TRANSNUCLEAIRE'S EXPERIENCE IN MARITIME TRANSPORTATION

M. Vallette-Fontaine

Transnucléaire, 9-11 rue Christophe Colomb, 75008 Paris, France

SUMMARY

Since the INF code requirement has been implemented in early 1995 laying down stringent requirements for ships transporting irradiated nuclear fuel, plutonium and high level radioactive waste, Transnucléaire has upgraded and operates two sister ships belonging to CMN shipping company and is well involved in the maritime transportation of radioactive materials.

This paper aims at analysing the various principles implemented by Transnucléaire:

- operate ships such as Bouguenais and Beaulieu in compliance with all existing regulations such as INF Code, Japanese KAISA...,
- keep the sea transportation of nuclear material at affordable price for all nuclear organizations especially those involved in research activities,
- avoid for non routine transports, the use of nuclear dedicated ships often precluded by its high cost,
- adapt the means to all possible evolutions, i.e. be prepared to offer improved ships to satisfy all the scale of requirements,
- find optimised technical solutions to comply with Japanese type B ship regulations at a reasonable cost.

CATEGORIES OF SEA TRANSPORTS

The main following categories of sea transports are highly affected by the new IMDG regulations requirements.

- front end products,
- experimental products,
- back end nuclear fuel cycle products.

Transnucléaire has analysed for each category the level of requirements related to the applicable INF code, which classify the ships able to transport radioactive materials according to their level of activity.

Front end products, not concerned by activity limitation, such as U_3O_8, natural or enriched, UF_6, UO_2 powder, UO_2 fresh fuel elements, transported for the purpose or as the result of transformation, according to the location of different mining, conversion, enrichment, powder manufacturing, or fuel manufacturing, between different countries such as South Africa, Russia, Canada, Niger, Australia, France, USA, Great Britain, Japan, Germany, Sweden, China, the better compromise is to use liner ships at a competitive level of price.

Currently, the transportation of front end products, is performed using standard liner ships to the satisfaction of the customers, but this solution has its own limitations:

- limited choice of liner ships, most of them being reluctant to transport radioactive material
- limited flexibility for the scheduling of the shipment,
- handling low radioactive material in public ports under safe but standard conditions,
- difficulties to ensure tracking of the materials

However, the level of price is competitive and conformity with international regulations is ensured. The question is for how long, considering the pressure of public opinion, a few shipowners will accept such transports. Nevertheless, few transports were performed up to now by chartered vessels.

Experimental products: for the transportation of MTR spent fuel elements, samples for post irradiation examination and others experimental products, due to a level of activity generally exceeding 4000 TBq, compliance with IMO/INF regulations and especially INF2 code is now compulsory.
Merchant liner ships are no longer suitable for the transportation of such products. For that reason the price of these transport has strongly increased.
Considering these experimental products and the large demand of all the countries involved in nuclear research and concerned by the return of spent fuel elements to the United States, Transnucléaire intends to offer to its research reactor customers the right prices, complying with the different regulations. The INF non-dedicated chartered ship is the right answer to this challenge.

The new IMO INF regulations have placed a high economic burden on the transport of experimental products. Until 1994, a liner ship transport was used at a given level of price; in 1995, due to the application of INF2 code, using non-dedicated INF2 ship, this price has been multiplied by 5, to be compared with a dedicated INF3 ship where price is 10 times the price of transportation using a liner ship.

Considering experimental products, a wide experience has been gained in the transport of INF material using nondedicated chartered ships. The Bouguenais and Beaulieu were upgraded according to the INF2 code in 1995 and 1996 and the Bouguenais classified as type A according to Japanese regulations in 1996.

Different transports have been successfully performed in Europe, between France and Spain, Sweden, England (as INF2 code classification), and between Japan and the United States (as type A Japanese regulation).

Regarding back end nuclear fuel cycle products, Transnucléaire has been involved in the transportation of spent fuel from Japan to France, in its casks of the TN12 family. It is also in charge of organizing on behalf of COGEMA various transports on board PNTL ships such as the return of vitrified residues to Japan. The transport of fresh MOX fuel elements from France to Japan is now under active preparation.
On behalf of COGEMA, Transnucléaire is responsible for all handling operations in Cherbourg harbour and for all measurements and reporting concerning physical protection to the French competent authorities.

