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An Overview of the Transportation of Radioactive Waste at Ontario Power Generation Facilities

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ABSTRACT:

The Radioactive Material Transportation Department (RMT) ensures regulatory compliance in radioactive material shipping within Ontario Power Generation (OPG). OPG provides a radioactive shipping program, high quality carrier service, stringent packaging maintenance, and quality assurance oversight to the corporation's nuclear facilities and its customers.

This paper will speak to the transport of radioactive waste in Ontario Power Generation. It will also mention non-waste shipments and the quality assurance programme used at Ontario Power Generation to ensure a high quality transportation system.

INTRODUCTION

The Radioactive Material Transportation Department ensures regulatory compliance in radioactive material shipping within Ontario Power Generation. Nuclear Waste Management Division (NWMD) provides a radioactive shipping program, high quality carrier service, stringent packaging maintenance, and quality assurance oversight to OPG's nuclear facilities and its customers.

In a typical year, approximately one thousand five hundred (1,500) shipments of radioactive material are made.. About one third of these are waste shipments usually heading for the Western Waste Management Facility (WWMF) near Tiverton, Ontario. OPG trucks travel approximately seven hundred thousand (700,000) kilometers annually. Materials shipped include tritiated heavy water, contaminated tools and equipment, low and intermediate level radioactive waste, solid and liquid samples, and used nuclear fuel.

Transportation systems are geared to the loads. The corporation owns and maintains specialized Type B packagings for Intermediate Level Waste (ILW) such as filters and ion exchange resins which tend to have high contact gamma dose rates. Type A qualified ISO containers are used as the packaging for low level waste. This allows several types of load configuration inside a qualified packaging and to classify the loads more accurately. Loads are tied down with engineered restraint systems meant to secure the payload during normal conditions of transport and to minimize load ejection in the event of a motor vehicle accident.

STAFFING

The Transportation of Dangerous Goods (TDG) Regulations made under the TDG Act require that all persons who handle, offer for transport or transport dangerous goods must be adequately trained and hold a training certificate. The only alternative is for a person to perform those duties under the direct supervision (line of sight) of a person holding a valid training certificate. Issuance of a training certificate is the responsibility of the employer. OPG staff involved in the transportation of dangerous goods is trained in the applicable aspects of the TDG Act and the Regulations made under the Act and is issued training certificates upon completion of the qualification. Employees are sent for requalification within a three month window at the end of the 36 month qualification period. Staff qualifications are reviewed routinely by supervision to see if they are applicable to the individual's work responsibilities prior to being sent for requalification. OPG tries to keep the number of employees with Class 7 qualification to only those who ship, handle, or carry regularly.

Nuclear Waste staff members are located at many different facilities within OPG. A high level of cooperation and communication both within the department and between facilities is required for consistent, safe transport of nuclear waste. The result is a small number of people spread over a wide area. Short descriptions of job functions for the various staff follow.

Class 7 Qualified Staff

Radioactive material that is shipped on the public thoroughfares falls under the Transportation of Dangerous Goods Act (the Act). The Radioactive Material Transport staff is trained in the appropriate aspects of dangerous goods shipping as defined by the regulations. Transportation Officers, Drivers, Responsible

System Engineers and Maintenance personnel all receive training in the regulations commensurate to their role in the process.

Class 7 Radioactive is one of nine classes of dangerous goods under the Act and therefore requires a valid Class 7 Certificate of Training.

Class 7 personnel are divided into different functions: Handler/Receiver; Carrier; and Shipper. OPG also designates certain health physics personnel as classifiers of radioactive material. All staff is trained and hold certificates of training issued by OPG.

Training for Class 7 personnel is the responsibility of the Nuclear Training Department.

There are also some *support staffs* who work behind the scenes to ensure that the flow of waste to the waste site is smooth. These support personnel are grouped as follows:

Operations Staff (WWMF) – These staff unload the packages at the waste site.

Maintenance Staff (WWMF) – Mostly mechanics, these people work on maintaining the packagings and some maintenance of the rolling stock.

Engineering Staff: Engineers look after day to day challenges and maintenance while others act as design authority for the packagings.

