French Management Model for Sustainable Transportation of Used Fuel – 15376

Catherine Shelton *, Helene Badia **, Gerard Orban *
* AREVA TN
** Electricite De France (EDF)

ABSTRACT

Safe and efficient transportation of radioactive material is key to the success of our industry. Used fuel transports are inherently complex due to the nature of the material and the high visibility. Only a few countries have developed comprehensive used fuel transportation systems that require a wide range of equipment, services and expertise. In the many countries, such as the Unites States, where interim consolidated storage, recycling or geological repository are not available yet, similar systems will have to be implemented. For more than 50 years AREVA TN has safely shipped more than 7,000 used fuel transport casks. The transportation system that was initially developed in the 1970s has been adapted and enhanced over the years to meet more restrictive regulatory requirements and evolving customer needs, and to address public concerns. The numerous "lessons learned" have offered data and guidance that have allowed for also efficient and consistent improvement over the decades.

Based on AREVA TN extensive expertise, this paper will describe the different phases and milestones that need to be met to set up, license and operate a successful used fuel transportation management system. Transportation of spent fuel in France could not be performed effectively and efficiently without strong collaboration with Electricite de France (EDF) who plays a critical role as the shipper. EDF will provide a nuclear operator's perspective on the most critical aspects of a successful used fuel transportation program

INTRODUCTION

Inventories of used fuel continue to grow. However, due to lack of final disposal repositories and limited recycling options, expertise with large scale transport campaign of used fuel is limited, as the need for this expertise is limited. Used fuel is (or has been) transported on a regular basis in Japan, Sweden, Russia, UK and France. The largest number of shipments has been performed through France to the AREVA La Hague recycling facility. The system deployed by AREVA TN covers different routes and modes of transport. Used fuel is currently shipped from overseas, several European countries and, of course, France. China, Spain and the United States will need to set up a large scale transportation program in the coming years.

This paper will describe the main steps for implementation of a sustainable used fuel transportation program, the key operational elements; the lessons learned from both the perspective of a nuclear fleet operator and a nuclear logistics operator, and will provide figures related to the successful program developed by AREVA TN.

IMPLEMENTATION

Volume of used fuel transported each year worldwide is very small compared to other hazardous materials and even other radioactive materials. An average of 400 used fuel transports is performed

annually compared to about 20 million consignments of radioactive material (which may be either a single package or a number of packages sent from one location to another at the same time).

A used fuel transportation program requires dedicated assets and also unique expertise in multiple fields with knowledge of regulations developed specifically for used fuel material transports (engineering, rail, road and maritime transport, inspection, communication, cask operations, quality assurance,…). Capital expenditures in key assets such as a railway terminal, state-of-the-art transport casks, a maintenance facility and, railcars are needed as well as personnel qualified and trained with the applicable regulations.

The implementation occurs in three key phases:

1. Long Term activities (15 to 10 years before starting operation): Prepare specifications, design, initiate procurement of assets
2. Mid Term activities(10 to 2 years); Acquire and test assets, qualify suppliers and staff, develop IT tools, procedures and processes and train
3. Short term activities (2 to 0 years): Prepare transport, pack and load, submit notifications, …

Long term activities that need to be initiated 15 to 10 years before starting transport operations consist mainly of:

- Define the specifications of the transportation model to include: fuel characteristics, annual volume, transport infrastructure limitations, interface with facilities, safety and physical protection regulations, project scheduling, …..
- Design and license the transport model to include:
    - Transport routes
    - Terminals (railway, maritime)
    - Cask and railcar designs
    - Auxiliary facilities: Maintenance for cask and rail car, cask preparation and receipt cask transfer,…
    - Process and procedures (high level)
- Procure assets
    - Based upon lead time to design, license and procure the assets, procurement of assets may be initiated in this phase

Mid-term activities that need to be initiated 10 to 2 years before starting transport operations consist mainly of:

- Acquisition and fabrication of assets: railway terminals, casks, auxiliary facilities
- Selection and qualification of suppliers
- Develop communication program and education of stakeholders
- Develop emergency response program
- Develop procedures and IT tools for tracking, scheduling and fleet management
- Hiring and training of staff
- Performing dry runs in various activities

Short-term activities that need to be initiated 2 to 0 years before starting transport operations consist mainly of:

- Training and testing the integrated model (assets and all stakeholders)
- Transport scheduling
- Fleet management

OPERATIONS

While it can take up to 15 years to develop a sustainable transport system, a single transport is typically performed within a short time frame. For example, for a domestic French transport of used fuel, the physical transport will take about 4 weeks from empty cask departure from La Hague recycling facility to return of the loaded cask to this same facility. Notifications to authorities will be initiated about 8 weeks prior to transport departure from the nuclear power plant. The main steps of a shipment can be broken-down as follows:

- Transport coordination with:
  - Authorities for different level of notices from advance notice to delivery notification,
  - Shipper and receiver for scheduling, document preparation conformity check-list, etc…
  - Suppliers for scheduling ,
  - Other stakeholders such as railway terminal operators, security representatives, etc...
- Empty cask and rail car preparation: Before being dispatched a cask to a nuclear power plant, verification of the conformity of the cask and rail car are essential (license, maintenance, internal equipment, radiological conditions, labelling, marking,…)
- Empty cask transport: cask is dispatched to nuclear power plant
- Cask loading operation:
  - Typically, the nuclear operator, EDF in France, is responsible for all on-site operations.
  - AREVA TN may provide assistance to ensure conformity of fuel being loaded with cask loading map and verify the conformity of the transport prior to his departure (radiological surveys, marking, labelling, shipping documentation,…)
- Loaded cask transport; cask is dispatched to final destination.
  - For transport in France from EDF plants to La Hague recycling facilities, commercial trains are used.
  - For reactors not connected to the rail spur, the heavy load truck shipment is initially performed.
  - All casks delivered to La Hague are delivered by truck as the facility is not connected to a rail spur (about 20 miles by road).

