is sent to La Hague with the TN17-2 cask through Belgium.

1.4. Waste production and dismantling (Figure 4)

In Belgium, all the nuclear waste produced is managed by NIRAS/ONDRAF and the exploitation of the centralized treatment and storage installations is executed by Belgoprocess.

The waste produced by the NPP, SCK and BN-Dessel is treated (or pre-treated) on site and transported in drums or containers by using specific TNB shielded containers.

Waste coming from maintenance of main components of NPP is sent back to the NPP.

Vitrified waste coming from fuel reprocessing in La Hague is sent back to Belgoprocess with the TN28 package.

1.5. Research, laboratories and medical (Figure 5)

The activities of LMHA hot cells in the SCK concerning analysis of spent fuel (rods), irradiated samples and core plates and the production of irradiated sources by BR2 need a lot of transports from and to everywhere in Europe using specific packages.

| | |
|-------------------------------|----------------------------------|
| Samples, rod segments, plates | using TNB145, TN5, TN6 or D14000 |
| Full length fuel rods | using BG18 |
| UMO plates and Pu sources | using TN-BGC |

Irradiated targets and sources are sent to IRE at Fleurus with AGNES, SCK, IRMM, FBFC and BND send samples to the International Atomic Energy Agency for controls.

1.6. Transport authorizations

All the transport authorizations for nuclear transport are delivered in Belgium by the FANC (Federal Agency for Nuclear Control).

The international regulations followed and the SCK internal procedure are described in the second part of this presentation.