Transportation Officers: The transportation officers provide arm's length oversight for all Type A and Type B shipments at nuclear facilities. They also assist with unusual and non routine shipments of all types.

WASTE PROCESSING

Each nuclear facility provides trained people to sort and ship waste. The facility itself becomes the shipper. At each nuclear facility, waste is divided into two streams: Processible and Non-processible. Processible waste is further divided into incinerable and compactable waste. OPG segregates the streams into Low and Intermediate Level Waste (based on activity and gamma dose rate) for shipment to the

Western Waste Management Facility. The table below shows the limits for Low Level Waste (LLW) based on gamma dose rate:

Waste Classification	***Dose Rate (gamma) in mrem/h***
LLW Incinerable	<60 @ contact
LLW Processible	<200 @ contact
LLW Non-Processible	<1000 @ 30 cm.

Intermediate level waste exceeds these limits and is limited only by the activity limits of the Type B packagings used to transport it. Anything exceeding ILW limits is considered high level waste (HLW).

High level waste is generally kept at the facility in storage pools until the activity dies down to a level where it can be safely stored in other means (> 10 years).

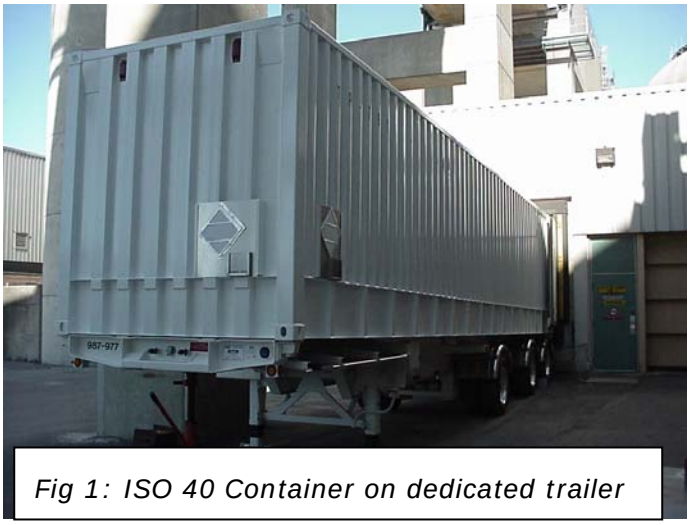

Fig 1: ISO 40 Container on dedicated trailer

With Low & Intermediate Level Waste (L&ILW), the majority of Processible wastes are incinerable. Items such as contaminated clothing, cleaning materials, gloves, wood, certain plastics, and certain liquids are collected, sorted, monitored and shipped in plastic bags within metal containers to the Western Waste Volume Reduction Facility. The containers are reusable and about 0.6 m^3 in volume. These containers are part of an engineered transportation system utilizing Type A qualified ISO 20 and ISO 40 containers mounted on dedicated road trailer chassis'. (Fig. 1) This waste is shipped to the waste site and burnt in an incinerator. The ash and stack filters from the burn are collected and stored as waste in permanent concrete trenches or storage buildings. Incinerating waste allows us to achieve a 75:1 reduction in volume.

Compactable material such as metal, insulations, and non burnable plastics are shredded (if possible) and compacted prior to storage as

"bales" in above ground storage buildings. Volume reductions up to 3:1 are possible with this method.

Non-processible material such as valves, pipes, machinery, motors, etc. are stored in large 3 m^3 blue bins at the facility. These are engineered to fit inside ISO containers and highway trailers. The bins themselves are not qualified packaging. For shipments classified as Low Specific Activity or greater, the bin(s) must go in a Type A qualified ISO 20 or ISO 40 container. During the course of reactor operations, system components and ion exchange resins will become highly activated and/or contaminated. This type of non processible waste must be transported in specialized Type B containers. The payloads are off loaded directly into in-ground tile holes to minimize exposure to the high dose rates. (Fig. 2)

Liquid waste is gathered at the generating facility and placed into drums. The drums are shipped once per year to an external contractor that is licensed for incineration. The ash from the burn is collected and shipped back to the waste site for storage and/or burial. All liquid waste shipments that use drums also use salvage drum overpacks as a precautionary measure.

