National Infrastructure for the Prevention of Radiation Accidents and Emergency Preparedness

By: Mamdouh Yassin Osman
Chairman,
Radiation Protection Technical Committee (RPTC)
Sudan Atomic Energy Corporation (SAEC)*

Abstract: The use of radiation sources in Sudan has been greatly increased following the discovery of oil by the end of last century. Regulation of such use is effectively achieved by the Radiation Protection Technical Committee (RPTC) of the ministry of science and technology. So far, no accidents that involve exposure to a large population or that lead to a serious contamination to the environment in Sudan have been reported. However, a number of incidents that carried the potential risk of exposing public and/or causing a large contamination to the environment have been recently discovered. In this report the current legislative framework for regulating the use of radiation sources is described with the emphasis on issues related to safety and security of radiation sources including radioactive waste. Also, incidents related to public exposures have been outlined together with the ongoing effort to strengthen the national capabilities regarding prevention of radiation accidents and emergency preparedness. Finally, main obstacles and needs are mentioned.

1. Introduction

The use of radioactive sources has been started in the country during the sixties of the last century. The major use then was in the medical field both for diagnostic and therapeutic purposes. Discovery of oil in the nineties of the last century has greatly increased the number of sealed radionuclide in the country. According to the last inventory (June 2007) the total number of sealed radiation sources in Sudan is 648. Table 1 shows the distribution of such sources per practice.

Table 1: Distribution of Sealed Radioactive Sources

S.No.	practice	No. of sealed sources	Percentage of the total (%)
1	Waste Management	348	49.8
2	Well Logging	160	22.9
3	Industrial Radiography	51	07.3
4	Education & Research	48	06.9
5	Gauges	43	06.1
6	Medical	38	05.4
7	Others	11	01.6
	Total	699	100

Well logging and NDT activities are carried out mainly at the south of the country, where major oil wells exist. As those two activities involve the use of substantially high activities of moving radioactive sources, they present the most potential causes of accidental radiation exposure to the public. It is believed that still some sources are not yet on records, this partially due to the fact that many radiation sources have entered the country well before the establishment of regulatory system in the country

and also due to the weak controls of such sources at the borders and to infrequent inspection missions that took place all over the years.

In 1991, the IAEA has helped Sudan to establish a central waste management site at Soba (about 25 km south the capital Khartoum). The site belongs to the SAEC. Most of the radioactive waste is Ra-226 needled that was brought to the country in 1967 for Brachtherapy. Other radioactive waste includes CO-60, Cs-137 beside some neutron sources. The centre is also providing the service of temporary storage of the imported radioactive sources.

2. Legislative framework

Two regulatory authorities for the regulating the use of radiation sources currently exist in Sudan, one under the ministry of health and the other is under the ministry of science and technology. The two regulatory authorities were established according to the 1971 and 1996 acts respectively. The only currently effective regulatory authority in Sudan is the RPTC established by the 1996 act. The RPTC is a national committee formed by the ministry of science & technology and comprises a chairman and 11 members drawn from some scientific and police institutes. The technical activities of the RPTC are conducted by a group of SAEC staff (mainly physicists) who - Since 2005 – do not engage in providing radiation protection services so as to secure a reasonable level of independency to the regulatory authority.

Current regulations contain many items that address the issue of prevention of accidental exposures associated with each practice. However such issues are not mentioned clearly in the current act nor they are consistent with the BSS recommendations. Licensing requirements include some of the items that should have been addressed in regulations. For example all applications for practice licenses are evaluated with respect to the measures taken by the applicant to ensure public protection and security of radiation sources, such evaluations are followed by pre license inspection for verifications.

Also the current regulations demand from the licensees to have adequate facilities, equipment and services for the protection of the public and environment. In addition regulations require that the licence holder employ qualified and well trained technical staff including a radiation protection officer responsible for performing safety related duties in public protection and security of radiation sources. Another important requirement is to have a quality assurance program implemented that include training and retraining activities for the staff. Regulations also demand from the licensee to have an effective emergency plans and response to such situations. Many other issues that could help in minimizing accidental exposure by ensuring safety and security of radiation sources have to be addressed in the act and regulations. A new act is currently being formulated and many of such issues will be included.

