

The UK TN GEMINI™ Fleet: Modernization, Maintenance, and Life Cycle Technical Services

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Abstract

LLW Repository Ltd, a key UK nuclear waste management company, is the custodian of three existing TN GEMINI™ Nuclear Decommissioning Authority (NDA) assets, that were manufactured and delivered by Orano TN in early 2000 and have not been operated for the past 10 years.

LLW Repository provides strategic Type B transport packaging capability through this TN GEMINI™ fleet to transfer legacy alpha contaminated drums from different UK nuclear installations to an interim storage facility.

As a high-integrity waste transport solution with an acclaimed French and British safety pedigree, the TN GEMINI™ container is a market-leading packaging, with high volumetric transport capacity and high flexibility in the variety of loaded waste.

LLW Repository has contracts in place with Orano TN, as the TN GEMINI™ Design Authority and manufacturer, to reinstate its existing UK fleet in full compliance and conformity with Safety Analysis Report (SAR) requirements. The scope of these contracts includes the modernization of the TN GEMINI™UK fleet and technical services for its maintenance and life cycle. These six-year contracts mark an important milestone in establishing a long-term partnership to achieve LLW Repository's mission for the safe and cost-effective transport of legacy waste. Orano TN will also supply new internal arrangements, recently approved by the Nuclear Safety Authority, enhancing the TN GEMINI™ container capacity to transport alpha contaminated waste.

The return to service of the TN GEMINI™ fleet has been brought about largely due to Orano TN's know-how acquired through the licensing, manufacturing, maintaining and operating of this Type B container for more than 20 years. To achieve full conformity and compliance of the fleet, specific and complex manufacturing operations have been deployed, sometimes making use of technology transfer from other business sectors or requiring a high level of skill in manufacturing the cask. The guiding principle in reinstating the fleet capability consists of maintaining SAR compliance thanks to an Orano TN multidisciplinary task force team.

The paper will describe some key challenges addressed by Orano TN in modernizing, maintaining, and providing life cycle technical services on the TN GEMINI™UK fleet during this exciting journey.

I - Introduction

LLW Repository Ltd, a key UK nuclear waste management company, provides services to customers to treat and dispose of low level radioactive waste, in addition to managing the national Low-Level Waste Repository in west Cumbria, on behalf of the NDA.

LLW Repository Ltd provides a strategic Type B transport packaging capability through its TN GEMINI™ fleet to transfer legacy alpha contaminated drums from different UK nuclear installations to an interim storage facility.

LLW Repository is the custodian of three existing TN GEMINI™ NDA assets that were manufactured and delivered by Orano TN in early 2000 and which have not been operated for the past 10 years.

LLW Repository contracted with Orano TN, the logistics subsidiary of the global nuclear fuel cycle company, Orano, as the TN GEMINI™ Design Authority and manufacturer, to reinstate its existing UK fleet in full compliance and conformity with Safety Analysis Report (SAR) requirements and to provide technical expertise during fleet life cycle management. The contracts cover the requirements of multiple UK nuclear Site Licensed Companies for a duration of up to six years, establishing a long-term partnership to achieve LLWR's mission for the safe and cost-effective transport of waste to a central storage facility at Sellafield.

To achieve full conformity and compliance of the fleet, a complete range of modifications, repair operations, and maintenance controls have been deployed, sometimes making use of specific packaging manufacturing knowledge. The guiding principle in reinstating the fleet consists of maintaining SAR compliance thanks to a multidisciplinary task force team.

In addition, Orano TN has licensed new TN GEMINI™ content (N°8 & 9) enabling Magnox to transport about 1000 HLW drums from Harwell to Sellafield from 2019 to 2024. These new internal arrangements, recently approved by the French Nuclear Safety Authority (ASN) and now awaiting the same from the British Nuclear Safety Authority (ONR), enhance the TN GEMINI™ container capacity to transport alpha contaminated waste.

Taking into consideration the Type B packaging program requirements, LLWR challenged Orano TN to commit to several objectives: develop a waste drum transfer program and a project critical path, mitigate technical risks, respect budgetary objectives, provide added value to assets, and prevent new packaging manufacturing expenses and delays.

