

Industrial Radiography in Sudan

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Abstract

The use of radioisotopes in Sudan started in 1965 in the medical field, and gradually expanded in agriculture, animal research, hydrology and recently industry.

In the last two years the oil is being explored and processed in the country at Southwest. About 8 foreign companies are involved in oil industry including exploration, establishment of refineries and construction of pipelines. Sudan's pipeline is the longest in Africa, about 1600 Km.

The estimated number of radiation workers in these Companies are 100, some of them are locals.

The country Regulatory Authority is Sudan Atomic Energy Commission (SAEC). The Commission provides personal monitoring services to all radiation workers in the country. Only about 20% of the radiation workers in these companies are under monitoring services.

The total number of registered sources about 500. Number of sources used in the industrial applications of about 50% of the inventory.

SAEC has difficulties in controlling the industrial radiography in the country. These difficulties can be summarized as follows: -

One) Difficulties pertaining to information provided by the Companies, which include:

- 1- not all sources used by companies are licensed and registered.
- 2- not all workers are under personal monitoring services.
- 3- no notification system available by the companies to the regulatory authority in case of accidents
- 4- no enough information available by the companies to SAEC regarding the radiation work done by them
(transparency).

Two) Poor Communications with the companies

Three) Resources constrains:

No enough resources for inspection missions (means of transportation)

Introduction: -

The quality control in the industry becomes a vital component for marketing and competition between companies and factories.

One of the techniques used for quality control (Q.C) is the non-destructive testing (NDT) or industrial radiography, using radiation sources. The technique can be used for the Q.C of refineries, pipelines, aviation, power generation stations, transportation sector and oil industry.

In most of developing countries the Q.C business using NDT technique were carried out by foreign companies.

Protection of workers, in the field of industrial radiography, is the responsibility of the companies and should be verified through strong regulatory control implemented by the regulatory authority. The radiation doses received by workers in this field are categorized as high doses compared to other radiation techniques. In most developing countries, the control of industrial radiography is not adequate to ensure the safety of workers, public and the environment.

The high economic impact of the business related to industrial radiography made the enforcement of the radiation protection regulations on these companies fairly difficult. This results in: -

- 1- No records for individual doses for the workers
- 2- Not all practices, imported sources and workers are licensed

- 3- No accidents records
- 4- Difficulties in carrying on site inspections

Sudan is one of the developing countries who started recently to have extensive industrial radiography business. The use of radioisotopes in Sudan started in 1965 in the medical field and gradually spread to other disciplines (agriculture, animal research, hydrology, industry, etc.). The expansion on the industrial field started in 1997 due to the oil industry. All companies dealing with industrial radiography in the country are foreign companies.

The number of sources imported in the last 4 years estimated to be twice as high as the previous years.

Number of radiation workers in the field of industrial radiography is not fully known. Not all workers are under personnel monitoring even the existing data is not on a regular basis.

Beside the difficulties mentioned above in controlling industrial radiography, other factors that may affect the control are, financial constrains and lack of sufficient trained personnel.

The control of industrial radiography needs strong government commitment and full legal power to the Regulatory Authority to enforce foreign companies to comply with the national radiation protection requirements.

Existing situation: -

In the last 4 years heavy work started in the field of oil industry in Sudan. This activity results in a great expansion in using industrial radiography.

New pipeline was commissioned last year. It is the longest pipeline in Africa reaching a length of 1610 Km. Another old pipeline which was commissioned in 1976 of length 815 Km is still in operation. The number of refineries increased to 5 as compared to two in year 1997. More than 8 foreign companies are involved in oil industry. These companies are using radioactive sealed sources.

According to the national registry of radioactive sources, number of industrial sources registered in the last 3 years amounts to about 50% of all sources in the country. Table (1) shows the number of sources registered in different application in the last 3 years.

Table (1): Number of sources registered in years from 1998 to 2001

field	Number of sources
Industry	72
Medical	45
Research	35

Number of workers in industrial radiography is not well identified. The estimated number is about 100 workers. Only 4 companies provided SAEC by their workers qualifications and personnel dose records.

According to the record until the year 2000, the highest average dose received by the workers was 5 mSv. Also the highest dose received by a worker was 7.2 mSv. Table (2) shows the number of workers in different application, the average dose and the highest doses received by the workers.

National Regulatory Infrastructure: -

In 1971 an Act ‘Regulation of use of Ionizing Radiation’ was issued, establishing a committee and empowering it the right to license and inspect diagnostic X-ray facilities.

The Atomic Energy Committee was established in 1973, the committee was given powers to oversee safety in all activities involving use of ionizing radiation.

Both Acts did not enable establishment of a radiation protection regulatory framework or a technical authority.

The Sudan Atomic Energy Commission (SAEC) Act was issued in January 1996. Under this Act, the Council of Ministers appoint a national policymaking BOARD.

