Proceedings of the 17th International Symposium on the Packaging and Transportation of Radioactive Materials
PATRAM 2013
August 18-23, 2013, San Francisco, CA, USA

Emergency Response Procedures and Trainings for Nuclear Material Transport Vessels against Earthquakes and Tsunamis

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ABSTRACT

The Great East Japan Earthquake which struck northeastern Japan on 11th March 2011 inflicted enormous damage including at the Tokyo Electric Power Company Fukushima Daiichi Nuclear Power Station. At that time, Nuclear Fuel Transport (NFT) was unloading Low Level Radioactive Waste containers from a dedicated vessel at a port in the Tohoku area. The port facilities lost power due to earthquake, and the tsunami attacked the port about 30 minutes after the tsunami warning was issued. Thanks to the swift response at the work site, she could evacuate out of the port safely.

In order to further enhance the safety of nuclear material transport, NFT together with the electric companies have reviewed the emergency response procedures during earthquakes and tsunamis to incorporate lessons learned from the Earthquake/Tsunami. To allow swift emergency evacuation during future tsunamis, the following major emergency response procedure items were reviewed:

- Deliberate procedures for collecting tsunami and earthquake information
- Establish a manual for emergency evacuation procedures from ports
- Ensure emergency power sources for the cranes in each port

In addition, NFT staff in each port have been trained to confirm the effectiveness of the manual for emergency evacuation procedures, the competence of the crew and the operation performance of our vessels. In drill, we assumed that the tsunami warning would be issued during unloading. In addition vessels conducting joint drill worked in

cooperation with staff on land in order to assure a safe departure from the port. We have repeated these procedures many times successfully.

INTRODUCTION

At 14:46 on 11 March 2011 , The Great East Japan Earthquake (magnitude 9.0) occurred in the Sanriku offshore area of northeastern Japan. At that time, Nuclear Fuel Transport (NFT) was unloading Low Level Radioactive Waste containers from a dedicated vessel at Port of unloading in northeastern Japan. At 14:49, a tsunami warning was issued for the Pacific Ocean side coastline of northeastern Japan.The vessel stopped unloading and began preparations to leave shore. While she was preparing to leave shore, a major tsunami warning was issued for the Pacific Ocean side coastline of northeastern Japan. 6 minutes later, the ship left shore without a tugboat or pilot, encountering tsunami waves coming at speeds over 10 knots. She had no trouble taking on the tsunami while sailing thanks to the swift response at the work site, and she was able to safely evacuate from port.

At the same time there were also 2 other Spent Fuel Transport Vessels moored at Port in northern Japan as well. As with the Low Level radioactive waste transport vessle, these Nuclear Material Transport Vessels also left shore without tugboats or pilots immediately upon issuance of the tsunami warning, and were able to reach an area safe from the tsunami.

Many ships were unable to escape the tsunami caused by the Great East Japan Earthquake, receiving serious damage as a result. The fate of ships in the area was determined by the ability to quickly implement emergency response procedures and reach areas safe from the tsunami.

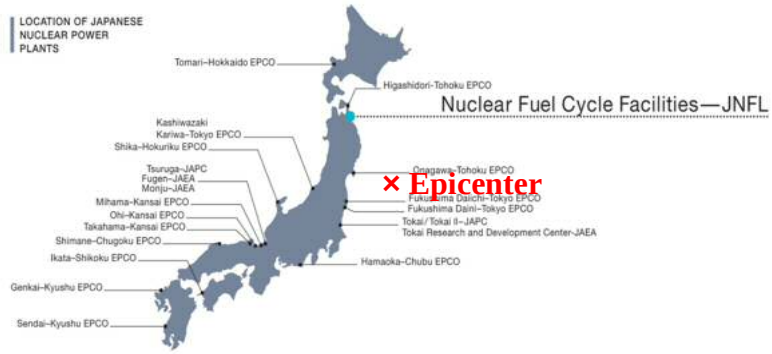


Figure 1. The Great East Japan Earthquake

EMERGENCY RESPONSE PROCEDURES

In order to further enhance the safety of nuclear material transport, NFT together with the electric companies have reviewed the emergency response procedures during earthquakes and tsunamis to incorporate lessons learned from the Great East Japan Earthquake of March 2011. To allow swift emergency evacuation during future tsunamis, the following major emergency response procedure items were reviewed:

1. Collecting disaster information

According to the Japan Meteorological Agency, the quickest way to get information on disasters such as earthquakes and tsunamis is via TV or radio. Therefore, we prepared TVs and radios at both headquarters and aboard ships in order to gain information. In addition, we have also secured methods of communication in case of blackout.

