2007 International Nuclear Atlantic Conference - INAC 2007
Santos, SP, Brazil, September 30 to October 5, 2007
ASSOCIAÇÃO BRASILEIRA DE ENERGIA NUCLEAR - ABEN
ISBN: 978-85-99141-02-1

COMMON ERRORS IN TRANSPORT OF RADIOACTIVE WASTE

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ABSTRACT

The transport of radioactive waste is a stage of the waste management and must fit the same protection and safety requirements of any radioactive material shipment. In Brazil, the radioactive waste shipments must comply with the national regulations for transport of dangerous goods and the specific regulation for the safe transport of radioactive material of the nuclear regulatory authority. In these regulations, the consignor is responsible for the safety during the transport, however, the unload operations are consignee's responsibility. The Radioactive Waste Laboratory of the Nuclear and Energy Research Institute, IPEN – CNEN/SP, receives institutional radioactive waste from several radioactive facilities in the country. During the unload operations, protection and safety items are verified, such as the data written into the transport documents and the maximum levels of radiation on packages. The records show that almost all shipments of radioactive waste presented irregularities that varied from mistakes in fulfilling transport documents, up to the total disregard to the regulations. The shipments that could result in radiological risk to the operators of IPEN – CNEN/SP gave origin to reports that had been sent to the nuclear regulatory authority to take steps to prevent new occurrences and to enforce consignors and carriers. The adoption of this procedure in any type of occurrence, as well as its institutionalization in all radioactive waste management facilities of the nuclear regulatory authority could be an improvement against the errors observed in this type of transport.

1. INTRODUCTION

The operator responsible for any practice that gives rise to radiation risks has the main responsibility for the safe management of any associated radioactive waste.

The operator may manage the radioactive waste in its own facilities, for example, segregating and safe storaging the wastes with short radioactive half-lives until their decay to clearance levels that allow their authorized removal from regulatory control. The radioactive waste may also be transferred to an authorized facility for management of radioactive waste. In these cases, it should be ensured that radioactive wastes are transferred in accordance with the waste acceptance criteria established by the waste management facility and that the waste transfers are accompanied by the necessary waste inventory information [1].

The off-site transport of radioactive waste is one of the stages of the waste management and must fit the same protection and safety requirements of any radioactive material shipment. In Brazil, the radioactive waste shipments must comply with the specific regulation for the safe transport of radioactive material of the nuclear regulatory authority [2] and the national regulations for transport of dangerous goods [3].

The operator is responsible for the safety during the off-site transport of the radioactive waste; even if the work is contracted to a third party, until the waste becomes the responsibility of the operator of the authorized facility for waste management. In the national transport regulations, the consignor is responsible for the safety during the transport, however, the unload operations are already consignee's responsibility [4].

The Radioactive Waste Laboratory of the Nuclear and Energy Research Institute, IPEN – CNEN/SP, is one of the facilities authorized for management of radioactive waste and receives institutional radioactive wastes from several facilities in the country. The Radioprotection Service of the IPEN – CNEN/SP verifies protection and safety items of the transport, such as the data written into the transport documents and the maximum levels of radiation and radioactive contamination on packages, in order to assure that the unload operations will be safe.

The shipments that could result in radiological risk to the operators of IPEN - CNEN/SP gave origin to reports that had been sent to the nuclear regulatory authority to take steps to prevent new occurrences and to enforce consignors and carriers.

The objective of this paper is to analyze the errors in off-site transports of radioactive waste detected during the overseeing of unload operations in the Radioactive Waste Laboratory of the IPEN-CNEN/SP.

2. FREQUENT ERRORS

The qualitative characteristics of the errors and the limited number of shipments of radioactive waste do not allow a statistic treatment of the data extracted from the registers, but the most common errors were classified into three main groups: package contents and packaging conditions; management of packages; and transport documents and administrative controls. Those errors are described below.

2.1. Package Contents and Packaging Conditions

In transport of disused sealed radioactive sources it was observed that the consignors confuse the concept of sealed source with special form radioactive material. Most of the sealed sources received were transported under the normative requirements applicable to special form radioactive materials, although not certified as such. In some cases, even sealed sources rejected because of radioactive leak were transported under those requirements.