Figure 1 Upstream of the fuel cycle

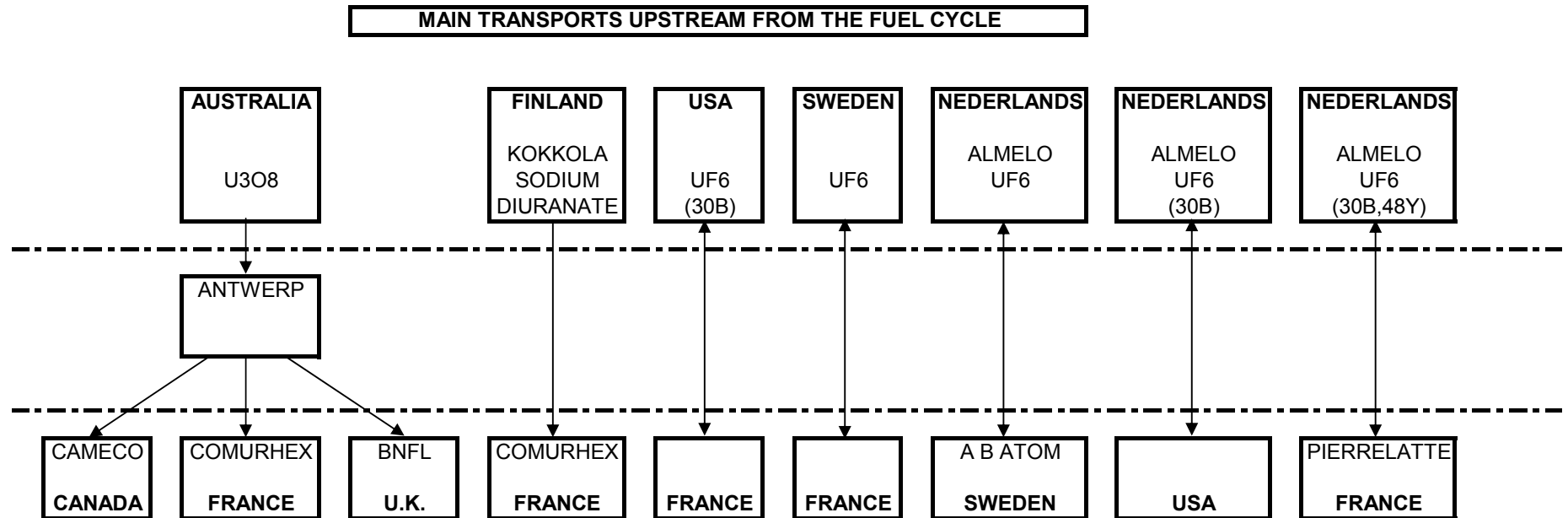


Figure 2 Fresh Fuel

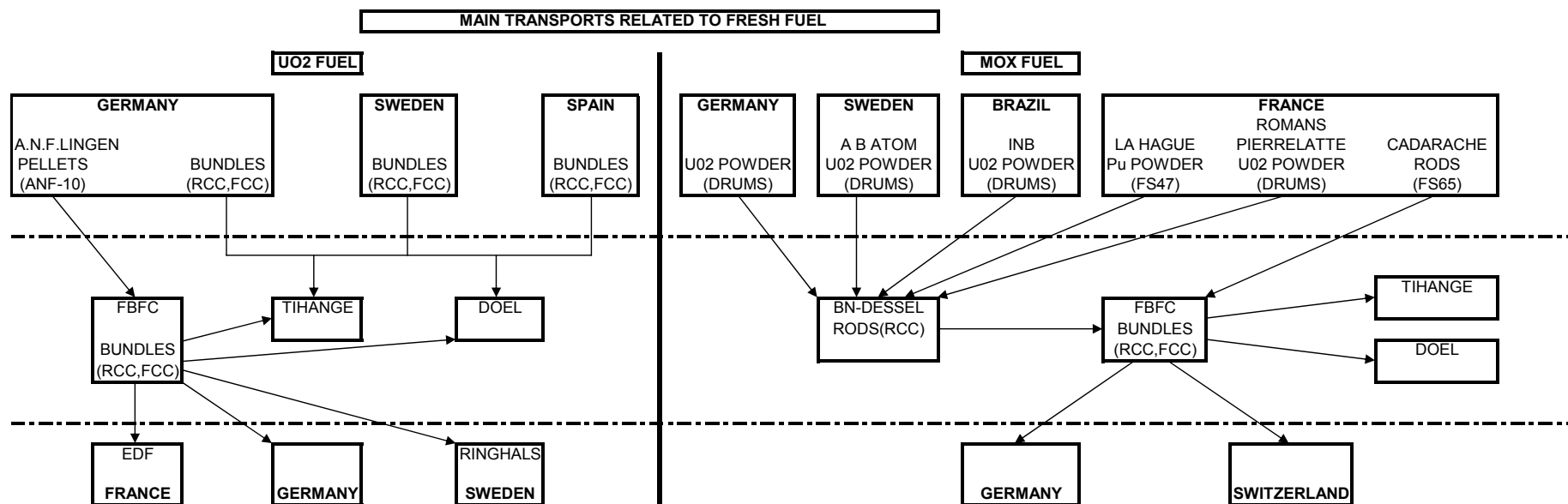


Figure 3 Downstream of the fuel cycle

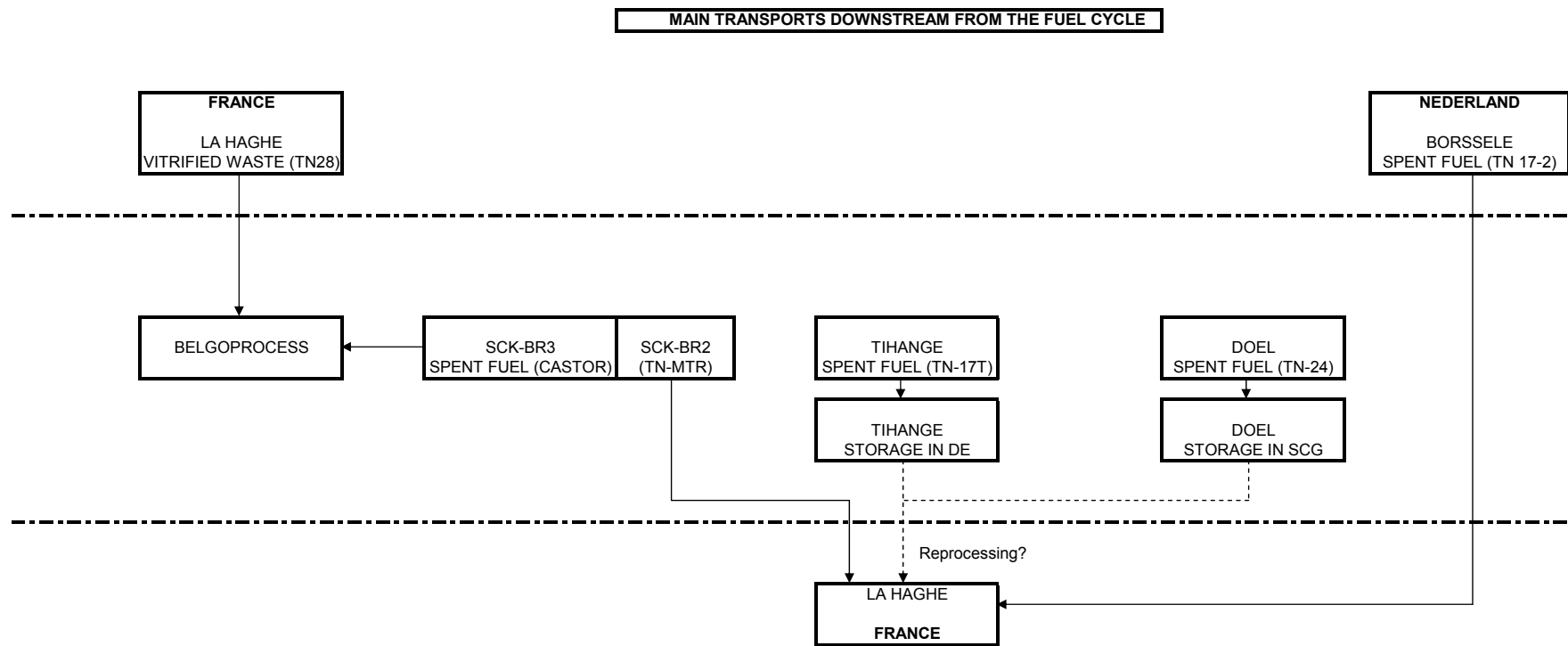


Figure 4 Waste production and dismantling

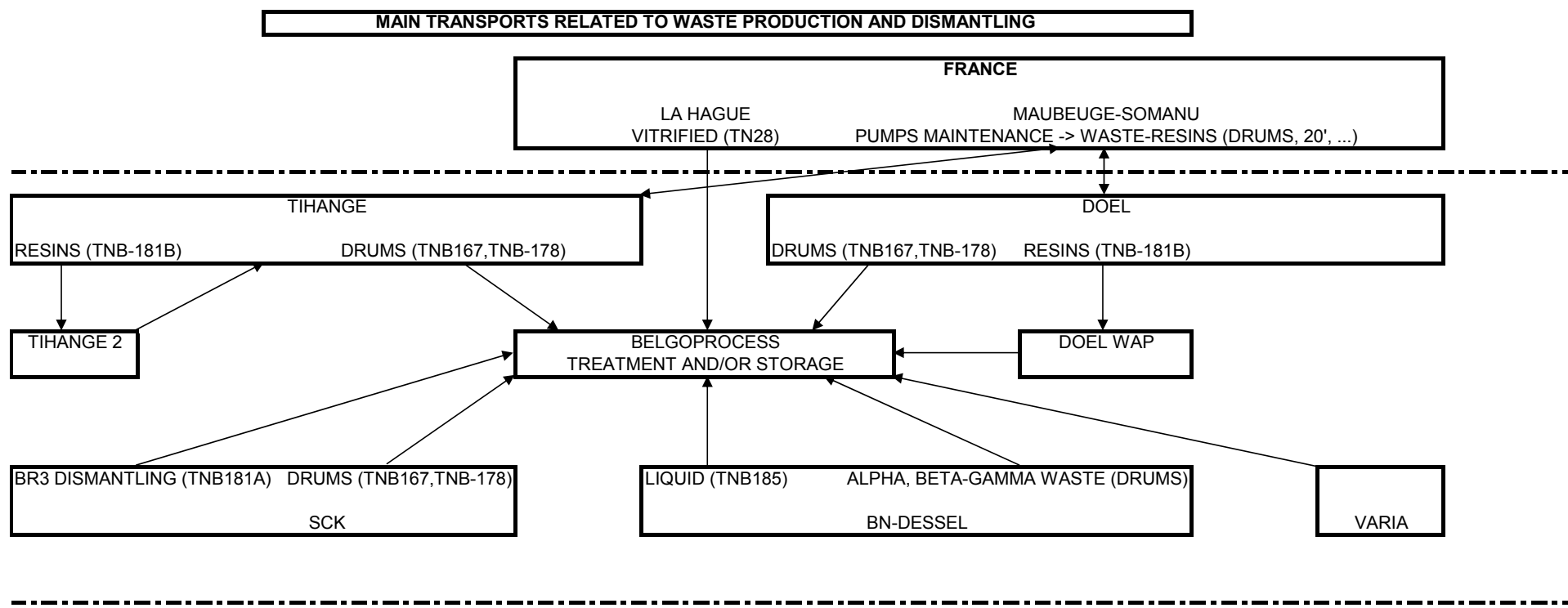
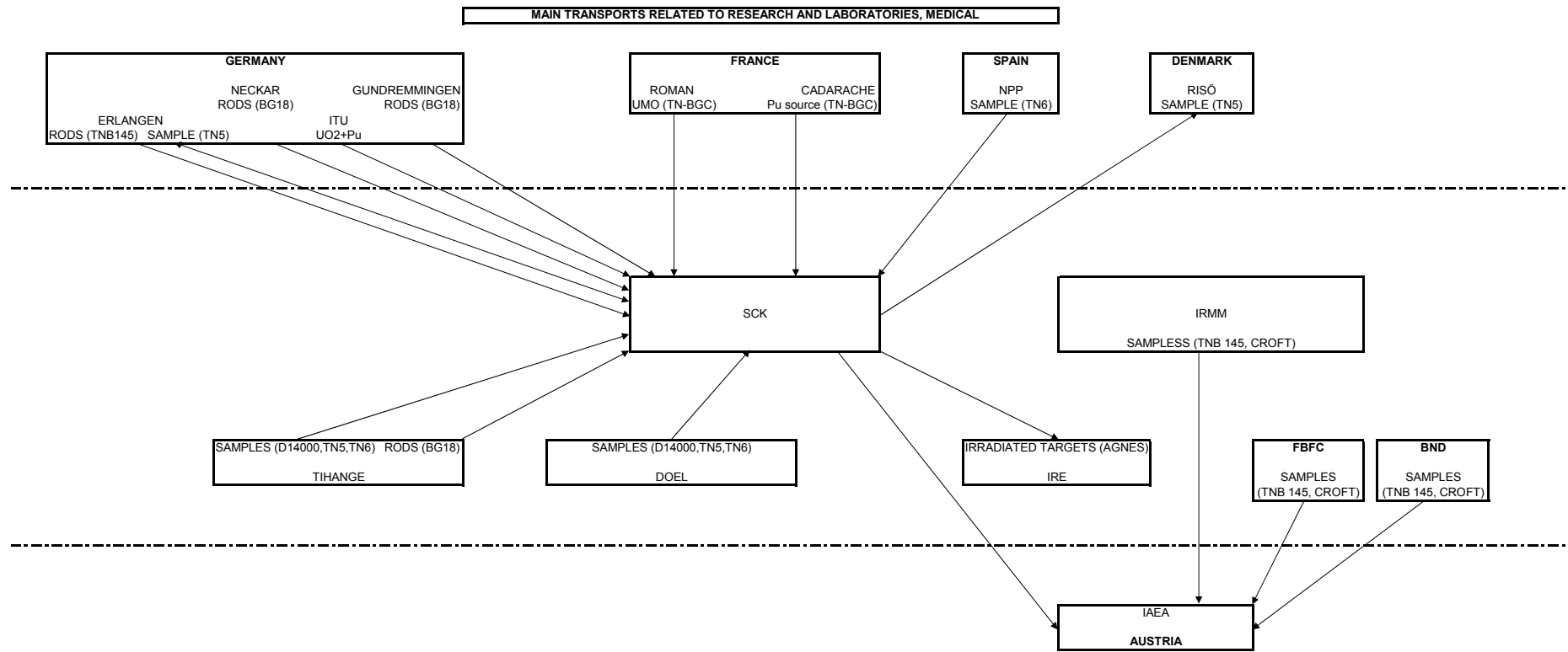


Figure 5 Research, Laboratories and medical



2. Model 151 document (Figure 6)

"Transport of nuclear materials"

The coordinator has to complete as much as possible the document before sending it to the radiation protection transport officer.

Once the document is completed and the transport is approved by the radiation protection officer the coordinator has the permission to execute the transport.

This document is internal distributed to the several departments involved with the transport.

- a) Radiation protection agent of the building where the material shall be send away or accepted
- b) Radiation protection transport officer
- c) Entrance control at the main gate
- d) Fuel account in case for fuel transport
- e) Insurance officer

The back-side of the document is a summary of the transport conditions of the container and the transport vehicle.

2.1. General information

- Date of transport
- Consignor
- Consignee
- Carrier

2.2. Custom-House for import

a) Road

Inland: Turnhout⁽¹⁾⁽³⁾, Zaventem⁽²⁾

Customs post offices: Hauser (Raeren), Eynatten (Raeren), Sankt Vith, Beaubru (Bouillon), Heer-Agimont (Hastière), Brûly (Couvin), Erquelinnes, Havay (Quévy), Hensies, Lamain (Doornik), Rekkem (Menen), Abele (Poperinge)

b) Rail

Inland: Turnhout, Zaventem

Customs post offices: Montzen (Plombières)⁽³⁾, Herbesthal (Station)(Lontzen), Erquelinnes, Quévy, Moeskroen⁽³⁾

c) Sea and river

Antwerpen⁽³⁾, Gent⁽³⁾, Zeebrugge (Brugge)⁽³⁾, heer-Agimont (Hastière), Erquelinnes

d) Air

Zaventem, Gosselies (Charleroi)⁽³⁾, Oostende (Middelkerke)⁽³⁾