2. Measures regarding emergency evacuation procedures from ports

2-1 Preparing a manual for emergency evacuation from ports

We established a manual for emergency evacuation procedures from ports by deliberating various scenarios such as scenarios where the tsunami arrives in the shortest predicted amount of time, and scenarios where the amount of time could be available for emergency lifting of cargo within the vessel and securing onto transport vehicles so as to remove them from the area. To allow swift emergency evacuation during future tsunamis, the following major items of the manual were compiled:

- confirming conditions at each port
- criteria for decision-making regarding emergency evacuation from port
- the chain of command if emergency evacuation from port is to be performed
- emergency evacuation areas for staff and vehicles

The basic policy for the manual is giving top priority to human life and drafting measures to secure safety for transport containers based on their type.

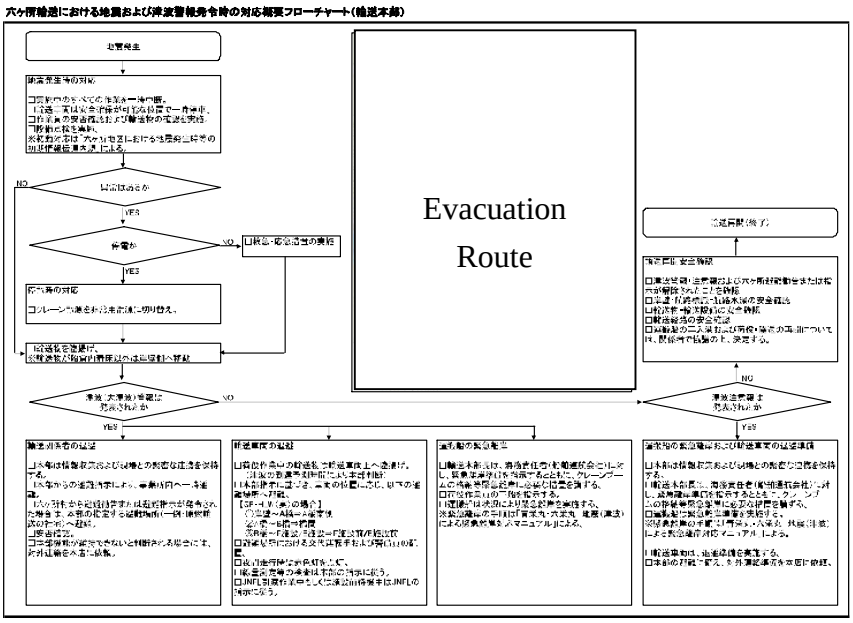


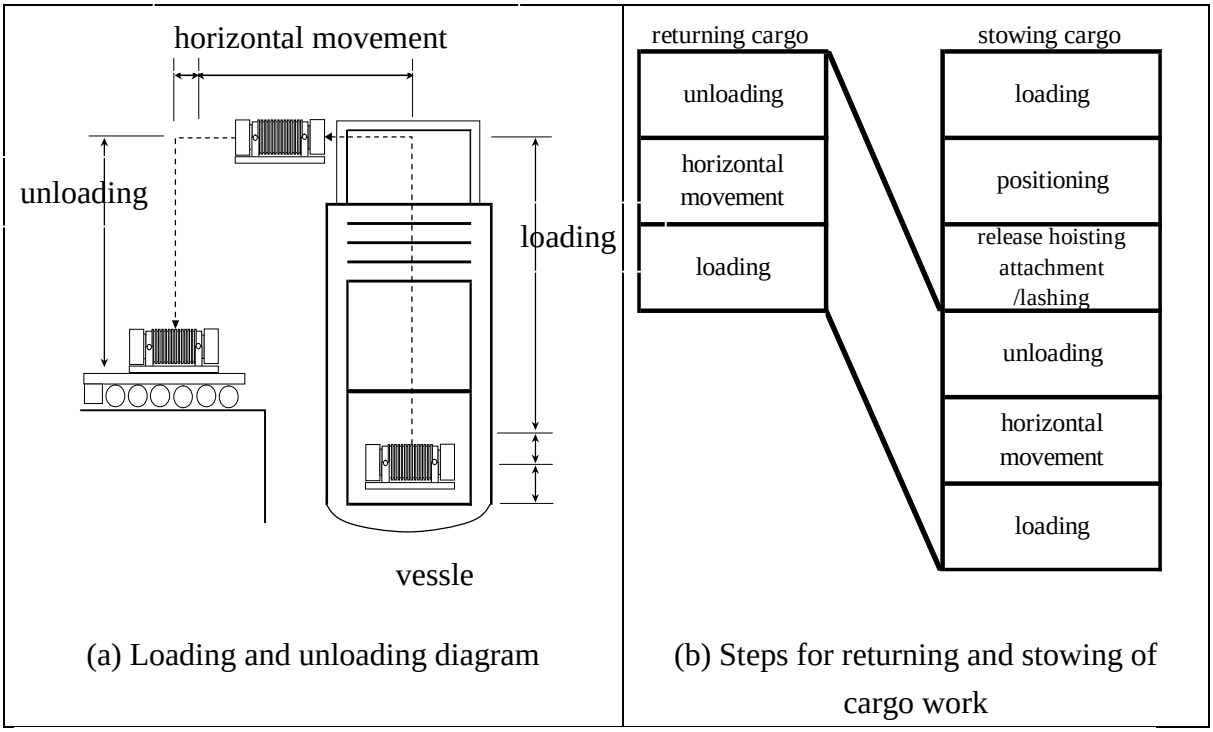
Figure 2. Manual (flowchart) for earthquakes and tsunamis

