

# Safe and Secure Transportation of Radioactive Materials in Pakistan and Future Challenges

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**Abstract.** PNRA is the sole organization in the country responsible to regulate all matters pertaining to ionizing radiations. For the safety of transport of radioactive material in the country, PNRA has adopted IAEA TS-R-1 as a national regulation. To cover the security aspects and emergency situations, if any, during the transportation of radioactive material, PNRA has issued the regulatory guide on 'Transportation of Radioactive Material by Road in Pakistan'. In Pakistan, low to medium activity radioactive sources are transported from one place to another by road for the purpose of industrial radiography, well logging, medical application, etc. According to national policy, sealed radioactive sources of half life greater than 1 year and with initial activity of 100 GBq or more imported in the country are required to be returned to country of origin (exported) after its use. Although the activities related to transport of radioactive material remained safe and secure and no major accident/incident has been reported so far, however, the improvement/enhancement in the regulatory infrastructure is a continuous process. In future, more challenges are expected to be faced in the safety of transport packages. This paper will describe the steps taken by PNRA for the safety and security of transport of radioactive material in the country and future challenges.

## 1. Introduction

Pakistan Nuclear Regulatory Authority (PNRA), the sole National Regulator, is entrusted under the PNRA Ordinance III of 2001 [1] "to control, regulate, and supervise all matters related to nuclear safety and radiation protection including safe transport of radioactive material in Pakistan." PNRA, through its rules and regulations, ensures and verifies that all activities related to safe and secure transport of radioactive material are performed in full compliance.

To control all matters related to safe transport of radioactive material in the country, PNRA has established a separate directorate, namely Directorate of Transport and Waste Safety (WSD). The said directorate (WSD) implements transport requirements addressed in national regulations PAK/916 which is based on TS-R-1 [2]. One of the foremost responsibilities of WSD is to protect the human being and the environment from harmful effects of radiation, either caused from radioactive waste and discharges or during transportation of radioactive material. Furthermore, PNRA has established National Nuclear Security Action Plan (NSAP) Project in 2006 which aims to develop a national sustainable system in nuclear security including security during transportation of radioactive material with the established response and recovery capabilities, integrated with national laws, regulations and procedures.

In 2007, Pakistan has made study on the Sabotage of a Spent Fuel Cask or a Commercial Irradiation Source during Transport in the country. This study was made at The Henry L. Stimson Center, USA from November 2006-February 2007. The paper stated that an act of nuclear terrorism is of remote probability in Pakistan, nevertheless, a hypothetical case study was made of sabotage on radioactive consignments during transportation within the cities of Karachi and Lahore of Pakistan and possible consequences were assessed using Hazard Prediction and Assessment Capability (HPAC) computer code. Pakistan's response to nuclear terrorism and the further need of improvements has been discussed in the said research work. Under this research work, it was concluded that fabrication of a

Radiological Dispersion Device (RDD) and Weapons of Mass Destruction (WMD) is not attractive to a terrorist group in general and specifically within the context of Pakistan [3]. Moreover, the controls around various nuclear installations and radiation facilities in Pakistan are enough to deter and delay a terrorist attack and any modified diversion would be detected in early stages.

## 2. Regulatory Framework

Pakistan is giving due importance to the safe transportation of radioactive material in the country even before the establishment of PNRA. The old regulations, Pakistan Nuclear Safety and Radiation Protection Regulations – 1990 also address the requirements for safe transport of radioactive material. Currently, Pakistan has adopted IAEA TS-R-1 [2] as a national regulation. To cover the security/safety aspects and emergency situations during the transportation of radioactive material, PNRA has issued the regulatory guide on ‘Transportation of Radioactive Material by Road in Pakistan’[4]. In addition to the requirements for safe and secure transportation of radioactive material in the country, this regulatory guide also provides guidance to cope with the emergency situation during transportation.

Under the national regulations on radioactive waste management [5], sealed radioactive sources containing long lived radionuclides (half- life >1 year with initial activity of 100 GBq or more) are required not to be purchased without the undertaking from the manufacturer/supplier to accept the return of the source(s) when; a) no longer useful for the intended purpose (i.e., spent sources) or b) not useful for another purpose or c) not useful to another user in the country for another purpose. The above condition is required to be included as part of the purchase contract without which the Authority does not grant no objection certificate for import.