(1): office only open for the import of products by companies established by the province of Antwerp.

(2): office only open on the condition that the import of the materials is allowed in the general or special license

(3): office only open for the import of radioactive appliance and materials what will not be sent to an storage neither to a particular storage of a public storage

2.3. Information about the radioactive material

To be completed if applicable

2.4. Residual heat

Highly activated materials or used fuel

2.5. Package information

The following types of packages are used for radioactive material.

2.5.1. Excepted packages

Four possibilities:

- Radioactive materials in limited quantities.
- Instruments and manufactured articles.
- Articles manufactured from natural uranium or depleted uranium or natural thorium.
- Empty packages.

Excepted packages are not subject to the provisions relating to:

- categorization, packages, packing, marking, labeling, shipper's declaration, ... provided that:

- they comply with general conditions ex. radiation level at any point on the external surface of the excepted package does not exceed 5 µSv/h;
- the activity falls within the limits of following table.

| Nature of contents | Instruments & Articles | | Materials |
|--------------------|------------------------|-----------------------|-----------------------|
| | Item limits | Package limits | Package limits |
| Solids | | | |
| Special forms* | $10^{-2}A_1$ | A_1 | $10^{-3}A_1$ |
| Other forms** | $10^{-2}A_1$ | A_2 | $10^{-3}A_2$ |
| Liquids | $10^{-3}A_2$ | $10^{-1}A_2$ | $10^{-4}A_2$ |
| Gases | | | |
| Tritium | $2 \times 10^{-2}A_2$ | $2 \times 10^{-1}A_2$ | $2 \times 10^{-2}A_2$ |
| Special form | $10^{-3}A_1$ | $10^{-2}A_1$ | $10^{-3}A_1$ |
| Other form | $10^{-3}A_2$ | $10^{-2}A_2$ | $10^{-3}A_2$ |

* Special Form: Special Form radioactive material is either an indispersible solid radioactive material or a sealed capsule containing radioactive material.