Alan Jackson, the Type B packaging program director said: "LLWR's engagement with Orano TN for these products and professional services contracts embodies a key part of our mission. Not only does it represent LLWR's international outlook for the safest solutions to the UK's

waste transport program, but it also shows our commitment to gaining the best value for the UK taxpayers' money."

II - TN GEMINI™ packaging

a) Packaging history

As a high-integrity waste transport solution with an acclaimed French and British safety pedigree, the TN GEMINI™ container is a market-leading packaging, with high volumetric transport capacity and high flexibility in the variety of loaded waste.

The TN GEMINI™ was the Orano TN response to the necessity to improve alpha contaminated waste drum evacuation in replacement of RD26 packaging (only one drum per cask). The main studies for this high-volume Type B fissile transport cask started in 1994 (concept drawings, SAR, drop tests...).

The first license was obtained in 1997 for content N°1, and the first TN GEMINI™ cask owned by Orano TN was put into service the same year. The first French license extension for content N°2, Orano TN applied for, was obtained in 1998, and the first license renewal was granted by the French Nuclear Authority in 2000.

In 2002, three TN GEMINI™ casks were delivered to BNFL in the UK. Validation of the license for content N°3 (UK waste box) was obtained in 2006.

Up to now, six TN GEMINI™ casks have been manufactured for France, five are still in use and one is no longer in service. The last cask was manufactured in 2015 for the CEA.

The last French prorogation was obtained in 2015.

The last TN GEMINI™ license extension was obtained in April 2018 to introduce new content, N°8 and N°9, for new UK needs (LLW contaminated by miscellaneous Alpha and/or Beta-Gamma isotopes, conditioned in concrete lined drums).

b) Packaging description

The TN GEMINI™ is a well-proven Type B packaging that has been used for 20 years in France and in the UK. The TN GEMINI™ has internal arrangements made for different types of drums that contain fissile material and Alpha contaminated waste. The main characteristics are:

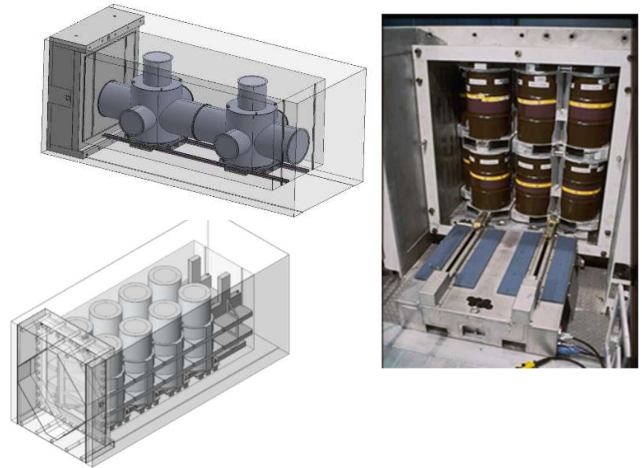
- Internal dimensions
 - Width: 1,840 mm
 - Height: 2,000 mm
 - Length: 4,510 mm