The convention on Physical Protection of Nuclear Material (CPPNM) and IAEA document INFCIRC/225 continues to be used as the overarching documents on physical protection of nuclear materials. PNRA ensure within the framework of its national law and consistent with international law that during international nuclear transport, nuclear material within its territory is protected at the levels established under CPPNM. On the other hand IAEA Code of Conduct on Safety and Security of Radioactive Sources is also being used for regulating all matters pertaining to safety and security of radioactive sources including transport.

## 3. Transport Safety and Security in Pakistan

In Pakistan, most of the radioisotopes are imported for medical, industrial and research applications however, a small number of radionuclides for the purpose of the medical application are produced in the country. All these radioisotopes are frequently transported from one place to another according to the job requirements. After useful application of sealed radioactive sources, these are either returned to the manufacturer/supplier or transferred to national waste storage facility. For the transport of nuclear medicine Type A packages are prepared and used in Pakistan (Fig. 1).

To ensure safe packaging, PNRA conducts transport inspection to witness Free Drop Test, Stacking Test, Water Spray Test and Penetration Test for a Type A package as required under TS-R-1. The package is used for the transportation of radiopharmaceutical to nuclear medicine centres in the country. In addition to regular transport inspection, PNRA also conducts unannounced inspection.



*Fig.1: Type ‘A’ Package used for transport of Tc-99m generators*

PNRA keeps strict regulatory control on all movements of radioactive material in and out of the country. Under the national regulatory framework, prior authorization from PNRA is required for import/export of radioactive material. Transport authorization is only issued to valid registration/license holders of PNRA. This authorization is mandatory for custom clearance. Licensee is required to keep record of all source movements especially in industrial radiography and oil well logging. To ensure safety during transportation, PNRA evaluates the shipping documents for import and export of packages containing radioactive materials and confirms that the shipments meet national and international requirements for transportation. Following are the main practices that are followed for compliance of TS-R-1 in the country:

- a) The radiation survey of the packages is performed to check any contamination. The package is also examined for any evidence of physical damage and assures that the security seal is intact. The packages containing radioactive material are picked up from the carrier promptly so that carrier personnel are not unnecessarily exposed to radiation. Only the authorized persons receive the shipment of radioactive material. In Pakistan before preparing a package for shipment, it is ensured that radioactive source/material is in proper shielded position.
- b) A dedicated vehicle such as wagon/truck is used for the transportation of radioactive material within the country. The closed vehicle is used for the transport of radioactive material and integrity of locks and seals are verified. No person is allowed to travel in the vehicle carrying radioactive material, other than driver/conductor and radiation supervisor. Furthermore in Pakistan transporter has been informed about the nature of material to be transported, drivers and radiation supervisor do carry some communication device e.g. mobile phone, special arrangements has been made during transportation to keep the movement of source/container to the minimum and transport document is provided to the transporters.
- c) During transport of radioactive material, the drivers have appropriate emergency arrangements such as fire extinguisher, rope, spare tyre, tools etc. The radiation supervisor accompanying the vehicle has tape, calibrated radiation survey meter and film badge/pocket dosimeter. In case of an incident/accident during transport of radioactive material, the carrier informs the responsible person of consignor and the National Radiation Emergency Coordination Centre (NRECC) at PNRA.
- d) A radiation protection programme is established by each licensee for the transport of radioactive material. Protection and safety is optimized in order that the magnitude of individual doses, the number of persons exposed, and the likelihood of incurring exposure is to be kept minimum.
- e) The workers involved in the transport of radioactive material receives appropriate training concerning the radiation hazards. The workers also have sufficient knowledge regarding packing of radioactive material, marking and labeling of radioactive material, loading and unloading of radioactive material etc.
- f) A background check of the workers to be involved in the transport of radioactive material is conducted to verify identity, credit history, criminal history, reputation and character. Psychological and medical screening are used to evaluate the mental health and stability of the individual; depression, schizophrenia, epilepsy, high/low blood pressure and other disorders are all taken into consideration.