Fig. 2: Bottom Unload Flask being off loaded over a tile hole.

The vast majority of the waste transported over the public roads falls into the Low Level Waste (LLW) category. Most of the remainder is classified as Intermediate Level Waste (ILW). These wastes include spent IX resins, used radioactive filters and irradiated reactor components that have been declared waste. These are transported in specialized Type B containers and off-loaded directly into tile holes at the waste site.

Some of the larger station components that are declared waste must be transported under special arrangement certificates issued on a one time basis from the CNSC. These shipments usually require a

considerable amount of lead time to adequately address all aspects of planning the shipment.

PLANNING

There are many types of radioactive material that may need to be transported from OPG facilities. Most of it falls into 6 broad categories: waste, tools, equipment, laundry, gauges and heavy water. Depending on the category, transportation planning is either an annual activity or ad hoc. Nuclear Waste Management Division (NWMD) has transportation officers located at each major nuclear facility who participate in the planning function. Although shipping is the responsibility of the facility of origin, NWMD staff attend facility planning meetings in an advisory capacity both to pass possible transportation requirements back to NWMD and to remind facility staff that movement of radioactive material must be incorporated into work plans and must be scheduled. Much of the waste stream transport needs are planned a year or more in advance to ensure a steady movement of material to the waste site and empty containers returned to the customers for refilling. Even specialized inspection equipment shipments can be scheduled to some degree around the published maintenance shutdown schedules. Forced outages obviously will disrupt the schedules but often the pre-planning is helpful and can expedite an urgent shipment.

Another type of planning that must be considered is transport equipment maintenance. Both packagings and rolling stock must be maintained to the schedules and standards set out by the Canadian Nuclear Safety Commission (CNSC), Transport Canada, and the Ministry of Transportation of Ontario (MTO). Maintenance is generally worked around known transport requirements. The Radioactive Material Transportation department maintains a fleet of packagings from re-usable excepted packagings through large Type B packagings (Fig. 3) capable of transporting large amounts of activity safely. Equipment breakdown en route is unusual and, should a recovery operation be required, it would be planned and executed carefully.

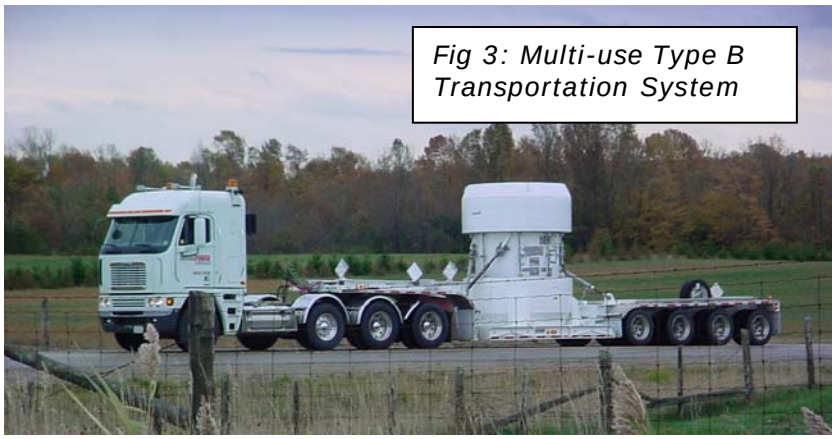

Fig 3: Multi-use Type B Transportation System

Another colleague is presenting the details of equipment maintenance.

Emergency response planning is carried out by the Emergency Preparedness Department at the corporate level with assistance from transport operations staff. Emergency exercises are designed around the most likely accident scenario that may cause a release to the public domain. Small scale drills and table top exercises are practiced at the section and department levels annually. Full scale corporate exercises that involve outside agencies are planned and executed every 3 to 5 years. Corporate staff that respond to emergencies are specially trained in the 3 C's – contain, control and confine – of contamination control in the natural environment. A third party site remediation company is kept on retainer in the unlikely event that a motor vehicle accident results in a release of radioactivity to the environment.