Many radioactive materials received in excepted packages had activities in excess to the allowed for that type of package. In spite of they presented maximum radiation level on the external surface limited to 5 μSv/h, there were cases that the activity contained in the excepted package exceeded in up to sixty thousand times the allowed value.

It is common the reuse of original packagings in transport of radioactive sources discarded as radioactive waste. Even though those packagings have been designed for those contents, some of them, especially type A projects, present containment systems that are disabled when the package is first opened. It was observed that some of those packages used in the transport of radioactive waste arrived not securely closed, because the consignors did not provide systems to compensate the devices disabled in the previous use of that packaging.

Another frequent problem observed in the reuse of packagings was their use with contents that they were not designed for. For instance, there were packagings designed for liquid contents that were used to transport solid radioactive waste. In many cases, in order to accommodate the radioactive waste inside the packaging the consignor simply removed inner parts of the package.

There were cases where the consignor used a package because it complied with the waste acceptance requirements established by the Laboratory of Radioactive Waste [5], but it did not comply with the minimum requirements for packages established in the transport regulations. For example, compressible solid radioactive wastes that were transported in plastic bags.

Significant part of the shipments under special arrangement, as those of disused teletherapy sources, showed problems in the assemblages used as packages. It was observed that the wood cradles provided by the consignors were not dimensioned to resist to the weight of the shield or to the forces that appear during the transport. In some cases the cradle broke or the shield became loosed from the cradle. It was also observed that, in shipments under special arrangement, the packages were rarely considered category III-yellow, as demanded by the regulations.

2.2. Management of Packages

The maximum radiation levels measured on external surfaces of packages and vehicles frequently did not agree with the values registered in the transport documents, but in few cases there were divergences in the package category.

In cases of reuse of packagings, it was observed that the consigners frequently maintain the labeling and marking from the original shipment. This procedure hinders the identification of the last consignor and, for instance, may create divergence between the activity indicated on the labeling and that in the transport documents.

When the consignor was also the carrier, or when the shipments were under exclusive use, many times the package marking was faulty with no external identification of the consignor or consignee.

The packages of radioactive waste rarely arrived properly fastened and could move within the vehicle enclosure even in routine conditions of transport.

2.3. Transport Documents and Administrative Controls

Practically the totality of the shipper's declaration forms received contained some mistake in fulfilling, mainly caused by the consignor inability in correctly define the consignment constitution. The indication of the original activity of the radioactive source instead of the maximum activity during the transport was one of the most frequent mistakes. The conceptual mistakes previously mentioned usually were consolidated in the declaration form fulfilling, as considering all the sealed sources as special form radioactive materials or defining labeling for excepted packages. Few shipper's declaration forms listed the identification marks of the certificates issued by the regulatory authority.

The consignor inaccuracy in defining the consignment constitution takes to failure in identifying the applicable UN number [6] and this implies in mistakes in fulfilling the transport documents as well as in the vehicle placarding.

The additional information about the dangerous goods and the consignor signed declaration that should be on the invoice body [4] are rarely provided.

The emergency guide is also a demanded transport document [4, 6] that frequently presents problems in its normative format and fulfilling [7]. The most common mistakes are outdated information, as authorities telephone numbers, and wrong emergency procedures and orientations. Not rare, the emergency guide was a copy of another product guide which the consignor simply changed its UN number and proper shipping name. It was also observed that some consignors used emergency guides from someone else different from the one responsible for the shipment.

3. DISCUSSION

The establishment of normative requirements for radioactive material transport has as main objective to provide an adequate level of radiological and conventional safety in all transport conditions, including possible accidents.

Each normative requirement collaborates for the safety in a different way. Some requirements provide inherent safety for the system, that is, even if all the other controls fail the risk will be still limited, as the activity limit for packages. Other requirements collaborate for a passive safety, that is, those that do not depend on additional actions once they are implemented; for example, the use of adequate packages. There are other requirements that participate in the active safety, which is associated to provisions that depend on complementary actions [8]. The package labeling and the regulatory authority permissions are in this last group.