Over the years AREVA TN has strengthened the transportation system that was developed more than 40 years ago with two key features:

- Implementation of a Transportation Risk Management™ (TRM) program. An independent team from transport operations teams is responsible of updating transport flows risk analysis, qualifying and inspecting suppliers and managing crisis in case of event.
- Strengthening of crisis management capabilities. In spite of the fact that we never faced an event with environmental impact, our crisis management program has been upgraded to ensure support to local authorities in case of event but also to provide immediate communication responses to media and public. Some examples of upgrades include the establishment of a 24/7 a crisis management center -- with multiple rooms dedicated to technical, communication, command center and meetings --as well as specific equipment to facilitate a quick response to the crisis. We perform an average of six drills per year with a minimum of one drill conducted on a national level.

Other enhancements of the AREVA TN model are rigorous security upgrades to ensure alignment with the stringent regulations that have evolved as a result of the increasing threat of terrorist acts.

LESSONS LEARNED

From a Nuclear Operator (EDF):

EDF operates 58 reactors in France. With increasing regulatory requirements, it is essential to sustain regular transports to make space in pools. Scheduling of transports is one of the main challenging activities. Numerous factors have to be taken into account, especially with availability of:

- Reactor building (avoid refueling outage, maintenance of handling equipment or other equipment, fresh fuel deliveries, etc...)
- EDF and AREVA TN resources
- Dedicated tools to support loading
- transport casks
- Railroad

In additional of safety and security requirements, other constraints either scheduled in advance (special events for example) or unscheduled (weather conditions, increase of security level for examples) are affecting the scheduling. An unscheduled event can have a major impact of the schedule (weather, media, technical events), with a need to be able to react quickly. Transparency and open dialogue between EDF and AREVA TN are essential elements to success.

Continuous improvement using lessons learned has helped EDF and AREVA TN strengthening our transport system. Some examples of improvements made over the years are listed below:

- In case of transport event, communication processes has been revised (communicate quickly, communicate on positive events,…)
- Technical modifications to transport casks and procedures to ease operations
- Trainings: understanding each other environment and constraints has helped facilitating the dialogue between AREVA TN and EDF operators

We could summarize our lessons learned with:

- Anticipation to take into account all the constraints and keep contingencies to meet annual transport targets
- Flexibility and reactivity to be able to respond to unscheduled events
- Keeping permanent focus on Safety, Security and Quality
- Seeking continuous improvement using lessons learned
- Transparency and dialogue between the different stakeholders

From a Nuclear Logistic Operator (AREVA TN):
AREVA TN lesson learned program is a powerful tool that contributes to a reliable and sustainable transportation system. Over more than 40 years of operations, thousands of minor events have been recorded in our data base. Lessons learned are used to improve the reliability of our transportation model. Our procedures, our assets, our specifications have been revised as necessary to increase the transportation security and safety using our lessons learned resulting from either during real-life events but also transport event drills.
As another example of lessons learned, over the years, several discrepancies were detected on the transport documentation, on the labelling, markings or placarding (missing labels, incorrect placard, transport documentation incomplete,..) . Even if minor, to avoid these recurring events, we have taken measures to eliminate those discrepancies by taking actions such as:

- Set up template file to records all survey results that will be used to generate the shipment regulatory documents
- Independent conformity verification prior to shipment departure
- Random inspection by our risk management team
- Establishment of a training center for operators (EDF, AREVA TN and other stakeholders involved in shipment).

TRANSPORTATION SYSTEM EXPERIENCE

We have included below the main figures of our experience:

- More than 75,000 LWR used fuel assemblies transported safely
- More than 200 heavy casks shipped every year for used fuel or HLW transportation for more than 40 years
- 1400 employees, including more than 140 class 7 drivers and 60 freight-forwarders
- More than 40 dedicated railcars carrying 100 ton casks at 100 kph
- 70 trucks engineered for heavy loads
- An average of six crisis management drills per year
- More than 1,000 “lessons learned” cases

CONCLUSION

A sustainable, successful and safe used fuel transport system requires a range of expertise and technologies: dedicated assets, up-front investments, well planned, designed and licensed equipment and foremost a knowledgeable and well-trained team that is experienced in all phases and demands of a complex transport chain. Removal of used fuel from pools and transporting it away from the EDF sites is critical to the ability of a reactor to operate smoothly and cost-effectively. EDF and AREVA TN have been continuously improving every phase and aspect of the transportation model to ensure it remains a state-of-the-art system that perform as safely and efficiently 100% of the time. Building on years of experience and incorporating new system and technologies to meet new demands will ensure the continued high level of success – and impeccable global track record – for many years to come.