2-2 Drill

For nuclear power stations where transport of cargo was to take place for the first time since the Earthquake, emergency port evacuation drill was performed for NFT staff at each port to confirm the effectiveness of The Manual For Emergency Evacuation Procedures. Drill was performed assuming for the harshest conditions. As for the handling of the containers, confirmation was required to determine whether stowing containers in the hold or returning them to the quay would be faster. It was confirmed that returning them to the quay is quicker than stowing containers in the hold. The scenario for drill is as below.

[Drill scenario]

I. A large scale earthquake occurred during loading, triggering a tsunami warning
II. Begin preparations to implement emergency evacuation procedures after receiving the tsunami warning
III. Switch cranes to emergency power system if the power system failed
IV. After switching to the emergency power system, we bring back nuclear materials to the transport vehicles, then the vessels are evacuated from the ports



(a) Loading and unloading diagram

(b) Steps for returning and stowing of cargo work

Figure 3. Handling of containers during emergency evacuation from port

2-3 Utilization of tugboats and pilots

Figure 4. Leaving shore with tugboats

Generally, we use tugboats and pilots so vessels can leave the shore safely. Upon consideration of the capability of ships and the experience of the crew (to be covered later on), we have decided to perform Emergency Response Procedure drill by NFT without tugboats or pilots. However, tugboats may be utilized to perform emergency port evacuation drill, depending on port conditions. Nuclear Material Transport Vessels have bow thrusters and a Vec-twin system, the latter being a transversal propeller device that increases maneuverability as it pertains to leaving shore. This shows that it would be more appropriate for the captains who are well versed in vessel capabilities to navigate the vessel when leaving port in an emergency, whereas pilots who are more familiar with navigating large vessels using tugboats.

Furthermore, our captains collect the latest information on the marine area and conditions of the ports from the pilots before the vessels enter the port. As a result, our captains have the ability to leave shore safely without pilots as well.

2-4. Ensure emergency power source for cranes in each port

Interference between cargo and the vessel must be avoided when performing emergency port evacuation. If power outages caused by earthquakes like those at the Fukushima Daiichi Nuclear Power Station occur during loading work and require the temporary cancellation of said work, this may impede emergency port evacuation by the vessel depending on the status of cargo. To ensure the safety of cargo and prevent impairment of vessel emergency port evacuation, reserve power was secured for the dock cranes as a blackout countermeasure. Also, during emergency response drill, we have performed switching to reserve power and have also performed operation of the dock crane using said reserve power.

2-5. Drill Result

Drill using Spent Fuel Transport Vessels has been performed at seven ports after the Earthquake and successfully verified the effectiveness of The Manual For Emergency Evacuation Procedures. We have proven via drill that vessels can be safely evacuated from port in a sufficiently shorter amount of time than the time of tsunami warning to the tsunami arrives. In the future, we will perform drill at other ports operated by electrical utilities where an emergency port evacuation drill has previously not been performed, so as to improve the effectiveness of the manual for emergency evacuation procedures.

Drills must be performed with the Low Level Radioactive Waste transport vessel in either port once a year. The Low Level Radioactive Waste transport vessel has a shipboard crane. Drill is performed with either the dock crane or the shipboard crane. We have confirmed that emergency port evacuation preparations can be made in the same amount of time for both cranes. As with Spent Fuel Transport Vessels, we have confirmed the effectiveness of the manual through drill.

3. EDUCATION FOR CREW

We regularly provide education to our crew on items such as systems and procedures so as to create a common understanding on emergency evacuation procedures, maintain skill level, and solidify the systems in place. It has been stipulated in the manual that emergency port evacuation drill shall be performed regularly.

4. CONCLUSIONS

NFT immediately undertook disaster relief measures after the occurrence of the Great East Japan Earthquake. Deliberation on the experiences gained from that Earthquake and investigation into disasters confirmed that emergency evacuation procedures are effective as vessel safety measures, and an emergency manual was drafted. Continual drill was performed to verify the effectiveness of the emergency response procedures and keep improving upon them. Drill was not only performed by NFT, but in conjunction with electric companies while confirming the collaboration between personnel on land and at sea.

We have not only implemented emergency evacuation procedures, but have also studied such countermeasures as salvaging of vessels. As a result of such efforts, we have gained valuable experience and knowledge regarding large scale disasters.

NFT continues to provide customers with reliable, safe and secure transport services by making full use of this experience while also striving to earn social reliability.