The activity limit for package imposed by the regulations, based on the Q-system [9], considers the risks of radioactive contamination and external exposures in accident conditions. Mistakes associated to the package radioactive content, as the activity value or if the source is special form radioactive material, interfere directly in the radiological consequences expected for accident conditions, affecting the transport inherent safety.

The containers used for collection and initial storage of radioactive waste should be robust in order to provide adequate containment of the radioactive material. Even if these containers comply with the acceptance requirements established by the waste management facility, they not always comply with the requirements for transport packages. In these cases, it is necessary to provide additional conditioning in order to comply with those requirements.

When a high activity source is dismissed, the radiological risk associated to handle and repackage the source could outweigh the advantages obtained using a certified package [9] and, in many times, the transport using its original equipment as package is preferable. Those equipments that have no package certification should be transported under special arrangement and with approval of the regulatory authority. The final assemblage approved for transport should comply with the basic requirements for packages, in order to be handled in a safe way in routine conditions of transport.

Even if a certified package is used to transport the waste, it is necessary that the consignor be attentive if the radioactive content is covered by the package design specifications. It should be considered not only the maximum allowed activity, but also the real condition of the content and its other dangerous properties.

Mistakes in choosing the adequate package for the radioactive waste, as well as the reuse of packages out of their design specifications, may take to other faults in the transport management in normal conditions, as lack of package labeling or absence of specific permissions needed for the shipment. In accident conditions, the package could not provide containment and necessary shielding for the radioactive content, affecting the transport passive and active safeties.

The reuse of packagings is previsioned in the transport regulations, but it is demanded that the packages operational and safety conditions be kept in each use. It should be provided by the consignor's transport quality assurance program, for example, that disabled devices of the package are replaced and that any label or marking from previous shipments are removed or hidden.

Deficiency in package labeling or marking may also take to the faults in transport management, as the storage in the same place of packages in amounts larger than would be allowed or the package non-acceptance by some carrier because of inconsistency with the transport document information. It also could happen the impossibility of shipment delivery because of consigner's faulty indication.

Many times the information on the radioactive waste inventory is transcribed directly to the transport documents without considering that their objectives are quite different. While the radioactive waste inventory worries about the waste information traceability, as the waste origin and its initial activity, the transport documents worry about the operations that should be taken along the itinerary, including the emergency situations that could happen. To inform just the initial activity and its reference date of a radioactive source can be adequate in an inventory document, but it can be a delay factor in responding a transport accident where information, as the half-life of the involved radionuclide, may not be readily available.

The initial procedures of the emergency first response personnel such as police, fire and medical first aid or ambulance personnel depend on the identification of the material involved in the accident. The identification usually is carried out checking the UN number or proper shipping name informed in transport documents or vehicle placarding. Incorrect information or its lack in transport documents negatively affects the transport safety and it may result in unnecessary doses or even aggravate the situation.

4. CONCLUSIONS

The records show that almost all shipments of radioactive waste received at IPEN-CNEN/SP presented irregularities that varied from mistakes in fulfilling transport documents, up to the total disregard to the regulations.

Packages that do not comply with the basic requirements to be handled in a safe way, as well as deficient package labeling and marking, or packages not adequately fastened to the vehicle, may compromise the safety during the unload operations.

The errors observed in transport of radioactive wastes may affect the inherent, the passive and the active safeties, so the transport safety depends strongly on the normative requirements fulfillment by consignors and transporters.

The shipments of radioactive waste received at any radioactive waste management facility of the nuclear regulatory authority that could result in radiological risk should give origin to reports to be sent to the nuclear regulatory authority to take steps to prevent new occurrences and to enforce consignors and carriers. The adoption of this procedure in any type of occurrence, as well as its institutionalization, could be an improvement against the errors observed in this type of transport.

ACKNOWLEDGMENTS

We express our thanks to Hissae Miyamoto who meticulously filed the transport documents and allowed the retrieval of essential information to develop certain sections of this paper.

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