# How Packaging Fleet Renewal Fits French CEA Programs

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## ABSTRACT

CEA’s (French Atomic Energy Agency) packaging fleet is dedicated to transportation of test irradiated fuels, of research reactors fuels, of navy propulsion fuels, and of waste coming from and to nuclear plants or facilities. This fleet encompasses more than 30 types of casks ranging from 5 to 30 tons, with either recent designs or other dating back to the seventies. A study has been launched in order to perform a global analysis of the life expectancy of the existing CEA and COGEMA Logistics cask fleets with respect to a 2015 target, in order to anticipate its renewal, while limiting the number of type of cask. Key elements like periodical evolutions of design and transport regulations, lessons learnt of existing casks (design, approval and extensions, operational feedback, maintenance and dismantling) are taken into account in order to ensure compliance and availability of the fleet. Moreover, from design to cask delivery, including regulatory tests, safety analysis report/ CoC, and manufacturing, 3 to 5 years is needed. Therefore cask development should be taken into account earlier of invest and research’s programs. The paper will address the current life expectancy study of CEA and COGEMA Logistics packaging fleet, based on lessons learnt and regulation evolution and on general R&D plans by user facilities. It will show how a comprehensive optimized fleet is made available to CEA and other customers. Such a fleet combines optimized investment and uses, thus entailing synergies for well-mastered costs of transports.

## FLEET INVOLVED

The existing fleet for CEA and COGEMA Logistics is composed of more than 3000 casks:

1. 37 for public road transports
2. 780 for internal nuclear site transports
3. 811 for on site intermediate storage
4. the remaining casks are waiting for decommissioning (1)*.  All different types of casks are coming from specific design accommodating and suitable with each nuclear facility. The following table summarizes the types for each content and number of casks.

Table I. Types for Each Content and Number of Casks

| **Not exhaustive list of casks** | **Types Number** | **Casks Number** | **Content** |
|---|---|---|---|
| Irradiated materials for laboratory research and reactor needs | 20 | 35 | Irradiated rods, plates, fuels, fuel parts, pellets |
| Non Irradiated Fissile contents | 12 | 2500 | Radioactive materials, uranium, plutonium in several chemical or physical forms |
| Residues and waste | 15 | 200 | Solid or liquid waste, activated or contaminated rejections |
| Transport Shells and Others | 25 | | Dismantling nuclear plant waste, low level waste, Radioactive sources… |

*60% of approvals are under IAEA 73, 35 % under IAEA 85 and the others under IAEA 96.*

(1)* See Poster Section « Package Dismantling » ref 6416



**EXAMPLES**

Fig. 1. IL47 cask

Used for irradiated uranium fuel rods or rod parts from UNGG reactors Commissioning date: 1980 Last license reference: F/231/B(U)F 30/04/97 under IAEA 1973

(1)* See Poster Section « Package Dismantling » ref 6416

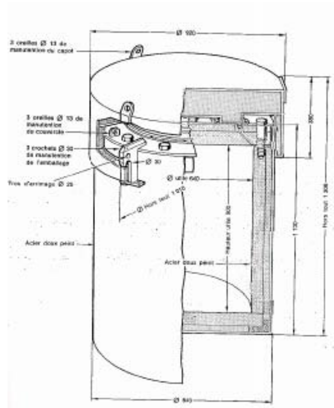

Fig. 2.  RD16 cask

Used for radioactive solid waste; Commissioning date: 1974; Last license reference: F/214/B(U)F 30/11/94 under IAEA 1973

## EVOLUTIONS OF IAEA RECOMMENDATIONS

The regulation requirement evolution for the safe transport of radioactive material induced more safety.

IAEA 85 regulations laid downs for the first time, quality assurance for cask design and manufacturing. These regulations required also for cask design the ability to withstand transport accidental conditions at low temperature.

IAEA 96 regulations recommend assurance quality regulations in design methods and test process. These regulations lay downs to:

- Consider water immersion tests under 200 m of water for type B(U) package.
- Water leaking into or out of casks to maintain sub-criticality during normal and accident conditions.
- Updating of radionuclide toxicity index : A1 and A2 values.

Manufacturing of cask under IAEA 73 approval is forbidden by IAEA 96, and manufacturing of new casks under IAEA 85 will be forbidden after December 2006, 31st.

Designers and worldwide competent authorities have applied these regulations under even more prescriptions such as:

- No risk of brittle fracture of containment barriers at low temperature.
- Guarantee leaktightness.
- Mechanical characteristics of actual casks have to be better than those of test mockup.
- Manufacturing of mock-up under quality assurance program.
- Tacking into account risk of radiolysis, permeability of containment seals.

To obtain approval for old packages under these new regulations can be quite difficult and often impossible.

## LESSONS LEARNED

### From user facilities

The main operator requirements are related to safety and training aspects.