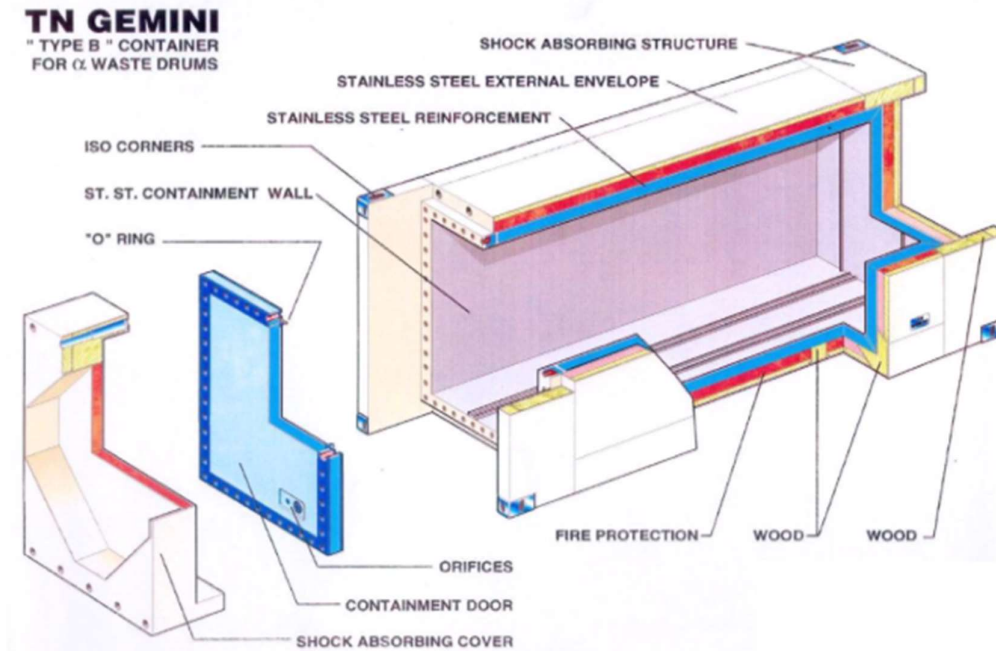
- Container with ISO corners
 - Dimensions:
 - 2,500 mm x 2,650 mm x 6,058 mm
 - Weight:
 - Empty: 24,200 kg
 - Total: 30,000 kg

The TN GEMINI™ content:

- Various internal arrangements to carry various sizes of drums
 - 100L or 118L (60 max)
 - 400L (2 max with 118L drums)
 - 220L, 360L, 640L
 - 870L (2 max)
- Waste box loaded with:
 - 200L drums (9 max)
 - 400L drums (5 max)



The TN GEMINI™ packaging design:



c) Orano TN expertise

Orano TN has been managing Type B packages for more than 50 years, ensuring life duration through license renewals and design modifications to guarantee performance.

Orano TN has vast experience in fleet life management and provides a complete range of services such as:

- Management of package documentation (instructions of use, specifications for maintenance, Lifetime Quality Records...)
- Management of spare parts
- Organization & execution of periodic regulatory maintenance & decontamination controls
- Design and manufacture of bespoke ancillary equipment
- Management of non-conformities
- Repair of damaged casks and design modifications
- Renewal of certificates

For customer-owned casks, Orano TN provides refurbishment, maintenance and repair services to ensure full quality compliance with transport regulations.

To meet the UK TN GEMINI™ fleet reinstatement challenges, Orano TN has deployed a tailor-made process and program based on its state-of-the-art expertise and knowledge in licensing, manufacturing, maintaining and operating such type B containers.

III – UK TN GEMINI™ fleet reinstatement

a) Reinstatement Program

Orano TN has developed a specific program to recondition the UK TN GEMINI™ fleet based on a step by step approach aiming to secure modernization and repair activities while mitigating technical, financial or schedule risks and constraints.