**Other Form: Radioactive material that does not meet the definition of special form

2.5.2. Industrial packages

Can be used for:

- Low Specific Activity (LSA) Material: radioactive material which by its nature has a limited specific activity or radioactive material for which limits of estimated average specific activity apply Three Group: LSA-I/LSA-II/LSA-III
- Surface Contaminated Object (SCO): Means a solid object which is not itself radioactive, but which has radioactive material distributed on its surfaces. Two groups: SCO-I and SCO-II.

Use of Industrial Packaging:

| Contents | Industrial package type | |
|------------------------|-------------------------|-------------------------|
| | Exclusive use * | Not under exclusive use |
| LSA-I Solid | Type 1 | Type 1 |
| Liquid | Type 1 | Type 2 |
| LSA-II Solid | Type 2 | Type 2 |
| Liquid and | Type 2 | Type 3 |
| LSA-III | Type 2 | Type 3 |
| SCO-I | Type 1 | Type 1 |
| SCO-II | Type 2 | Type 2 |

- c) Type B(U) needs unilateral approval, i.e. approval by the competent authority of the State of origin except that:
1. a type B(U) package design for fissile material must require multilateral approval;
 2. a type B(U) package design for low dispersible material must require multilateral approval.

Type B(M) needs multilateral approval.

- d) All type B packages must comply with the requirements for Type B Packages.

The following 8 tests will be carrying out on the container:

1. shielding test;
2. criticality;
3. impact;
4. drop;
5. mechanical resistance;
6. heat approval;
7. leaktest;
8. design and construction.

Other security measures:

- the container has to be sealed;
- the container has to be brand along outside on readable and permanent way with:
 - mark of identity, granted by the competent government;
 - serial number so each package of the same model could be recognized;
 - the terms TYPE B (U) of TYPE B(M) of TYPE B(U)F of TYPE B(M)F;
 - cloverleaf wrought or marked on the outside covering resist against water and fire.

2.5.5. *Type C packages*

Type C packages may be transported by air carrying radioactive material in quantities exceeding either 3000 A₁ or 100 000 A₂, whichever is the lower for special form radioactive material, or 3000 A₂ for all other radioactive material. Whilst Type C packages are not required for carriage of radioactive material by road in such quantities (Type B(U) or Type B(M) packages suffice), the following requirements are presented since such packages may also be carried by road.

Type C packages shall not contain:

- a) Activities greater than those authorized for the package design;
- b) Radionuclides different from those authorized for the package design or;
- c) Contents in a form, or physical or chemical state different from those authorized for the package design;

as specified in their certificates of approval.

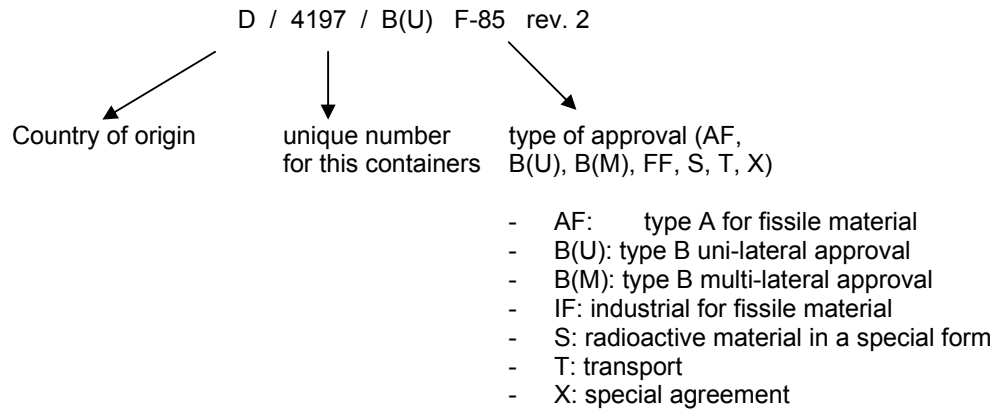
Each type C package design shall require unilateral approval except that a package design for fissile material shall require multilateral approval.

2.5.6. *Packing identity*

For example: TN6-1, BG 18, MTR

2.5.7. Packing approval

For example



2.6. Documents

2.6.1. Transport license

There are three type of licenses.

2.6.1.1. General license

Authorized to transport companies for regular transport of radioactive material during max 5 years the license can be extended.

2.6.1.2. Particular license

Authorized to a transport company to transport only once radioactive material.

2.6.1.3. Special license

Authorized for only one transport arrangement that exceeded the limits of the general and particular license. Within the same special license more than one transport of a loaded container is allowed. We have three classes of special license:

Klasse 0: no special requirements.

Klasse III: presence of two drivers is required in the truck.

Klasse II: presence of two drivers is required in the truck and the transport is accompanied by a vehicle equipped with intervention material.

Klasse I: presence of two drivers is required in the truck and the transport is accompanied by a vehicle equipped with intervention material. Supervision by the police during the transport and permanent radiocontact between the vehicle and the central communication centre is obliged.

RIS/7 S.015.BG.02.098

RIS: Radiation Ionizantes

6: import

7: transport

A: general license

B: particular license

S: special license

SI: special license international

015: identification of the license holder

BG: letter code indicating the difference between the licenses of the license holder

02: year of approval

098: rank number of the license

2.6.2. Transport insurance

Always required for each transport, certificate of financial guarantee.

2.6.3. Determination of the category

| Category | Transport index | Maximum radiation level at any point on external surface at 1 m distance |
|--|-------------------------------------|--|
| I-white | 0 | Not more than 5 μ Sv/h (0.5 mrem/h) |
| II-Yellow | More than 0 but Not more than 1 | More than 5 μ Sv/h (0.5 mrem/h) but not more than 500 μ Sv/h (50mrem/h) |
| III-Yellow | More than 1 but Not more than 10 | More than 500 μ Sv/h (50 mrem/h) but not more than 2 mSv/h (200 mrem/h) |
| III-Yellow and under exclusive use | More than 10 | More than 2 mSv/h (200 mrem/h) but not more than 10 mSv/h (1000 mrem/h) |

Except for consignment under exclusive use the transport index of any individual package or over pack must not exceed 10. In addition for fissile material the criticality safety index of any package or over pack must not exceed 50. The CSI may be zero.

2.7. Back side document 151 control by arrival or departure (Figure 7)

Always to be completed before the truck leaves the SCK site.