According to the regulations, licensee should keep records of discharged activities for each radionuclide. The most important practice available in the country that might lead to activity discharge to the environment is the nuclear medicine. There are only two of such departments in the country. The most used radionuclide is Tc-99m. I-131 is used for treatment of thyroid cancer cases; there is a special room for the patient undergoing such treatment with a separate bathroom so as to collect all of the secreted

radioactive iodine in stop tanks before allowing it to be discharged to the common sewage system.

There is no national waste management strategy in Sudan. However the first option for dealing with a radioactive waste is to return it to the supplier. A regulation on the control and management of radioactive waste was issued in 1998 and these prescribe the necessary regulatory, administrative and technical provisions for this purpose. According to this regulation, responsibility of dealing with radioactive waste rests on the licensee, however the licensee is not authorized to dispose of this waste without prior approval from the regulatory authority. The licensee has to bear all financial expenses needed for the management of radioactive waste should it be done by the central waste management site. Also, and in accordance to the regulations importing a sealed radioactive source of radiation activity that expected to be greater than 100 MBq after 10 years from the import date, is conditioned by the presence of contract between the licensee and the supplier (or any other suitable body) to export the source within one year from the date he is requested to do so (by the regulatory authority).

The licensee is also responsible for collection, classification and interim storage of radiation waste arising from his licensed activities. All radiation waste that are not expected to decay to the clearance levels within one year should be presented to the regulatory authority case by case to take the appropriate decision. Only the waste management unit of the SAEC is licensed to deal with radioactive waste that needs more than one year to decay to the clearance levels. Also regulations request the licensee to keep the radioactive waste to the minimum.

Requirement for safe storage of radioactive waste as well as Clearance levels are stated in the regulations. Application of these limits is controlled through inspection missions.

3. Regulatory Activities

Updating of the inventory of radiation sources are carried out through licensing and inspections. All radiation sources imported to the country have to be licensed. The transport of those sources shall also be licensed and has to follow the regulation for the safe transport of radioactive materials issued in 1998. One important conditions mentioned in this regulation is that radioactive sources should be accompanied by a person knowledgeable about radiation protection and equipped with a suitable radiation monitor. The importance of this condition arise from the fact that transporting radioactive material can takes long time (days) using bad roads and may encounter bad weather conditions, in addition such trips could also take routes through unrest areas. More efforts are needed to ensure security of radiation sources during transportation. Intensifications of inspection missions especially for practices that carry high radiation risk and located at remote areas, have been taking place since 2005. Enforcement actions succeeded to bring more radiation sources under the control of the regulatory body as well as to return some of the unused sources to the supplier (outside the country).

No formal program yet in place for searching for orphan sources, however three major missions took place for monitoring public exposure which has been utilized also to look for orphan sources. These missions took place in 2002 to the northern state, 2003 to the eastern state and in 2007 to the Nile River state. Apart from that, searching for

orphan sources is an activity that takes place routinely during each announced and unannounced inspection missions. Limited number of equipment and trained personnel are the most obstacles in continuing this program.

Recent inspection to the only central radioactive waste management facility existing in the country reveals the necessity for improving security measures for the site and the need of implementing a QA program.

