Impact of IAEA 85 Implementation on Transport of Medium Level Waste in France

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1. SCOPE

For a long time, medium level wastes generated by EDF reactors (such as ion-exchange resins and filters) have been immobilized within a solid matrix and packed in concrete cylinders. These concrete cylinders are then sent to ANDRA low/medium level waste storage site.

According to the previous transport regulation (IAEA 1973), these packagings were classified as Industrial Packagings, and they were transported by railways and road as such.

Since the implementation of IAEA 1985, some of these packagings - with the more irradiating contents - are no longer classified as IP but as type B packagings, because the dose rate at 3 m of the unshielded content exceeds 1 rem/h.

The concrete cylinders are considered as a standard equipment by EDF, and furthermore they have been licensed by ANDRA for long term disposal in compliance with the storage regulations. Therefore, any change in the design of the disposal conditioning would entail operational and financial burdens.

EDF requested TRANSNUCLEAIRE to handle this problem and to find a solution meeting the IAEA 1985 regulation while keeping the handling/transport operations of the new package as simple as possible.

The purpose of this paper is to describe the solution proposed by TRANSNUCLEAIRE and to explain its justification as regards IAEA regulations.

2. TRANSPORTS OF EDF MEDIUM LEVEL WASTE

2.1 Description of the cylinders

The different medium level wastes produced by EDF during operations of their power plants are the following:

- ion-exchanger resin,
- primary loop filters,
- concentrates,
- various irradiating wastes.

All these wastes are placed into two main families of concrete cylinders named C4 (outside diameter 1100 mm, height 1300 mm) and C1 (outside diameter 1400 mm, height 1300 mm). Within these two families, there are different versions according to concrete wall thickness, presence of additional lead shielding, etc..

But the basic features of these cylinders are common to all types :

- cylindrical container with a wall and a bottom made of concrete slightly reinforced by steel rods,
- optional layer of lead for additional shielding,
- thin layer of polystyrene to accommodate differential thermal expansion,
- internal layer of carbon steel,
- the cylinders are plugged with cement or resin, poured in place after loading the wastes in the cavity,
- at the top side of the cylinder there is a groove used for lifting and handling.

Figure 1 shows typical C1 and C4 cylinders.

The total mass of the cylinders ranges from 2500 kg to 5000 kg.

For such cylinders, the activity of the content results from activation products such as mainly Co58, Co60, Mn58.

Total volumic activity in a cylinder varies from a few Ci per cubic meter to 1500 Ci/m^3.

Every year, EDF operations generate around about 2500 such cylinders.

2.2 Regulatory aspects

Inside the cylinders, the radioactive waste is mixed with or surrounded by a binding agent such as polyester resin or cement.

Therefore, according to previous IAEA regulations, this type of material was classified as Low Specific Activity (LSA - Paragraph 121 (d) of IAEA 73 (as amended)).

The activity inside the cylinder is considered as uniformly distributed and the average estimated specific activity does not exceed 10^{-4} A2/g (at least 10^{-3} Ci/g).

In the IAEA 85 regulation, as concerns specific activity of the material, it can be classified as LSA 2 or LSA 3. It means that the cylinder will be an IP 2 packaging because the transport is made in exclusive use.

Nevertheless, a new requirement is imposed by IAEA 85. Paragraph 422 of IAEA 85 (as amended 1990) requires that if the radiation level at 3 m of the unshielded content exceeds 10 mSv/h, the cylinder cannot be an IP packaging anymore. In fact, in this case, the cylinder must be a type B packaging.

2.3 Consequences of IAEA 85 requirement

The number of EDF cylinders which could be affected by this new imposition is about 500/year (out of a total of 2500/year).

This new imposition concerns essentially the cylinders containing ion-exchanger resin and primary loop filters.

The large number of cylinders involved explains why it was important for EDF to develop a type B cylinder remaining as simple as possible, and that could be handled by the existing means at EDF power plant and at ANDRA facility. EDF requested TRANSNUCLEAIRE to investigate this new problem and to make recommendations to meet these objectives.