Figure 7 Back side document 151



Ph C nr :

To be completed by radiation protection agent

13 DEPARTURE - ARRIVAL

Date : _____ Hour : _____

14 Category of package : _____ 15 Criticality Safety Index:

I-WHITE

II-YELLOW

III-YELLOW

Transportindex :

16 Dose rate measurements : _____ Unit : $\mu\text{Sv/h}$: mSv/h :

Maximum in contact with the package

Maximum in contact with the vehicle

Maximum at 2 m distance from the vehicle

Maximum on drivers seat

17 Contamination controle :

Removable α - contamination on package : _____ Bq/dm^2

Removable $\beta\gamma$ - contamination on package : _____ Bq/dm^2

Controle of cargo space : _____

18 Documents available ? Yes No

19 Labelling of the package conform the category? OK

20 Labelling of the truck and cargo space closed
en werd de laadruimte afgesloten ? OK

21 License plate of truck : _____

22 Remarks :

Operator : SKV-

Name :

| | | | | |
|--|-----|----------------------------|------|-----------------------------|
| Isotopic Composition (before irradiation) | U : | ^{233}U = % | Pu : | ^{238}Pu = % |
| | | ^{235}U = % | | ^{239}Pu = % |
| | | ^{238}U = % | | ^{240}Pu = % |
| | | | | ^{241}Pu = % |
| | | | | ^{242}Pu = % |

In case the transport contains different materials with different characteristics, an information sheet should be completed for each type of material.

3. Additional information

3.1. Transfer of nuclear fuel materials towards SCK•CEN – LHMA (Figure 8)

All this information has to be provided by the consignor of the fuel, before the shipment, in order to make it possible for the consigner to:

- inform the safeguard correctly;
- have irradiated fuel data used for the waste characterisation program "CARAFVAL";
- check the transfer data after the unloading of the container.

3.2. European regulation N° 1493/93 and 92/3

Those regulations shall apply the shipments between Member States of sealed sources, other relevant sources and waste.

The request for a license is remarkable different for transport of encapsulated sources and other relevant sources. Always try to use "the relevant source" if possible.

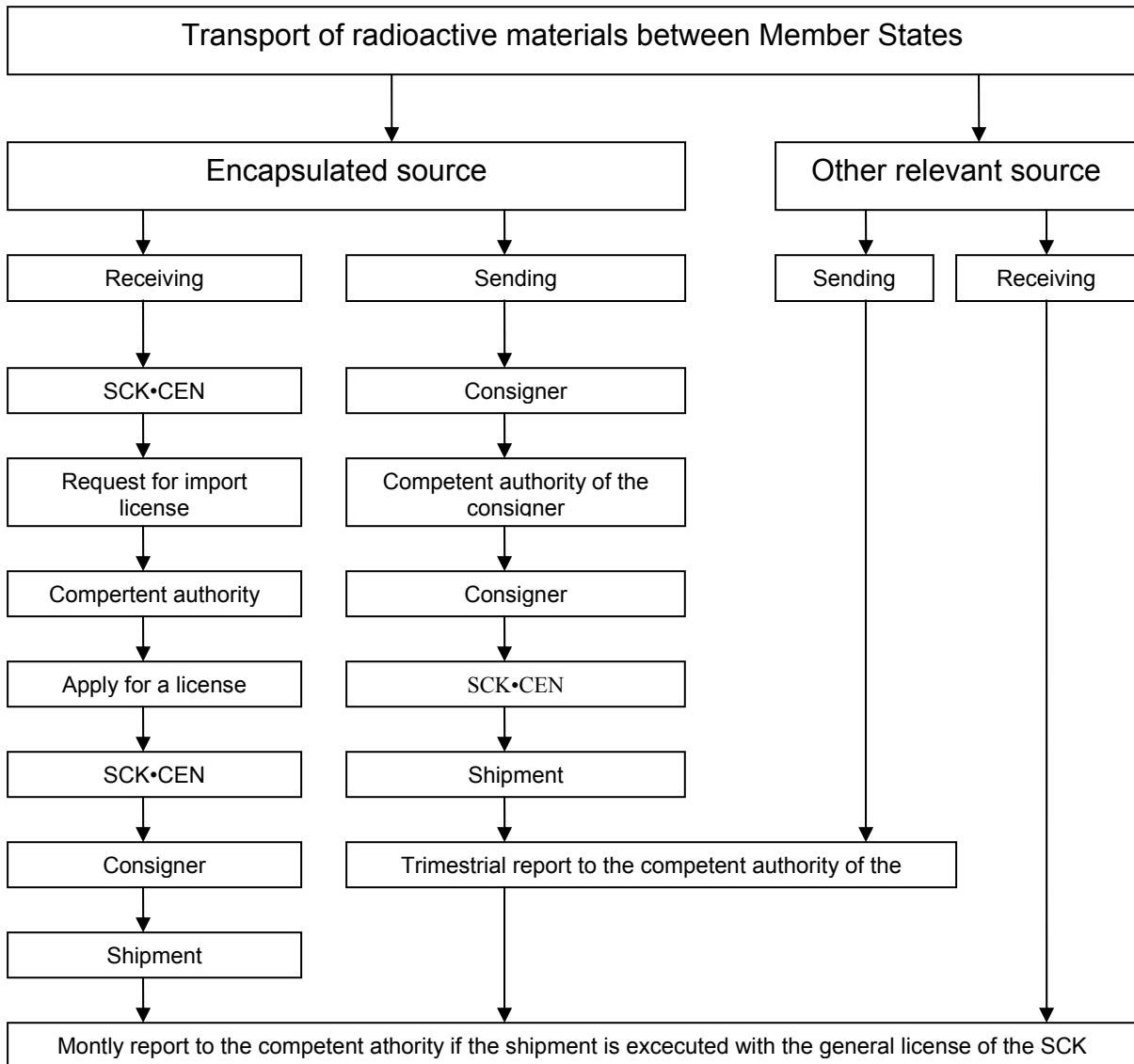
Sealed source

Radioactive material that is permanently sealed in a capsule or closely bounded and in solid form. The capsule or material of a sealed source shall be strong enough to maintain leaktightness under the conditions of use and wear for which the source was designed, also under foreseeable mishaps.