4. Inspections Findings

Inspection missions reveal the existence of many cases of non compliance of the licensee with the current regulations and instructions. Many of such non compliance may lead to accidental exposure to the public and may results in large scale accidents that require emergency interventions. Examples of that are:

- Inadequate storage facilities for radioactive sources e.g. unacceptable leakage levels form the storage containers or the improper location of the storage facilities. For instance; two large stores for radiation sources were found to be in the vicinity of an explosive storage area.
- Absence of workplace monitoring program in the controlled and supervised areas.
- Inadequate level of security of radiation sources both at storage sites and during use.
- Unsuitable of source accountability program and record keeping.
- Inadequate level of education and training of the technical staff regarding radiation protection issues.
- Inadequate level of training of radiation protection officers.
- Inadequate supervision of discharge of radioactive waste
- Many radiation sources – about 50 - found during inspections, were not on RPTC records.
- Lack of conducting regular training courses nor exercises on emergency response for radiation workers and other personnel.
- Incidents and accidents related to radiation sources are not promptly notified to the regulatory authority nor appropriately documented.
- Majority of radiation workers are not aware of the national regulations and requirements for the control of radiation sources.
- Absence of most of the records that control the use of radiation sources e.g. area monitoring records, dosimetry records, etc.

5. Reported incidents

A number of incidents - that involved the risk of radiation exposure to the public and the potential of causing large scale accidents - have been discovered during inspection missions or reported to the regulatory authority, the following are a list of them:

- In March, 2003 a radioactive source that belong to one of a well logging company has been picked up by one of the local citizen, the source was Cs-137 of 540 μCi; used for logging tools calibration. The source was in a well locked metal box. The licensee did not inform the regulatory authority of this incident until discovered during an inspection mission that took place two years later in 2005. Although the licensee did a lot of efforts to find the source,

the source was found by chance about one month later by a driver working for an NDT company.

- A damaged moisture/thickness gauge that contains two sources Cs-137 and Am/Be, were left behind by a foreign company in a common store for about 9 years before reported to the regulatory authority.
- A 150 mCi of I-131 found its way to a pharmacy and stayed there intact for more than 15 years before discovered and reported to the regulatory authority.
- 7 sources (4 Cs-137 & 3 Am/Be) have been lost (abandoned) during a four well logging procedures. Only two of such incidents have been reported - at the time of the incident - to the regulatory authority, the other two were discovered during an inspection mission.
- Two unlabelled radioactive sources were found in an storage for radioactive materials belongs to a well logging company, the licensee could not identify the sources and fails to provide any explanations for their existence in the storage area.

6. Needed Measures

The above mentioned incidents raised the necessity of taking some regulatory measures first to discover similar incidents that may have taken place and also to minimize the probabilities of occurrence of such incidents in the future and to upgrade the national capabilities regarding taking measures for environmental remediation in case of accidents and in long term radioactive waste management after an accident.

The following has been identified as the necessary steps to achieve these objectives:

- Strengthening the legislative frame work by drafting a new act – consistent with the current international recommendations - that establishes an independent regulatory authority in Sudan with sufficient financial and man power resources.
- Issuance of the relevant regulations and codes of practice.
- Revising the existing codes of practice so as to match with the current international recommendation.
- Strengthening the control of radiation sources movements at boarders.
- Strengthening the physical protection of radiation sources not only in the storage areas, but especially in the weakest point of their use and during transport. This is the case where the sources are more liable to be stolen or used for illicit actions.
- Establishment of regulatory authority branches at different regions of the country for more effective performance of regulatory functions over the whole country (area of 1 million square mile).
- Preparing and implementing a program for searching for orphan sources.
- Establishment of an information system to inform the public about radiation safety and security of radiation sources and other relative issues e.g. emergency preparedness and radiation regulation system available in the country.
- Encouraging more centres in the country to provide radiation protection services including training.

- Laying down and implementing a monitoring system of radioactivity in materials collected for recycling.
- Strengthening the security of the only existing site for management of radioactive waste.
- Speeding up the process of finalizing a national emergency plan and preparedness.
- Launching a program for monitoring radiation levels arising from NORM as a result of oil exploration and other similar activities.
- Implementing a formal program for collecting Information about the materials that go for recycling in the country in order to launch a program for checking their contamination levels.