Since 9/11, security of the load has an increased profile and is added to the mix of items that must be considered prior to putting any radioactive material on the road. Security usually doesn't affect the regular waste streams, however, some loads do have increased security risk. Used fuel shipment planning, for example, is done months in advance with risk analysis being calculated up to the completion of the run. For security reasons, information about the shipment tends to be kept compartmentalized with only a small number of security-cleared individuals privy to the whole picture.

PACKAGE PREPARATION

As mentioned earlier, waste is segregated into three categories: processible, non-processible and compactable. This is done at the nuclear facility sending the material. At OPG, there are a number of so-called standing shipping permits that permit automatic classification of waste provided it meets with stringent criteria in terms of dose rate and activity. The first step in the physical preparation of the radioactive material for shipment is to survey the material. In the case of bagged waste, the bags are monitored in purpose-built monitors which both weigh and calculate the activity for each bag.

Fig. 4: Waste Handling Area

As long as the bags meet the criteria, they are loaded into stainless steel reusable storage containers (RSC's) which are subsequently loaded into an ISO container. As long as the criteria for the standing shipment permit are not exceeded, the shipment is then classified by the staff loading the ISO.

If the activity or dose rates of the bagged waste exceed the standing permit limits and for non-bagged waste, detailed surveys are carried out by qualified handlers and the results taken to a designated classifier in the Radiation Protection Department. He/she classifies the material and from this point on, only staff holding the appropriate level of Transportation of Dangerous Goods training for Class 7 Radioactive will handle the material. Depending on the classification, an appropriate packaging is selected and the material is placed inside and secured. Most re-usable permanent packagings have detailed procedures describing the loading and unloading evolutions. Procedures are reviewed and revised at least every two years.

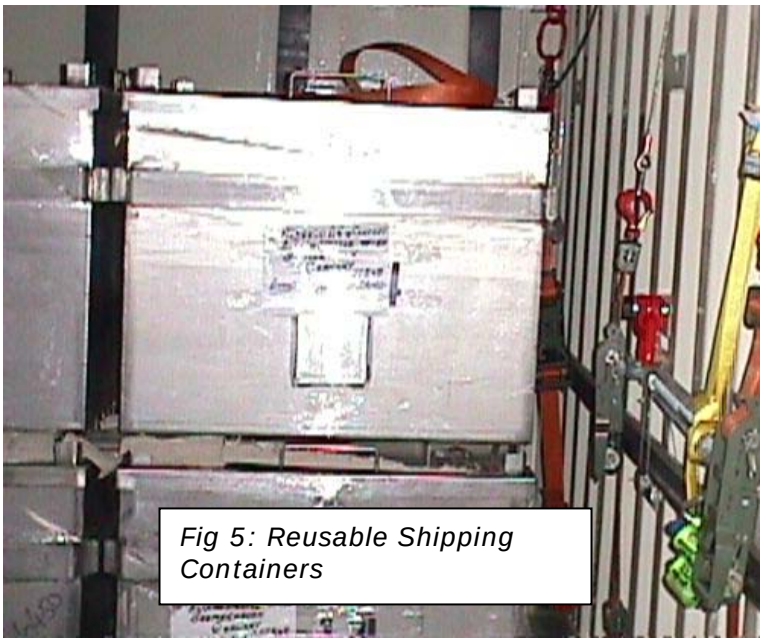

Fig 5: Reusable Shipping Containers

The package, once assembled, is surveyed again and the shipper categorizes it. He/she will prepare the paperwork and apply the correct labels, information and safety marks. OPG uses proprietary software called ESAF or Electronic Shipment Advice Form, to collect and store information about the shipment in a database which is used by all locations within the corporation. The program is also capable of producing legal shipping documents which accompany the load while it is in transit. Once the shipping documents are produced in their final form, the database record is locked. Any changes to the paper documents must be documented in a supplementary note field in the database. Notes may be added but not deleted. This feature preserves quality assurance accountability.