Relevant source

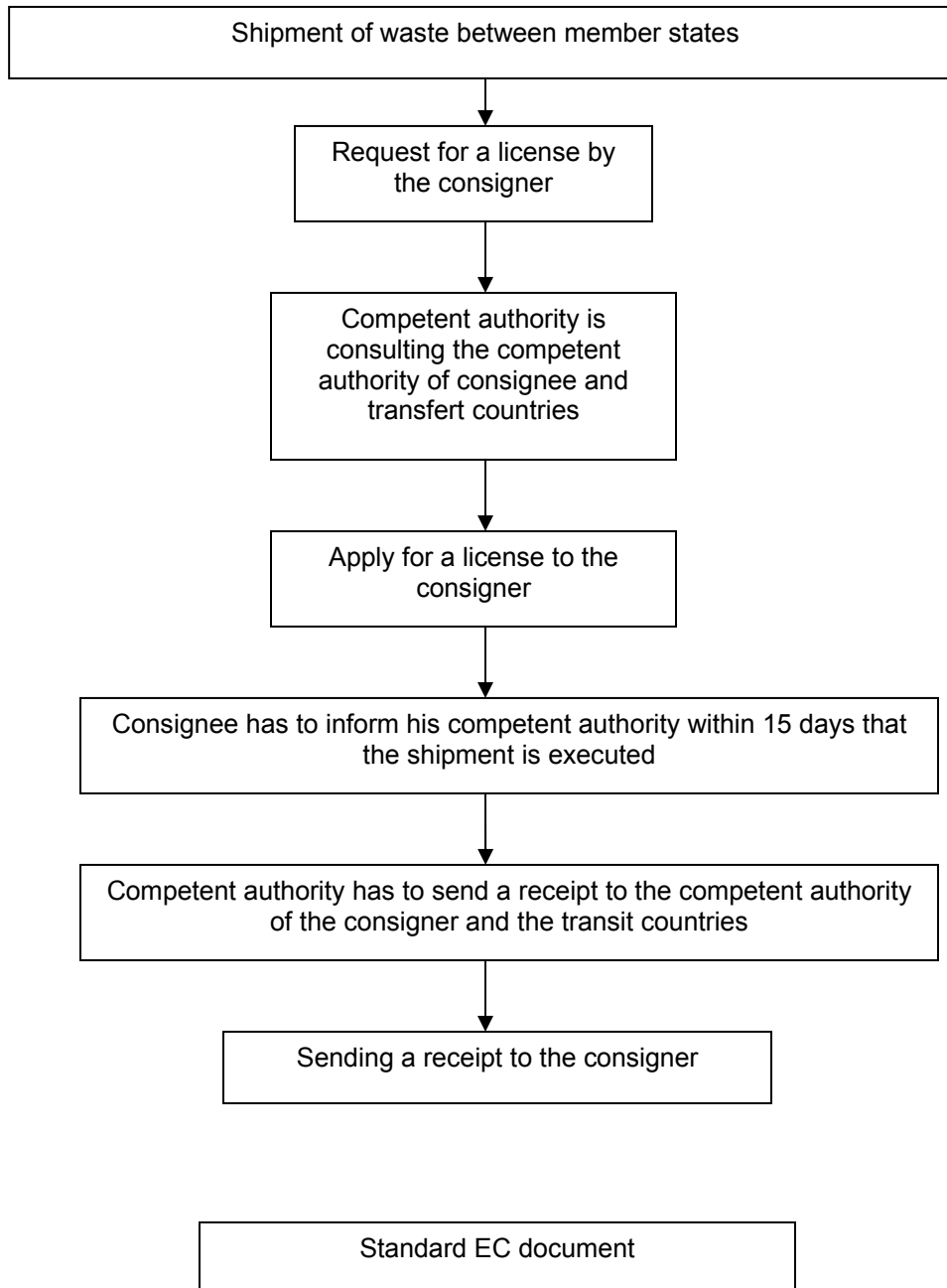
Any radioactive substance seat being a sealed source intended for direct or indirect use of the comising radiation.

3.3. Shipment of encapsulated and sealed sources European regulation N° 1493/93



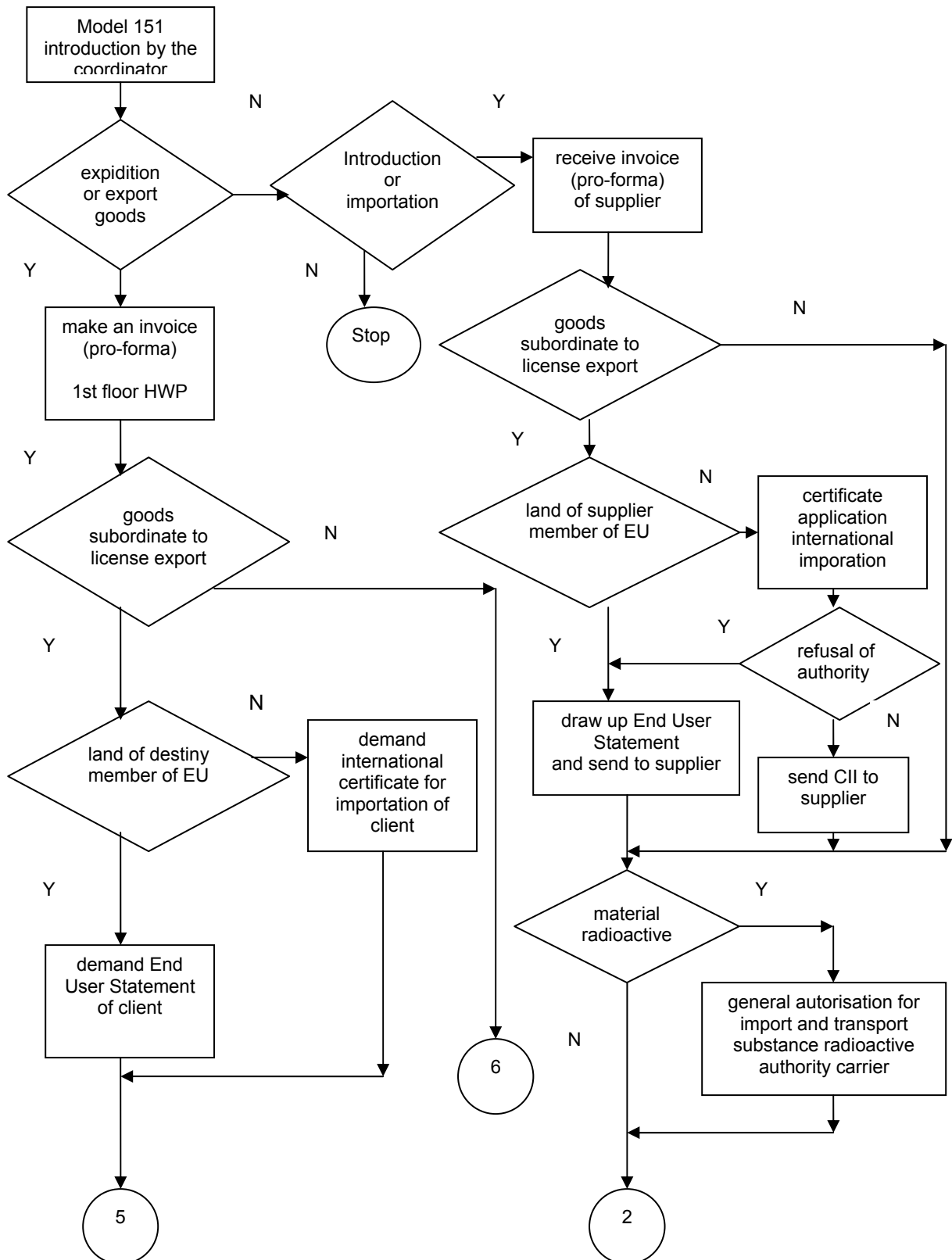
3.4. *Shipment of waste (92/3)*

The flow chart for the shipment of waste between EC countries is totally different from the flow chart for sources (see 3.3)