In addition to the establishment of National Radiation Emergency Coordination Centre (NRECC), PNRA has established Nuclear Security Emergency Co-ordination Center (NuSECC) at PNRA HQs for coordinating efforts in case of a nuclear or radiological incident/emergency including incident/emergency during transportation. It aims to monitor the progression of the emergency and provide an expert opinion to response organizations for mitigation of radiological consequences. Under the NuSECC, a net work of six emergency mobile vehicles equipped with advance radiation detection equipment is in place at six different major cities of Pakistan to provide the response in case of any nuclear security events. NuSECC is manned round the clock and is capable to assess, control,

respond and co-ordinate in case of a radiological emergency within 4-6 hours in major cities of the country.

#### 4. Combating illicit trafficking

In Pakistan, threat of illicit trafficking of radioactive materials is minimal because all major nuclear and radiation facilities are under strict control of the Government. However, by virtue of its location at the crossroads of international trade routes, Pakistan shares borders with India, Afghanistan, Iran and China. A great volume of trade goods enter and exit from these borders on daily basis. Without monitoring tools on the entry/exit points, it is not possible to check any illicit trafficking of radioactive material. Pakistan, as an aspiring industrial state, is recipient of scrap metal from various countries. Without stringent checks on the incoming scrap consignments, there is a possibility that some contaminated material or consumer goods manufactured from contaminated material might enter in country unknowingly.

There may be a risk that some unscrupulous persons might try to ship radioactively contaminated consignments (rejected from other countries) into Pakistan. In situation like these, the ability of Custom Officials, who by virtue of their constant presence at the borders and legal authority vested in them, are vital force for enforcing the strategy of preventing illicit trafficking of radioactive materials. PNRA stands committed to assist the authorities in their efforts to stop illegal movement of radioactive materials at national-borders before entering or leaving the country.

In this regard, PNRA signed a Memorandum of Understanding with Federal Board of Revenue (FBR) in 2008 to equip selected entry/exit points of the country with radiation detection equipment and to provide necessary training to Pakistan Custom officials. It was intended to provide necessary awareness to ensure that radioactive materials are appropriately monitored and controlled. To ensure safe and secure entry/exit of radioactive material in the country, PNRA provided Radiation Detection Equipment, training, maintenance facility and technical assistance to Pakistan Customs at the following entry/exit points [6]:

1. Sost (Pak-China Border)
2. Torkham (Pak-Afghan Border)
3. Chaman (Pak-Afghan Border)
4. Tafftan (Pak-Iran Border)
5. Gwadar Sea Port (Arabian Sea)
6. Wagha (Pak-India Border)
7. Karachi Sea Port (Arabian Sea)
8. Bin Qasim Sea Port (Arabian Sea)



#### 5. Challenges

Due to increased interdependence in contemporary world, illicit movement and security during transport of radioactive materials is no more a problem of a single nation. The threat of transboundary effects of radiological incidents require enhanced cooperation and coordination among the States to prevent, detect and respond to the illegal movement of radioactive materials.

The challenge of safe and secure transport of radioactive materials cannot be reined in by a single organization therefore there is a need to involve other stakeholders to cope with the challenges.

There is a need to have effective control on long borders of Pakistan with its neighbor countries to prevent any illicit entry/exit of radioactive material.

## **6. Measures to cope with the Challenges**

Under the national project (NSAP), PNRA has taken step to make enable the concerned national authorities to interdict illegal movement of radioactive materials at the international borders before entering or leaving the country.

PNRA has involved and prepared national stakeholders who have knowledge of trade and legal powers of border monitoring, to perform their duties in more effective way in the subject area. This objectivity lead the regulatory body to work in liaison with law enforcement agencies like customs, border guards and other authorities at entry/exit points.

The provision of radiation detection equipment and training to Pakistan custom officials has enhanced Pakistan's capacity to detect and interdict the incidents of illicit trafficking of radioactive materials at its borders. Apart from these steps, there is still room for further improvements. So far PNRA has equipped eight entry/exit points under the first implementation phase of MoU, however, other entry/exit points, international airports, dry ports and custom stations are needed to be equipped with radiation detection equipment in the second phase.

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