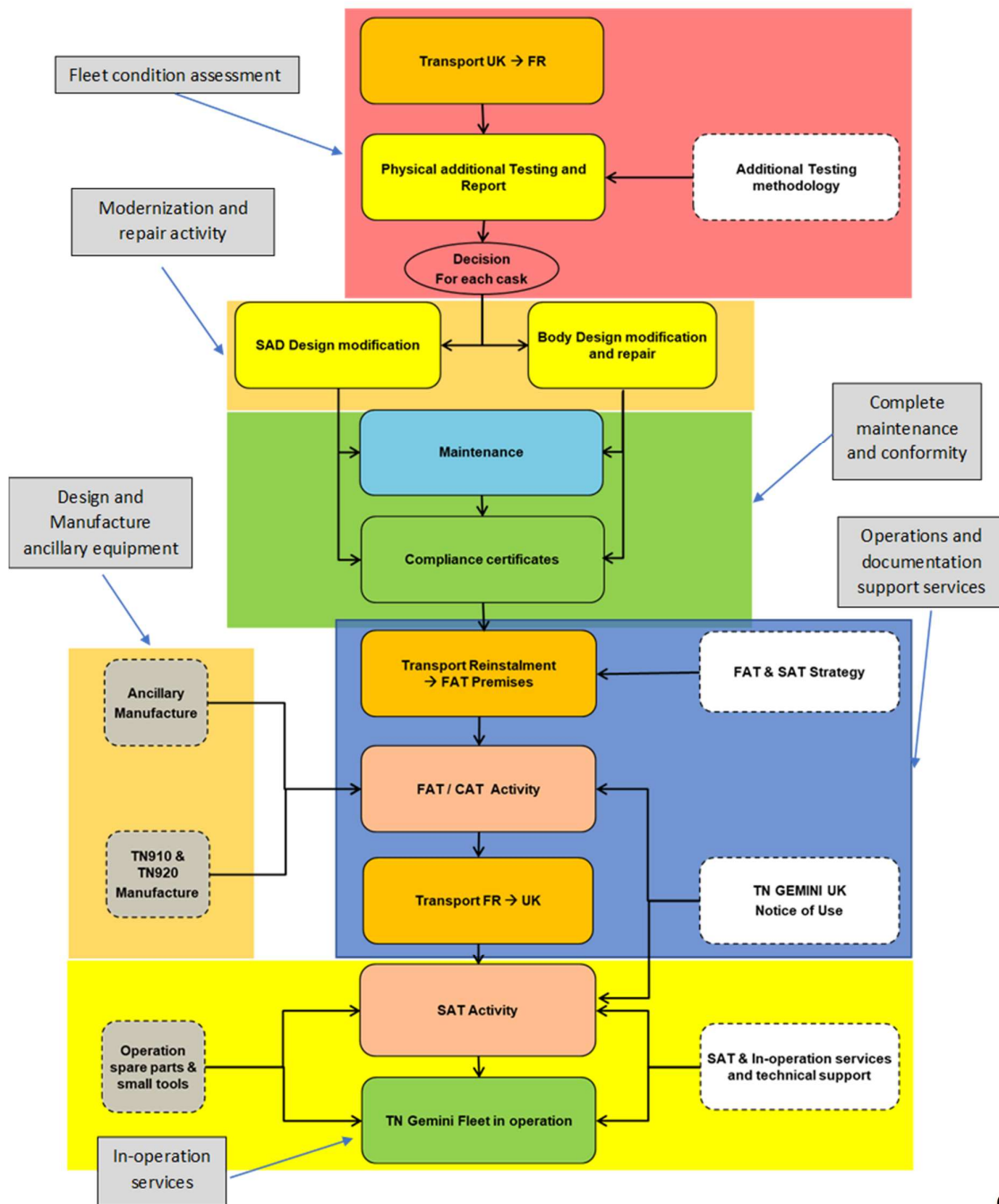
Throughout the project Orano TN and LLWR maintained constant communication on work progress and critical points when encountered to decide on program adjustments and mitigate risks.

Orano TN also worked closely with LLWR to establish and agree on the overall approach. LLWR needed to guarantee that the overall quality approach was acceptable as an Intelligent Customer under the UK nuclear Site License requirement. This work included the introduction of LLWR quality intervention points which Orano TN fully supported.

The reinstatement program was composed of the following seven main phases:

- Fleet condition assessment
- Modernization and repair activities
- Complete maintenance and conformity
- Design and Manufacture of ancillary equipment
- Operational tests and interfaces
- In-operation services

Program main activities:



b) Fleet condition assessment

The program, and more specifically the condition assessment work, was deployed to enhance cost savings opportunities through a risk reduction? approach with modernization and optional repair activities while meeting schedule milestones and the waste drum transfer commencement date objective. A detailed initial condition assessment and complementary tests and controls were necessary to identify and specify the reinstatement scope of work to return the existing fleet of three TN GEMINI™ casks to an acceptable standard prior to utilization.

A first condition assessment was carried out in the UK utilizing the local supply chain to check the packaging condition and define necessary complementary controls and tests so as to specify a repair method and which techniques to be implemented.

After taking custody of the packaging from LLWR in the UK the second complementary tests and controls were conducted in France at the manufacturing supplier facility of the TN GEMINI™ fleet. The purpose of the work was to validate, in the short-term, the feasibility of the repair activities and to mitigate identified risks. The work was carried out by a multidisciplinary team composed of Orano TN and the manufacturing supplier cask engineers and experts.