- A common practice for container loading and unloading operations which are to handled inside controlled areas of nuclear facilities consist of performing cold tests prior to any operation. This requirement of cold qualification is motivated by safety. This check up allows the control of all necessary handling steps and operations in a safe situation during the whole process or in case of anomalies. For instance, after a loading operation it must be possible to reverse the situation and unload the content if necessary. Furthermore, this control must validate the working method and the operator training.
- Concerning design studies, the handling of packages and the leak tightness tests must be performed horizontally in order to prevent any height work.
- Some improvements must be integrated on packages including their tools equipment : for instance, possibility to remove sideways the shock absorbers by limiting their handling.
- To apply ALARA method to reduce the worker dose rates.

### From licenses and new contents delivered

According to IAEA recommendations, licensing process upgrades to high-level quality:

- Design methods (criticality calculation software for example) have to be qualified according to specific tests or measurements.
- Drop test mock-up manufacturing process is achieved with high level of reporting. Mock-up’s characteristics (dimensions, mechanicals, materials, containment screwing system…) have to be perfectly known to evaluate actual behavior of casks under accidental conditions.
- Cask materials have to be have adequately at low temperature.
- Restraining hypothesis, as radiation effect on hydrogen material for example lay down to decrease contents mass.
- Tightness has to be controlled before each transport operation if necessary.

Adaptation of the cask design concept could therefore require a new approval from authorities (such as new seals, shock absorbers or modification of the cavity).

**From maintenance**

- **Types of maintenance:**

  - Preventive maintenance (in compliance with safety analysis report and approval) which is depending on the frequency of cask utilization (cycles) and/or cask in service duration with:

    1. The dismantling of each part of the cask where a damage or wear is noticeable
    2. The check of the handling points
    3. Leak tightness test defined for cavity and seals
    4. Visual aspect checking
    5. Inspection of components and replacement if any
    6. Decontamination if necessary
    7. Spare parts mainly used
    8. …

  - Corrective maintenance (incidents) during normal operational conditions (loading and unloading): Generally screws, seals, helicoil replacement

- **Data collecting process**

The data collecting process consists of identifying all sources of information that can be used to build the maintenance feedback and report it in a database. The database is analysis with frequency approach per Non Conformity type and casks. The report is used, on one hand, to find as soon as possible a solution to the event and hence sort out a corrective or preventive action and in other hand to give maintenance feedback for each new design study.

Example of feedback regarding the fleet involved:

1. Ageing of casks: (seals, handling points and general outside cask aspect)
2. Evolution of leak tightness test criteria due to the new regulation or modification of the content
3. Difficulty to check the leak tightness of any cavity if test point is not included in the original design (necessity to use specific methodology, costly and taking a long time to implement it).
4. Specific facility tools to preserve seal faces, cavity, …

**SYNTHESIS**

With respect to 2015-year target date, we evaluate that 85 % casks will be renewed, and only 15 % could be re-usable.

Few of them will be upgraded (new containment seals or screwing system, new structure materials…), perhaps with limited contents. Some of the other will be downgraded (from type B to type A or IP2 for example). Others will be used as storage casks, but the most part of them will be decommissioned.

In the same time, new casks have to be developed. As example, the packages IL 28, IL 47 and TN™ 6/2 under IAEA 73 approval designed for irradiated UO2, MOX, RNR, MTR contents from laboratory research and reactor. They were replaced by the single TN 106 package (IAEA 96):

- Multi length of cavities for several contents.
- Horizontal loading/unloading and handling for more security
- Easy shock absorber removal
- Easy decontamination
- Easy trunnions checking and replacement
- Optimized weight for loading transport system less than 40 tons
- Few spare parts
- Dry and water loading/unloading

Fig. 3. TN™ 106 cask

**NEW NEEDS**

Considering the target date of 2015, the main research and dismantling programs are identified.

We notice:
- The dismantling of the fast breedor reactor Phenix from 2009 which requires to evacuate sodium waste,
- The startup of the JHR reactor from 2015
- Preparation of the Tritium transports for the startup of ITER reactor.

**CRITERIA FOR NEW CASK DEVELOPMENTS**

New casks will have to take into account all requirements of regulations for high-level of safety and will replace several old casks. The main criteria are the following:
- Cask materials (structure metals, seals, damper materials, internal system…) will be selected with the aim to have good behavior on a large range of temperature in drop and fire conditions.
- Specific phenomenons will be managed in transport such as radiation effect on hydrogen material, permeability of containment seal…
- New materials will give more margins with regulations criteria.
- Design including multi lengths of cavity.
- High quality of design method, tests, manufacturing and maintenance.

New casks could be easier to use, optimizing safety, and radiological issue for workers (ALARA) at the nuclear facility.

Multi-purpose use of new casks will be achieved in several actual and future nuclear facilities.

## CONCLUSION

This study performed by CEA and COGEMA Logistics, will allow to dispose in due time, optimized fleet for CEA and COGEMA Logistics needs.