The SAEC BOARD, beside its promotional function, has the mandate to establish the National Regulatory Authority (Radiation Protection Technical Committee 'RPTC'). RPTC is a national committee responsible for: -

- Preparation of drafts of Radiation Protection Regulations and field specific Technical Guidelines to be issued by the BOARD,
- Setting radiation protection and environmental monitoring policies and priorities and securing funds to enable implementation and promotion of these activities,
- Supervision of implementation of Regulations and Safety Guides by the designated radiation protection institution,
- Issuance of licenses for practices

RPTC designated the Department of Radiation Protection and Environmental Monitoring (DRPEM) to act as its technical arm and carry out inspections and regulation and safety guides enforcement and provide quality control and calibration services.

Table (2): Radiation Work Force (Registered and monitored)

	Field		No. Of		Average dose mSv	Highest dose mSv
			institutes	workers		
1	Diagnostic radiology	Governm	12	196	0.23	0.55
		Private	7			
2	Radiotherapy		2	48	0.41	3.8
3	Nuclear medicine		4	48	0.2	0.67
4	Radiography students		2	250		
5	NDT		4	68	5	7.15
6	Research		1	35	0.33	0.4
	Total		32	620		

Control of Industrial Radiography: -

The control of industrial radiography in the country is still not adequate. The constrains facing the control could be summarized as follows: -

- 1- **Foreign Companies:** controlling of foreign companies in most cases is a difficult task. The is due to the fact that the concerned authorities in the country were not involved in the stage of setting the contracts with these companies (Regulatory Authority, Environmental Protection Authority, etc.).
- 2- **Licensing of imported Sources:** difficulty in licensing all imported sources due to custom officer's faults. Another factor is lack of experience in developing and improving licensing forms and applications to be made more restrictive and informative.
- 3- **Availability of workers records:** not all companies provide personal monitoring services to the workers. Some of the companies have their own services but no records available to the SAEC. Quality of TLD results was not checked.
- 4- **Emergency plans:** no information available about the emergency plans of the companies in case of radiation accidents. The system of notification to the SAEC in case of accidents is in-adequate.
- 5- **Communications:** difficulties in communicating with these companies.
- 6- **Low economic resources** for the regulatory authority to carry out inspections for verification: Means of transportation – proper cars – are not available to travel to the fields.
- 7- **Lack of enough trained personnel**

Efforts done by SAEC to Control the Industrial Radiography in the Country: -

1st) Regulations:

To control all radiation work in the country, including industrial radiography, the SAEC BOARD issued the following regulations:

- 1- "General Procedures for Radiation Protection, 1996"

- 2- "Basic Requirements for Radiation Protection and Dose Limits, 1996"
- 3- "Regulation on Licensing Procedures for Radiation Work, 1996"
- 4- "Safe Transport of Radioactive Materials, 1998"
- 5- "Control and Management of Radioactive Materials, 1998"

Two safety guides were issued: -

- 1- "Protection in Nuclear Medicine Departments, 1998"
- 2- **"Protection in Industrial Radiography, 1998"**

The last guide was issued in time with the expansion of industrial radiography in the country. This guide covers the following: -

- 1- Medical records of the workers
 - 2- Requirements and regular check of equipment and their specifications.
 - 3- Requirements of facilities in closed and open areas.
 - 4- Regular investigations of sources containers, storage and repair of its equipment.
 - 5- Training, radiation measurements, transportation and dose limits.
 - 6- Emergency requirements and records of accidents.
- 2nd) To control the import and export of radiation sources, five workshops were organized for the Custom Officers in Khartoum Airport and Port Sudan (Sudan Harbor). The officers were trained in using radiation monitors for detection of unauthorized/unlicensed sources entering the country. Now movements of export/import of radiation sources is reasonably controlled. SRS software is being used for sources registration.
- 3rd) For the expansion of personnel dosimetry, the DRPEM is using now Harshow 6600 for personnel monitoring, about 1000 TLDs are available. For calibration and quality control of TLD and survey meters the SAEC has established SSDL for protection level through IAEA assistant.
- 4th) Training of Staff: The DRPEM recruited 7 technologists. National Training Course of two months on "Basic Radiation Protection" was organized for the staff (Jan-Feb. 2001). The total number of staff amounts to 15. This staff is responsible of all technical aspects regarding the radiation protection in all applications in the country.
- 5th) Establishing of national capabilities for NDT: To limit the role of foreign companies in the field of industrial radiography the SAEC is implementing now an IAEA technical co-operation national project. The objective of the project is to establish the national capability to perform non-destructive testing (NDT) for quality in industry, metallurgy and civil engineering construction with the aim of improving safety standardized NDT practices and harmonized certification schemes. The project period is 2001 to 2004.
- 6th) Public involvement: Number of seminar was organized by SAEC to sensitize the higher authorities in implementing the national radiation protection regulations and guidelines needed in the oil industry sector. Two seminars were organized in collaboration with: -
- 1- Sudanese Environmental Protection Association
 - 2- Institute of Environmental Studies

Conclusion:

Industrial radiography in most of the developing countries is not appropriately controlled.

Industrial radiography sector started to be a major user of radiation sources in Sudan. Despite the efforts done by SAEC to control the industrial radiography, still the control is not proper.

Government commitment is an important factor for proper control of industrial radiography in the country. Strengthening of regulatory authorities, trained manpower, adequate equipment, strong legislation, effective methods for enforcement and strong government commitment are of important factors to have established system of controlling the industrial radiography in the country.

References: -

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