Based on the results of the complementary tests and controls on the first TN GEMINI™, the complete reinstatement program and schedule was drafted identifying cost saving opportunities such as the modernization and repair of the existing Shock Absorber Door (SAD) instead of the manufacturing of new ones.

c) Modernization and repair activities

Following the fleet condition assessment results and challenged by the overall program schedule and critical path, Orano TN issued “reinstatement specifications” related to modernization and repair work for the three TN GEMINI™ casks.

The specific work performed on the TN GEMINI™ SADs consisted mainly of the implementation of necessary design modifications such as the replacement of telescopic tubes, the definition of new wedges after inspection of the SADs.

The generic work done on all TN GEMINI™ casks (body, lid, and SAD) consisted mainly of the repair of all accessible surfaces (including sanding/blasting/painting as appropriate), and the complete replacement of all spare parts (gaskets, bolts, valves...).

d) Complete maintenance and conformity

Orano TN carried out a complete maintenance program on the three TN GEMINI™ casks in order to provide LLWR with a new “initial reference” for all future transportation and maintenance cycles.

To set this new “initial reference,” the complete range of maintenance and control activities in compliance with the SAR requirements were deployed on each cask

To optimize the overall program schedule, Orano TN has deployed the maintenance and control activities all along the modernization and repair activities.

Based on the maintenance report and Quality Plan, Orano TN will issue a Maintenance Certificate.

To validate that the fleet is compliant with the SAR, the Orano TN Engineering department and Safety/Quality department will issue the conformity certificate for the packaging design based on an initial manufacturing and reinstatement work conformity analysis.

Upkeep of the Lifetime Quality Records for the packaging reflecting the final position is an important element that Orano TN and LLWR work together to deliver.

e) Design and manufacture of ancillary equipment

In response to LLWR’s request for a full and complete solution, Orano TN worked closely with the operators in the UK to ensure that specific requirements for local ancillary handling equipment were met. This work will form part of the following integrated testing.

f) Operational tests and interfaces

To optimize cask operation, and more specifically to provide easy-to-use cask loading and unloading activities, Orano TN has designed a full range of equipment (internal equipment and ancillaries) taking into consideration the customer’s and its own experience in operating and managing a Type B packaging fleet:

- The internal equipment, TN910 and TN920, currently under fabrication, can be handled with different means (forklift truck, crane...) to ensure its usability on multiple sites.
- A new loading platform and lifting frame was developed integrating site operator needs and specific constraints related to dimensions and removability. Other site safety and security requirements were integrated into the design. The equipment is currently under fabrication.

To demonstrate full operability and interchangeability prior to shipping the equipment to the UK sites, Orano TN will conduct Factory Acceptance Tests (FAT) and Customer Acceptance Tests (CAT), all equipment must fit each cask. The FAT/CAT operations and

sequences will comply with FAT/CAT specifications agreed upon with the final customers and all involved with UK operations.

g) In-operation services

Once the fleet and equipment are delivered to the customer premises in the UK, the customer's operators will conduct further Site Acceptance Tests (SAT) to validate the different operation sequences and operator capability. Orano TN will provide training support and expertise to the customer's operators to guarantee that SAT activities are successful.

Orano TN has also developed, in partnership with a French company, virtual reality (VR) training solutions for operators. Immersive learning reduces on-site operation risks and is a cost-effective way to secure the program schedule and commissioning activity for the Type B program.

Conclusions

The reinstatement program of the UK TN GEMINI™ fleet will provide a number of key benefits to UK tax payers thanks to LLWR diligence and vision.

Orano TN's multi-skilled expertise in design, licensing and manufacturing of Type B packaging and in the management of complex projects enabled the teams to meet technological and scheduling milestone challenges. Moreover, its know-how and experience in managing a Type B packaging fleet, operations, maintenance and conformity throughout the package lifecycle were essential to this "back to life" packaging strategy.

Acknowledgments

Many thanks to Alan Jackson and Darren Holt for the construction of this reinstatement program and the trust they put in the Orano TN teams in making this challenge a great success.

Many thanks to all the colleagues and partners involved in this program, for their commitment and capacity to adapt their mode of working, constantly innovating to find effective solutions.

References

TN GEMINI™ SAFETY ANALYSIS REPORT