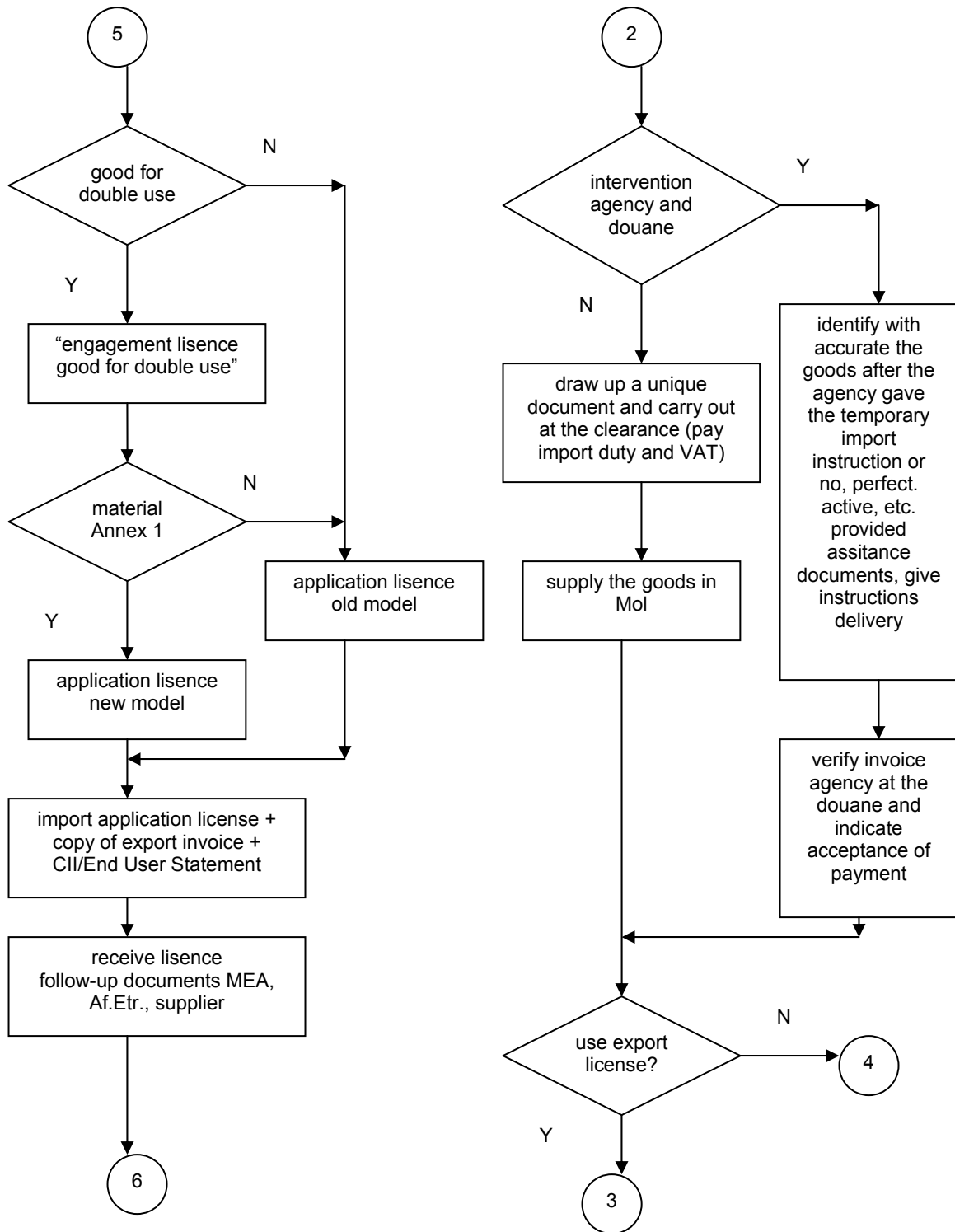


3.5. *Flow-chart of the SCK•CEN import-export QA procedure*

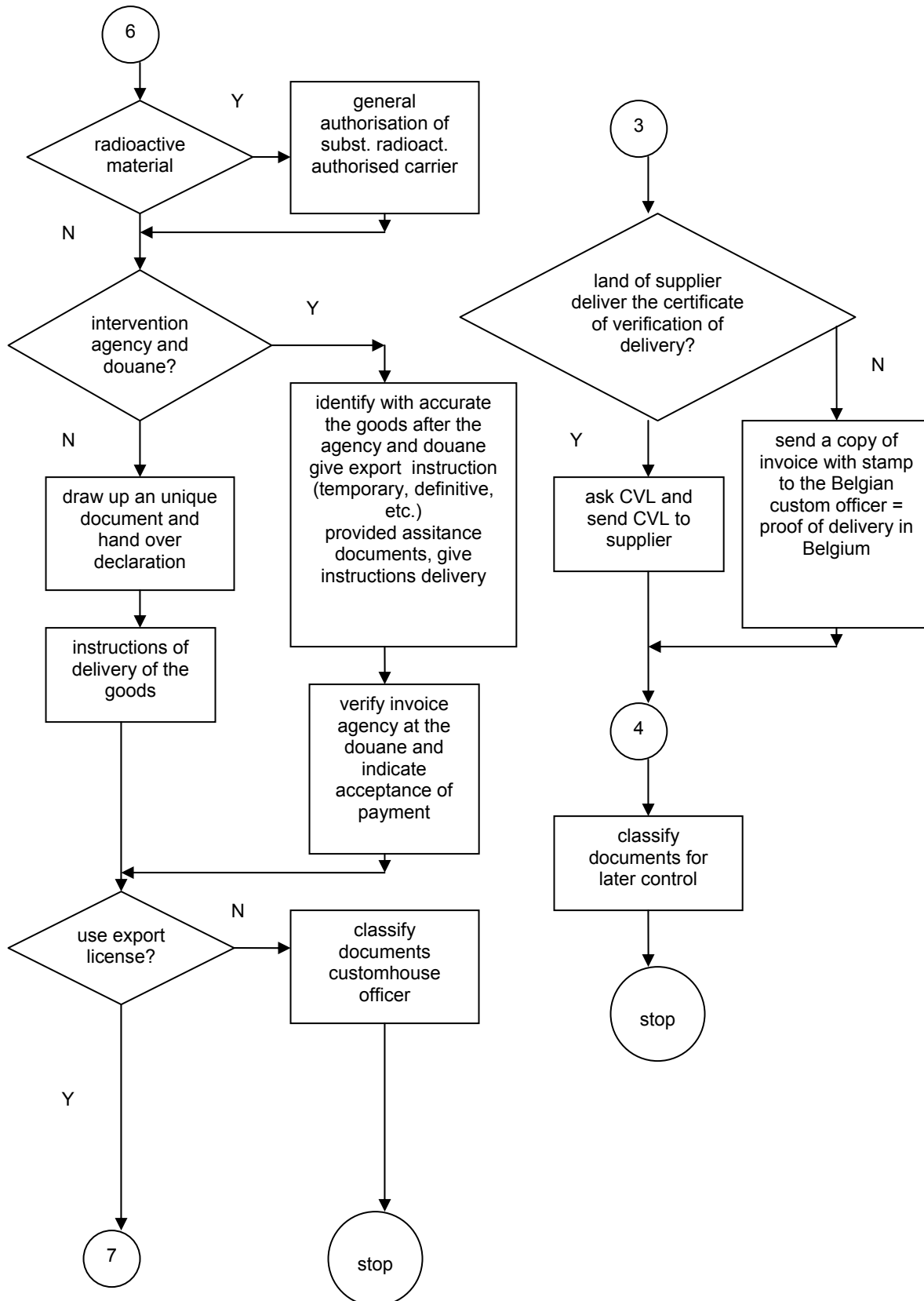
This flow-chart gives an impression of the amount of work to do between the moment that the coordinator has send his request to the radiation protection officer and the final approval for the transport of radioactive material.