3. TRANSNUCLEAIRE SOLUTION FOR A TYPE B CYLINDER

3.1 Principles

Very quickly, it appeared obvious that the classical solution for a type B package (i.e tight containment vessel with gaskets, shock absorbers, etc...) will not satisfy both handling conditions and price objectives.

It therefore seemed necessary to use the particularity of the content itself to demonstrate that the cylinder is in compliance with type B requirements.

As already mentioned, the content of the cylinder is a radioactive material mixed with or surrounded by a binder such as polyester resin or cement.

This type of concrete cylinder with its content had been tested in accordance with the very severe criteria of the agency responsible for their storage (ANDRA). It had been shown that the contents of these cylinders withstand lixiviation tests with a release rate substantially lower than the limits of IAEA 85 for B type in normal conditions (10^{-6} A_2/h i.e 4.10^{-7} TBq/h)

Therefore, the idea was to demonstrate that in accident transport conditions, the content of the cylinder was still able to present a very low activity release. For that, it was necessary to show that, after drop, puncture and fire tests, the content of the cylinder was still undamaged.

3.2 Development of TRANSNUCLEAIRE overpack

It is clear that if an unprotected cylinder is submitted to a 9 m drop, its concrete shell will break and that the content could be exposed to the flame during the fire test. Direct exposure to the flame is not acceptable because in this case, resin or cement would reach a high temperature and release more activity than allowed.

TRANSNUCLEAIRE developed its overpack with the following philosophy :

- Prevention of activity release is made by the content itself (radioactive wastes immobilized in resin or cement matrix)

  On the basis of previous tests, it is shown that if the matrix remains below 120°C, no activity release occurs from the matrix.

- The concrete cylinder must remain in place around the content after the drop and puncture tests in order to act as thermal insulation during the fire test. However some limited cracks can occur in the concrete without any further problems during fire test.
- In order to maintain the integrity of the concrete during drop and puncture tests, it can be surrounded by a steel overpack.

A sketch of this overpack is shown in figure 2.

At the moment, two 9 m drop tests campaigns have been performed on C1 and C4 half scale models showing that with this steel overpack, the resin or the cement matrix of the content remains undamaged and well protected in order to withstand fire test.

The next step will consist in manufacturing several full scale prototypes to perform drop, puncture and fire tests, with temperature instrumentation of the representative inactive content in order to show that it remains below allowable limits.

3.3 Industrial operations with the overpack

We have drawn on fig. 3 the flow chart of tests and operations to be performed for transport of the cylinders under IAEA 85 regulation.

The first step is to decide, using dose rate measurements outside the cylinder and reading of a correlation table, if a type B is necessary or not.

If not, the cylinder remains an IP cylinder without overpack and the transport is performed as usual.

If the test shows that a type B packaging is necessary, a steel overpack must be placed around the concrete cylinder at EDF power plant and removed upon arrival at ANDRA storage site.

The design of the steel overpack allows for automatic locking of the steel cylinder onto the steel bottom in order to reduce as far as possible personnel dose rate exposure.

4. CONCLUSION

On behalf of EDF, TRANSNUCLEAIRE has defined a strategy and designed a simple overpack with a view to allow transformation of concrete IP cylinder into type B packagings.

The existing concrete cylinders can remain in use, avoiding a new qualification in accordance with long term storage criteria.

This overpack has been designed to provide simple and efficient handling conditions which remain very close to those of the unprotected concrete cylinders.

