Safety And Security of Radioactive Sources in Nepal

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1. Abstract:

In Nepal, radioactive sources are mainly used in the medical field. Small quantities of low-activity radioactive sources are used in research and education. Since 2005 Ministry of Education, Science & Technology (MoEST) has completed five projects and on inventory of radioactive sources being used in Nepal. A study was designed to determine the actual number of radioactive sources including country of origin, date of installation, source number, activity etc. After becoming a member country of the International Atomic Energy Agency (IAEA), the responsibility of Nepal has increased many folds. The United Nations (UN) Security Council Resolution 1540, which is binding on all member states, contains obligations regarding accounting and physical protection on nuclear materials as well as commitments to prevent trafficking in weapons-related material and their delivery systems. Radioisotopes in hospitals, academic institutions, research laboratories etc. in Nepal are categorized per IAEA Technical Document TECDOC-1344. While some significant steps have been taken to secure high activity radioisotopes in Nepal, with the help of the United States Department of Energy's Office of Radiological Security (ORS), many challenges lie ahead in securing Nepal's radioactive sources. Despite all the impending challenges, Radioactive Substances (Utilization and Regulation) Act 2020 has materialized effective as of July 2020. Similarly, Radioactive Substances (Utilization and Regulation) Regulations has been approved by the council of Ministers in 24th March, 2022.

2. Background

In Nepal use of radioactive materials are almost solely confined to the medical field, mainly in radiation therapy and nuclear medicine. Since 2005, inventory of radioactive materials was started. Studies were designed to find out the actual number of radioactive sources in Nepal including date of installation, country of origin, source number, activity etc. The inventory of radioactive isotopes in Nepal is concerned with the current status of radioactive materials and where they reside. It is also concerned with radiation safety and security of these radioisotopes. The inventory of radioactive isotopes used in different institutions includes imported radioisotopes used mainly for medical purpose, calibration and research proposes. This inventory does not include natural occurring radioactive isotopes. The IAEA encourages all governments "to take steps to ensure the safety of radiation sources and the security of radioactive materials". As a first step towards securing the radioisotopes in Nepal we have conducted a survey of imported radioactive sources which is the first step required for subsequent safety and security measures taken in future.

(a) (b) (c)

FIG. 1. (a) Nuclear Materials Regulatory Directive, 2015 (b) Radioactive substances (Utilization & Regulation) Act 2020 (c) Radioactive substances (Utilization & Regulation) Regulations, 2022

3. Current Status & Security of Radioactive Materials in Nepal

In Nepal the use of radioactive isotopes is very limited. In 1972, first use of radium source in medicine was started at Parapokar Maternity Hospital, Kathmandu for cervical cancer patients. In 1987, use of a radioisotope in medicine was started in Nuclear Medicine at National Academy of Medical Sciences (NAMS), Bir Hospital. Cobalt-60, was first introduced in 1991 with at NAMS, Bir Hospital, Kathmandu. In 2015 first blood irradiator (Caesim-137) was introduced in Civil Service Hospital of Nepal, Kathmandu. Radioactive materials being used in medicine include Irridium-192/Cobalt-60 for brachytherapy, Tc-99m from Mo-99/Tc-99 generator, Iodine-131 and FDG 18 for nuclear medicine. Medicine is the predominant use of radioactive isotopes Nepal. Some institutes use low-activity (micro curie) radioisotopes mainly for academic purposes. Nepal does not have any nuclear power plants or nuclear facilities and no nuclear material (e.g. uranium, plutonium) is present in the country.

Table 1: Institutions having physical protection security system

Site Name	Source Type
NAMS Bir Hospital, Kathmandu	Cobalt- 60 (recently disposed) Iridium -192
Bhaktapur Cancer Hospital, Kathmandu	Cobalt- 60 Iridium -192
B.P.K. Memorial Cancer Hospital, Bharatpur	Cobalt- 60 Iridium -192
Manipal Teaching Hospital, Pokhara	Cobalt- 60
Om Hospital & Research Center, Kathmandu	Iridium -192
Civil Service Hospital of Nepal, Kathmandu	Caesim-137

Nepal began the process of securing category 1 radiological sources in June 2008 by partnering with the United States Department of Energy's Global Threat Reduction Initiative (GTRI), now the Office of Radiological Security (ORS) [5]. As a first step towards securing the radioisotopes in Nepal, physical security system was installed with the help of ORS. In June, 2008 the first Physical Protection Security Systems (PPSM) in Nepal were installed at the National Academy of Medical Sciences (NAMS) Bir Hospital, B.P Koirala Memorial Cancer Hospital and Bhaktapur Cancer Hospital. These initial upgrades were completed in September, 2009. These three sites use Cobalt-60 Tele-therapy machines for cancer treatment. Later, installation of a PPSM was performed at the Manipal Teaching Hospital to protect a Cobalt-60 tele-therapy machine. PPSMs were also installed to protect sealed radioactive sources used for Brachytherapy at Bir Hospital, Om Hospital and Bhaktapur Cancer Hospital. In 2018, a PPSM was installed with the help of ORS to protect a Caesium-137 source used for blood irradiation at Civil Service hospital of Nepal. Recently, one disused Cobalt-60 source was successfully repatriated to the country of origin for disposal.

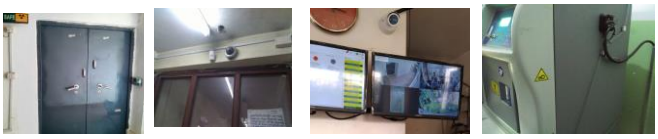

Figure 2: Physical Security system installed with the help of US DOE Office of Radiological Security Program in Nepal

4. Issues & Challenges

As per "Radioactive Substances (Utilization and Regulation) Act 2020" in Section two there is a provision of establishment of separate regulatory body. The most essential introduction of Radiation law and regulations is now already a law of land. In law, there is the provision of separate regulatory body in the act which is now in application for administrative requirements (notification, authorization, review and assessment, inspection and enforcement) and technical requirements (occupational protection, public protection, medical exposure, radioactive waste management, transport of radioactive materials, security of radioactive materials and emergency preparedness and response.

In absence of regulatory system, qualified experts, budget to maintain security equipment, it is a challenge to maintain and sustain PPSM system installed at different centers with the help of US DOE ORS program. Even though with high budget was allocated for decommissioning and disposal of Cobalt-60 disused source for country of origin for disposal, NAMS, Bir hospital had faced a big challenge for disposal which costs huge efforts and time. There is yet another challenge to identify national secure storage place where we can securely store disused sources buried at the premises at B.P.K Memorial Cancer Hospital, Bharatpur as well as Radium source buried at Teku Hospital, Kathmandu.

5. Conclusions

In conclusion radioactive source security is needed to bring high level attention and timely action by the government. As a first step towards securing the radioisotopes in Nepal, PPSM has been installed with the help of Office of Radiological Security (ORS) at all category 1 sources. The best way for country like Nepal, to move towards the use of alternative technologies if available. e.g. shifting from Co-60 tele-therapy units to linear accelerators, phasing out cesium-137 blood irradiation for X-ray radiation technology or Ultraviolet radiation. There are many benefits of using alternative technology as they are very safe to use and need no security system and less regulatory paper works. IAEA encourages all governments' parties "to take steps to ensure the existence within their territories of effective national systems of control for ensuring the safety of radiation sources and the security of radioactive materials".

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