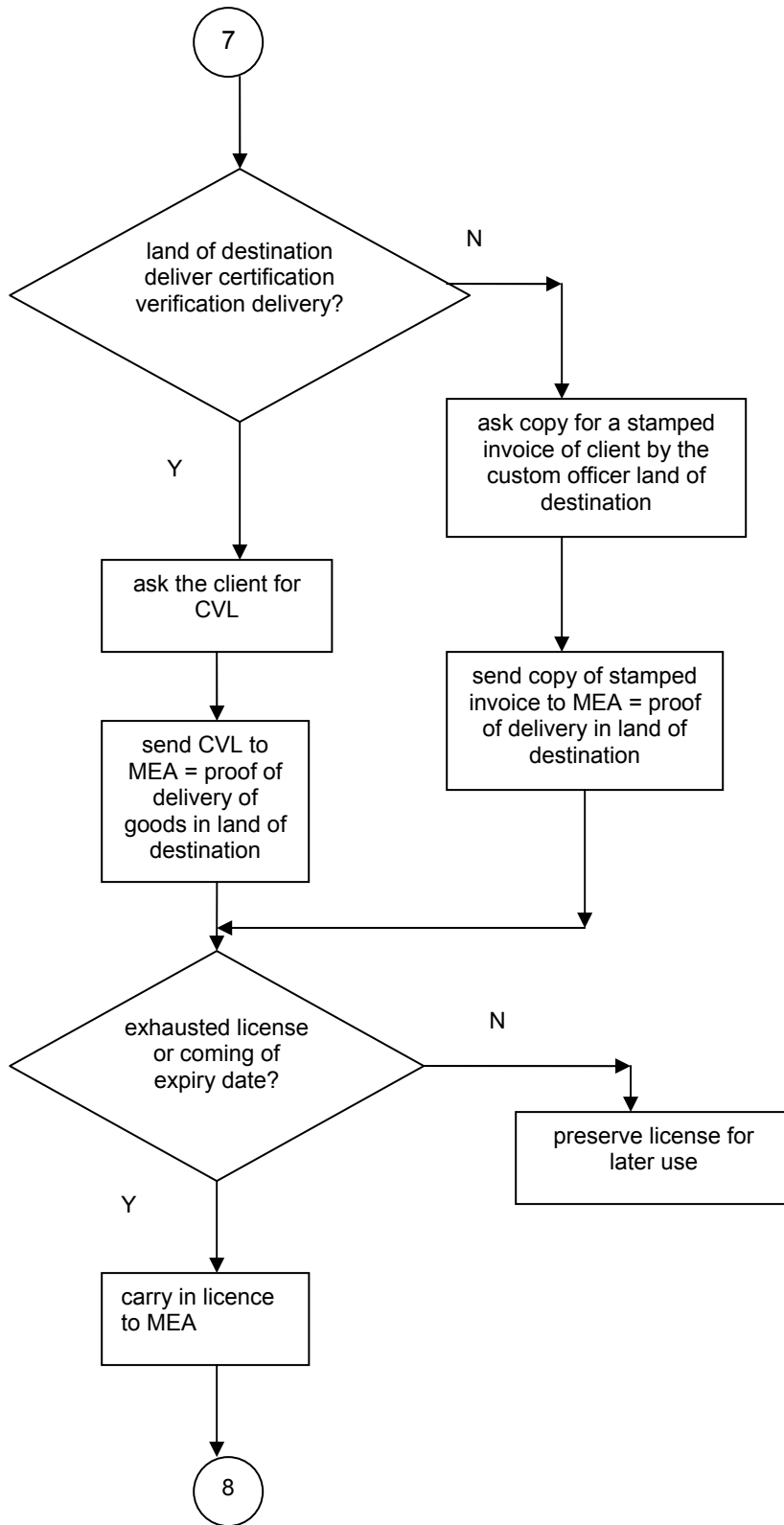
- *CII: International import certificate
- *MEA: Ministry of Economic Affairs
- *Af. Etr.: Ministry of Foreign Affairs
- *CVL: certificate of verification of delivery



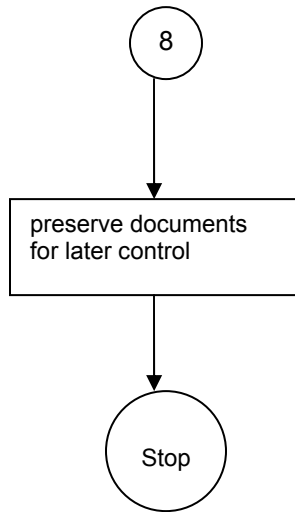
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