FIGURE 2

TRANSNUCLEAIRE OVERPACK

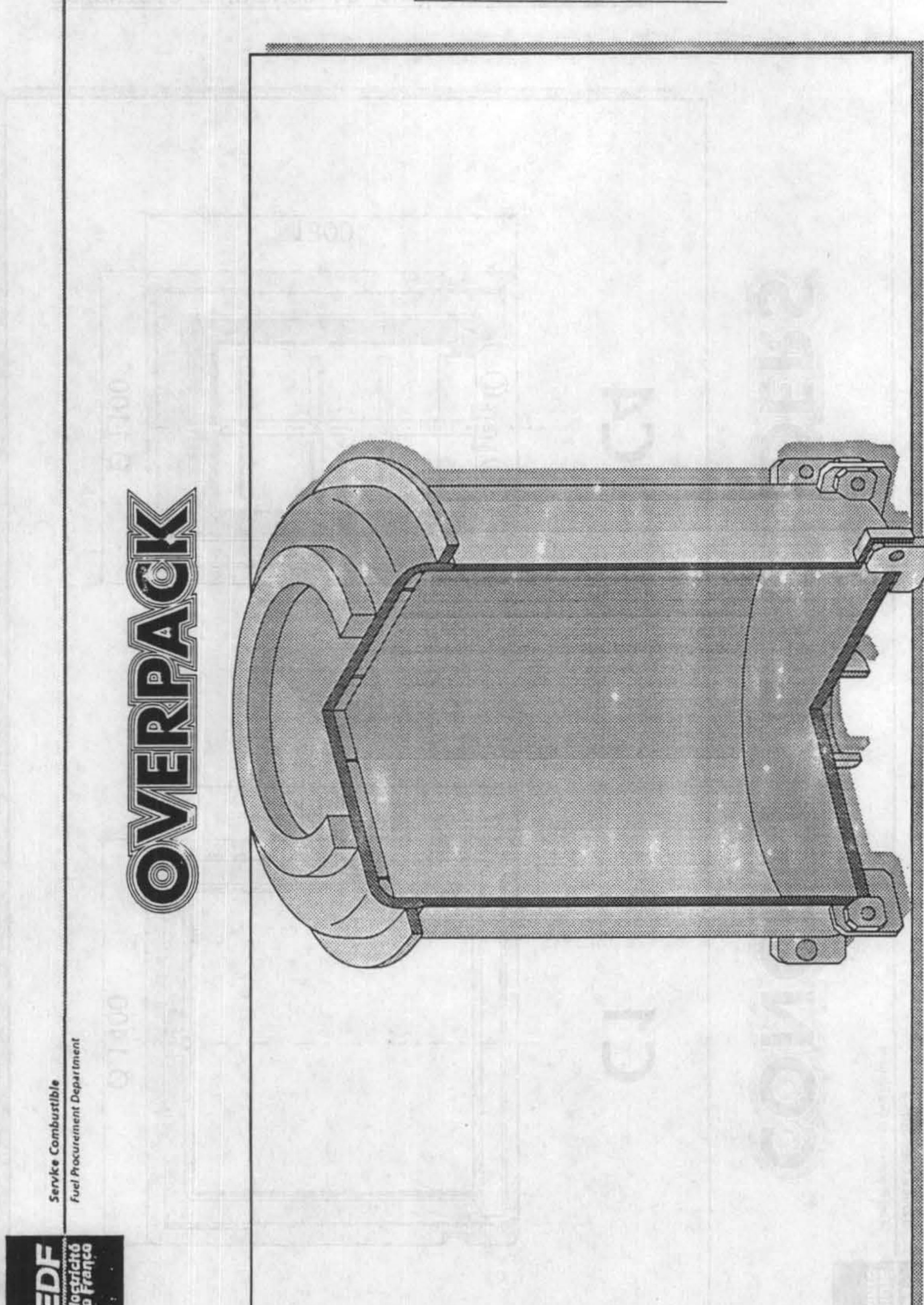


FIGURE 1

EXAMPLES OF C1 AND C4 