7. Current and Future Plans

A new act has already been drafted during the first quarter of 2007. The act establishes an independent regulatory authority and repeals the two currently available acts (the 1971 & 1996 acts). Currently the draft is under final revision by a committee formed by the director general of SAEC and hopefully it will be enacted by the end of this year. Also four codes of practice for radiation protection in diagnostic radiology, radiotherapy, well logging and in education and research are scheduled to be drafted during 2007.

Regarding the security of radiation sources, Sudan has participated in the AFRA project (Strengthening National and Regional Capacity of AFRA Member States in Nuclear Security RAF/0/021). A national committee for nuclear security was formed in 2003, the purpose of which is to lay down and supervise a national program that provide effective physical protection of radioactive sources and their installation in addition to combating illicit trafficking of radiation sources. Under this project a number of training courses and workshops have been held. About 12 persons mainly from the law enforcement personnel have attended such events. However, the overall progress of this project is relatively slow, away for the training courses and workshops no other assistance were provided e.g. survey meters , radiation detectors for environmental levels, contamination monitors, food monitoring system etc.

Assistance was requested from the police to provide physical protection for the waste management site. Plans have been set to establish regulatory offices at the main sea harbour in Sudan (Port Sudan) and at the south, implementation of such plan is subject to the provision of adequate financial and man power resources. In order to upgrade the level of awareness and understanding of the radiation issues for police personnel the regulatory authority has recently tailed an academic course on basic radiation physics and radiation protection and suggested to be incorporated into the syllabus of the police academy. The suggested course includes also topics on security of radiation sources and emergency preparedness.

Also and in the light of the severe shortage of radiation protection officers and radiation protection experts available in the country, the RPTC drafted a detailed of M.Sc program in radiation protection. The course is to be under the Sudan Academy of Sciences (SAS) and the first intake for this course is expected to take place in September 2008.

Efforts of the Regulatory authority have finally succeeded in establishing a national committee for emergency preparedness in 2007. The committee involves representative from 14 relevant institutes such as ministry of health, ministry of interior etc. as well as SAEC. It is expected that a national emergency plan – endorsed by the regulatory authority - will be established by the mid of 2008. Participation of Sudan in the IAEA regional project RAF 9/034 that aims to strengthening the regional capabilities regarding the emergency response and preparedness will help the country to effectively implement the action plan related to this project.

8. Conclusion

Great efforts are needed to decrease the probability of accidental exposure of the public to radiation and to strengthen the security of radiation sources. Serious steps has been taken since 2005 to achieve this goal, where a new act has been drafted to establish a truly independent regulatory authority and to repeal the currently existing two conflicting and contradicting acts, issuance and revision of some codes of practice, implementing a more effective authorization program and increasing the frequency of inspection especially to the high risk practices located at remote areas. Enforcement actions succeeded in achieving a better level of compliance to the regulations including the returning of two disused sources to the supplier and relocation of more than 100 sealed sources in a more safe and secure place away from an explosive storage. The long standing assistance from the IAEA has helped the country to attain a reasonably acceptable level of safety and security of radiation sources, however continuation of such assistance is needed particularly in revising the drafted new act and regulations as well as in provision of necessary equipment and training programs for the ongoing relevant projects.

REFERENCES

[1] Proceeding of the first coordination meeting on the regional project, RAF 037, April 2007.

[2] Proceeding of the second coordination meeting on the regional project, RAF 031, April 2007.

[3] International Atomic Energy Agency, Code of Conduct on the Safety and Security of Radioactive Sources. IAEA/CODEOC/2004.

[2] International Atomic Energy Agency Regulatory Control of Radiation Sources GS-G-1.5, 2004

[3] International Atomic Energy Agency Independence In Regulatory Decision Making International Nuclear Safety Advisory Group (INSAG) Report 17, IAEA (2003)

[4] Proceeding of the second coordination meeting on the AFRA project, RAF 021, June 2005.

[5] Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety. Safety Standards Series No. GS-R-1, IAEA, 2000.

[6] International Atomic Energy Agency, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115, IAEA, Vienna, 1996.

[7] SAEC act 1996

[8] Regulation of waste management, 1998