The package is then moved to the shipping area of the facility (Fig. 4) or, in some cases, the package is shipped from wherever it is loaded. Once the package is on the truck or the highway tractor has backed and hooked onto the trailer, vehicle surveys are performed. Tamper evident security seals are installed on the package and the numbers recorded on the shipping documents. Lastly, the final information entered into the database. The paperwork is approved by the shipper

and hard copies are produced for signatures. At the same time, e-mail notifications occur automatically to Corporate Security, and to the consignee. Since the information is now locked and permanently stored in the mainframe database, all that is required in an emergency would be to access the computer for all the pertinent information.

Package preparation can take from a few hours to a few weeks depending on the payload. Large package preparation often requires formal procedures and/or work plans to follow due to the complexity of the packaging. It's important for consignors to remember the time component to ensure drivers and rolling stock are not delayed due to incomplete shipment preparation.

TRANSPORT

Once the paperwork is complete, the package is ready to be "offered for transport" by the consignor. Within OPG, the consignor is the facility from which the shipment originates. NWMD personnel assigned to the facility may be required to assist with or advise on the shipment preparation. Shipment oversight by NWMD is mandatory on all Type A and Type B shipments originating from an OPG facility. NWMD Transportation Officers provide this service to all OPG facilities that need to ship radioactive material.

All OPG drivers have extensive training and experience with Class 7 shipments. Each driver has both a general TDG carrier certificate plus extra training for Class 7 Radioactive. Drivers also participate in the corporate drills and exercises.

OPG trucks are driven over standard routes for routine shipments. Non-routine and high security routes are planned with assistance from Corporate Security. The corporation also uses satellite tracking to monitor truck/package locations throughout the journey. Most trips occur during the daylight hours. Drivers are encouraged to make conservative go/no-go decisions in the event of poor weather or road conditions. Public safety and load integrity are always top priority for OPG drivers. This philosophy has helped maintain an excellent safety record. There have been only a handful of motor vehicle accidents involving OPG rolling stock. OPG has been on the road since the late seventies and recently completed 15 million kilometers with only 5 minor mishaps.

RECEIPT OF SHIPMENT

Upon arrival at a nuclear facility such as Western Waste Management Facility, OPG trucks are inspected just like every vehicle that enters the secure area. Large package seals are inspected for evidence of tampering. If the seals are intact, the truck is cleared to the appropriate unloading dock. A Class 7 qualified receiver meets the truck/package and performs a receiving inspection with the help of a checklist. The checklist is often customized for specific packages. For example, receiving a small excepted package involves only a single sheet generic checklist while a complicated package like a loaded heavy water tank requires completion of a 2 page checklist.

Once the receiver is satisfied with the paperwork and the condition of the package, he or she signs off on the shipping document, relieving the driver of responsibility for the load. Small packages are unloaded by the facility staff and the truck is released for service. For large loads the tractor usually disconnects and leaves.

At this point, the tractor will often go on to pick up another trailer or payload and the cycle begins anew. OPG planners do a good job of keeping the number of “bob tail” or empty runs to a minimum.

QUALITY ASSURANCE

In order to keep the Radioactive Material Transportation department running at a high quality level, the corporate program is built on the IAEA Safety Series 113 “Quality Assurance for the Safe Transport of Radioactive Materials”. The elements outlined in the document form the basis for the program document. The program document establishes the responsibility and the framework for the program. By complying with the program document, OPG ensures that audits are simply a routine chore and may be performed either internally or by outside agencies on short notice. OPG is regularly visited by the Canadian Nuclear Safety Commission, Transport Canada, and DMV (Loss Control) auditors and inspectors. To date, the feedback from the inspectors has been positive. Internal auditors will usually pick one area of the program to look at each year.

There isn’t room to go into each element of Quality Assurance in detail here but each element is addressed by some system within the corporation. OPG has found compliance to well-established quality assurance elements results in safe, reliable and consistent transport of

radioactive material and that it is well worth the time and effort expended.

CONCLUSION

Shipping radioactive material over public roads requires careful planning and execution to ensure the safety of the public and the environment consistently year after year. One of the best endorsements a program like this can earn is that no one in the public domain has heard much about or is very concerned that it exists. Ontario Power Generation has achieved this.