CONCRETE CYLINDERS

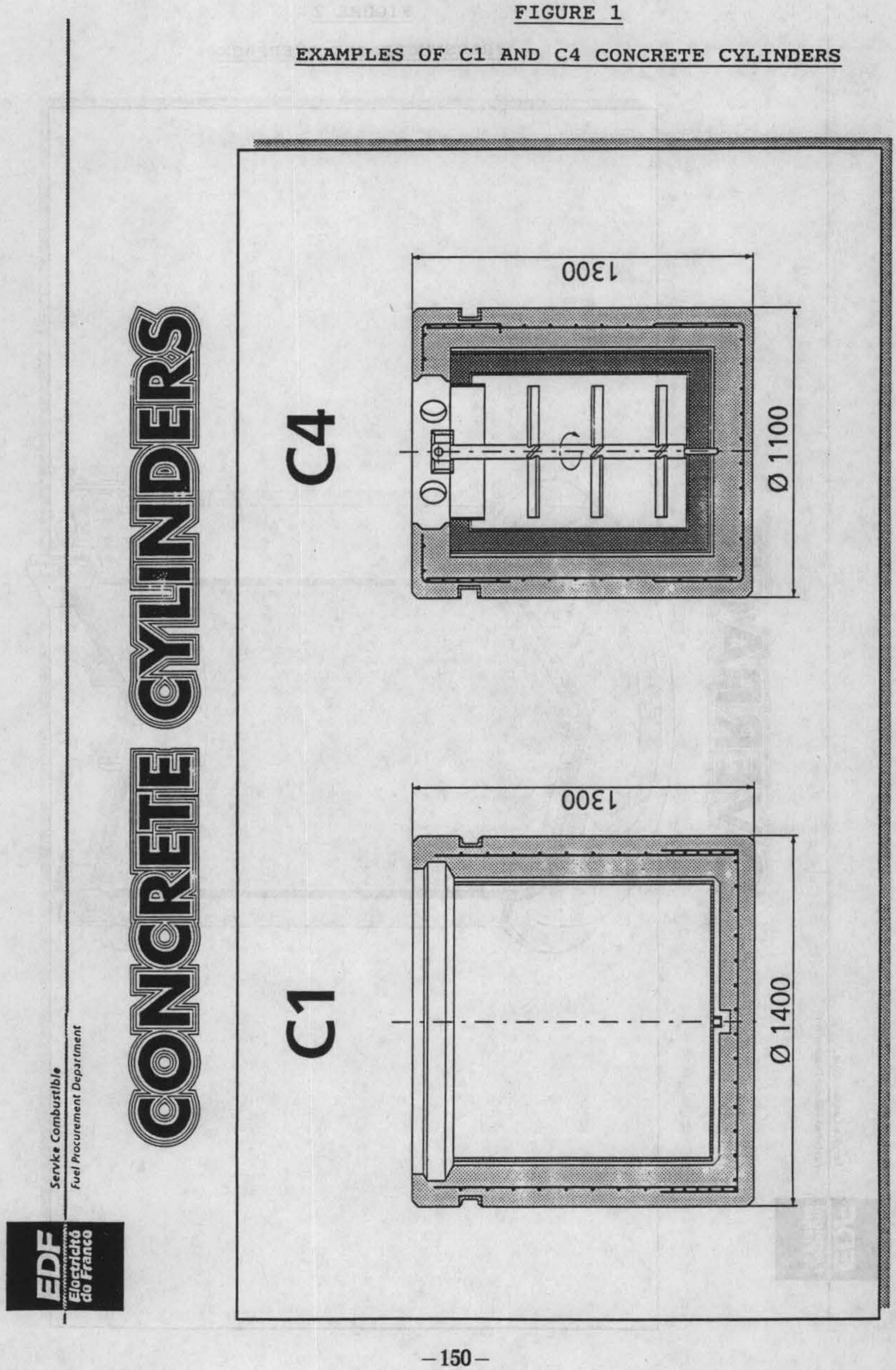
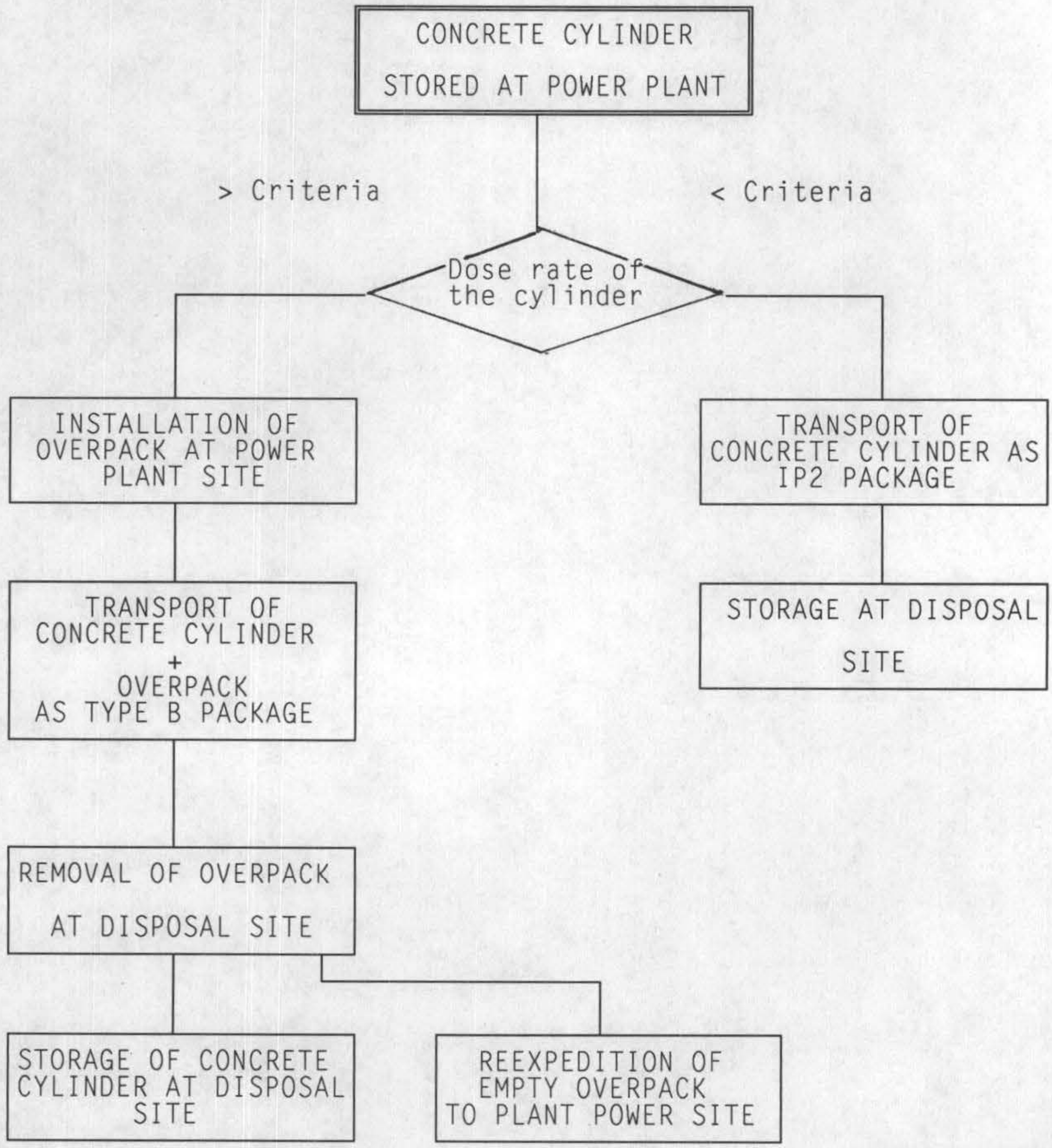


FIGURE 3

OPERATION DIAGRAM FOR TRANSPORT OF EDF MEDIUM LEVEL WASTES



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