FUTURE TRENDS

The coming challenge for Transnucléaire is to:

- develop front end transports using chartered ships,
- adapt the INF2 ships to INF3 code and to Japanese regulation,
- improve again shipping conditions.

For future front end transports, from Europe to USA and Japan or other overseas countries, the possibility of using chartered ships is under study. All handling at French ports is now fully witnessed by Transnucléaire operators.

Regarding activity level to be transported, Transnucléaire has analysed the conditions to satisfy the INF3 code requirements by offering to customers the use of non dedicated chartered vessel, to transport several spent fuel casks around Europe, by meeting the requirements of the INF3 classification considering the level of total radioactivity. For that purpose, the reinforcement of the cargo hold of one of the two ships has been studied to comply with the conditions of the stability after severe damage as required by the INF3 classification. In fact the difference between INF2 and INF3 lies mainly on the criteria of stability after damage. To comply with this requirement, the cargo hold of the ship should be divided by a leaktight transverse bulkhead and appropriate floaters. In these conditions, the ability of the ship to transport other industrial goods would not be much affected.

For the return MTR fuel elements, from Japan to the United States, the conditions to satisfy the Japanese requirements imposing more stringent criteria than those of the INF3 code have been considered. The purpose being to offer to Japanese customers the same advantages as for European customers: the use of a nondedicated chartered vessel to transport MTR spent fuel and irradiated samples directly from Japan to the United States.

As stipulated by Japanese criteria for collision resistance and stability after damage, the reinforcement of the structure of existing ships must be foreseen to comply with the KAISA 520 requirements and especially the resistance of the ships'structure to a collision with a T2 tanker of 23,400 tons cruising at 15 knots.

A development study has been performed and the cargo hold of the ships is able to withstand collision after installation of watertight removable steel absorbers all along the new holds. The new holds located in the middle of the present cargo hold are also removable and constitute watertight dungeons equipped with all piping and electrical systems satisfying KAISA 520

requirements. Stability after damage is ensured by watertight removable floaters and by two watertight removable transverse bulkheads. The capacity of the cargo holds for radioactive material transport according to Japanese criteria currently foreseen will be eight ISO 20 ft containers. Of course the final decision of modification will be taken according to:

- JMOT's final acceptance of the Safety Analysis Report,
- cost of the additional structure,
- market data.

SHIPPING CONDITIONS

Physical protection aspects: Transnucléaire has also considered the case of Nuclear material Class II transportation by one of its two nondedicated chartered vessels and proposed technical improvements to the French competent authorities, to prevent misappropriation of Class II nuclear material. To satisfy their requirements, a specific equipment has been developed and is ready for implementation on board ships whenever needed.

Transportation survey: Satellite tracking is performed by Transnucléaire for all the road or rail transports on the national territory, as well as for maritime transports with its two nondedicated vessels using GPS and Inmarsat satellites system. The last transports of MTR elements from France to the United States was tracked all along the route without any incident.

Emergency response plan: While an Emergency Response Plan is implemented by Transnucléaire for the national transports to support French Competent Authorities and Prefectures, Transnucléaire has thought about risks with maritime transportation considering the two non dedicated chartered vessels.

The aim to develop a Maritime Safety Response Plan leads Transnucléaire to study in conjunction with IFREMER specific conditions to recover casks in case of ship sinking. For that purpose a study is underway concerning:

- localisation of cargo holds panels in deep water and the system for quick opening,
- unstowing of the packaging at distance,
- recovery system of the packaging (specific crane hook operating from adapted vessel),
- radiation monitoring equipment under the water.

CONCLUSION

After 30 years of experience in sea transport of radioactive materials using liner ships, Transnucléaire, in association CMN, operates non-dedicated INF ships and an adaptation of this solution to Japanese regulations is under study. On the other hand, international transports are increasingly performed using chartered ships for various categories of radioactive material.