REGULATORY CONTROL OF LOW LEVEL RADIATION EXPOSURE IN TANZANIA

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Abstract

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In Tanzania, the radiation protection law was issued in 1983. Under this law, the National Radiation Commission is responsible for safe uses of ionizing radiation. The regulatory control of the resulting doses from the uses of radiation sources in medicine, industry, research and teaching is presented. The system of control reflects the existing interactions between the National Radiation Commission and users through the established radiation protection infrastructure. From the national dose registry data, it is found that the highest annual individual doses over 10 years ago, came from less than 5% of total monitored workers and were in the range 10 - 15 mSv yr\(^{-1}\). The experienced radiation levels in uncontrolled areas of potential workplaces is less than 1 \(\mu\text{Sv h}^{-1}\). The possibility for associating such low dose levels to the effectiveness of the existing regulatory dose control framework is discussed. Despite of this achievement, the need to improve further the radiation protection and safety programs is found necessary.

1. INTRODUCTION

The National Radiation Commission (NRC) was established by the “Protection from Radiation Act 5, 1983” of the United Republic of Tanzania. Under this law, the NRC is responsible for the safe uses of ionizing radiation. The law enables the promulgation of codes of practice as approved by the responsible minister to ensure that appropriate standards of radiation protection and safety are met. The recent code of practice was approved and put into force in 1990 and is based on the Basic Safety Standards [1]. Currently, regulations on radioactive waste management and control of radiation contamination to food stuffs are being prepared.

In Tanzania the major practices where radiation exposure to workers and members of the public is possible, are found in medicine, industry, research and teaching. More than 90% of these applications are medical; of which nearly 99% involve diagnostic radiology. The increasing uses of ionizing radiation in Tanzania, have demanded an effective system of control in order to keep the potential radiation exposures as low as practically achievable. This paper discusses the regulatory control methods undertaken by NRC to achieve this demand.

2. METHODS

2.1. Legislation and Licensing

The legislation requires that all ionizing radiation users be registered and licensed annually. The activities requiring licensing include possession and use of radioactive materials
with activities above 3.7 kBq or 74 Bq g\(^{-1}\); or any ionizing radiation emitting device capable of giving a dose rate not exceeding 1 mSv h\(^{-1}\) at 1 m. The import and export of all sources of ionizing radiation as well as the disposal of radioactive waste is also subject to licensing. The issue of the licenses depend mainly on the adequacy of radiation shielding of premises, availability of qualified operating personnel; standard performance of equipment and good radioactive waste management as is applicable. The radiation safety program at each centre is supervised by a Radiation Safety Officer (RSO) who is appointed by NRC.

2.2. Radiation safety inspections and radiation surveillance of workplaces

The validity of the issued licenses is further subject to the verification of continuing good radiation safety status at the centres through a planned quality audit program based on recommended standards [2,3]. Particular attention focuses the assessment of radiation levels in uncontrolled areas. Essentially all centres are supposed to be inspected annually in order to update relevant records before the issuance of the following year license.

2.3. Personnel monitoring service and standardization of dose measurements

The NRC operates a centralized Personnel Radiation Monitoring Service using LiF thermoluminescent dosimeters (TLDs) to about 1000 radiation workers. The dose limit of 50 mSv y\(^{-1}\) [1] is applicable pending the review of the law for the adoption of new dose limits [4]. In order to ensure traceability of the dosimetry to the international measurement system, the National Calibration Laboratory (NCL) for ionizing radiation was established and became operational in 1995. The laboratory is a member of IAEA/WHO network of Secondary Standard Dosimetry Laboratories (SSDLs).

2.4. Radioactivity and ambient radiation monitoring

This program is based on geological surveys indicating the existence of uranium, coal and phosphate bearing minerals. The aim is to collect scientific data on safety aspects of the practice on the basis of which decisions or measures can be taken to limit the radiation doses. Some collaboration on the subject exists with the IAEA, SateilTurvaKeskus (STUK) and the Global Environment Monitoring Network (GERMON).

2.5. Education and Training

The NRC undertakes a training program to radiation workers and safety officers in the country in order to ensure that appropriate knowledge of radiation protection and safety is imparted to them. The training is provided through the IAEA training program and also through regular annual national seminars. The seminars are offered to radiation workers and customs control, clearing and forwarding officials. There is also a plan to extend the seminars to the police officers following two recent incidents on illicit trafficking of spent industrial radioactive devices. A wide range of topics on radiation protection and safety are covered in the seminars and also in public media.

3. EXPERIENCES

Since the legislation on control of ionizing radiation sources and practices, considerable experience has been acquired. The legislation is now familiar to the majority of ionizing radiation users. Currently, about 300 radiation work places and installations have been
licensed and their compliance with license conditions is satisfactory. Less than 40% centres, majority being diagnostic radiology facilities do not comply fully. Most of the centres which do not comply, lack adequate radiation shielding, satisfactory performing equipment and/or qualified operating personnel. These centres fail to implement the usually recommended remedial measures due to financial constraints. Frequent malfunctioning of diagnostic x-ray machines in most of these centres is still significant the situation which has forced NRC to provide quality control checks and maintenance services.

The positive impact of the education and training program in making the radiation protection programs successful is clearly evident. Even more evident is the good cooperation received by NRC from users and members of the public. The direct reporting of RSOs to NRC on matters concerning radiation protection and safety and the recent arrests of illicit spent radioactive devise traffickers signifies this good will.

The introduced dose control measures has resulted into low dose levels to radiation workers and members of public. For example the maximum individual doses in the period 1986-1996 were in the range 10 - 15 mSv y\(^{-1}\) and were received by less than 5% of total workers. It is also interesting to note that during this period, there were no over exposures recorded. Table I summarizes the data from the national dose registry.

**TABLE I. THE RELATIVE DISTRIBUTION OF OCCUPATIONAL DOSE FROM 1986 TO 1996**

<table>
<thead>
<tr>
<th>Annual dose range (mSv y(^{-1}))</th>
<th>Relative distribution of individual doses (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 5</td>
<td>75.8</td>
</tr>
<tr>
<td>5 - 10</td>
<td>20</td>
</tr>
<tr>
<td>10 - 15</td>
<td>4.2</td>
</tr>
</tbody>
</table>

With respect to members of the public, the situation of radiation exposure is also encouraging. Radiation survey measurements around radiation workplaces show that the radiation exposures in uncontrolled areas do not exceed 1 \(\mu\)Sv h\(^{-1}\). However, the program on radioactivity and ambient radiation level monitoring has revealed significant levels in some places which call for attention. Typical radioactivity and ambient radiation levels are given in table II.

**TABLE II. SOME RADIOACTIVITY AND AMBIENT RADIATION LEVELS IN TANZANIA**

<table>
<thead>
<tr>
<th>Sampling site</th>
<th>average radioactivity level of (^{238})U (Bq kg(^{-1}))</th>
<th>average ambient radiation (nGy h(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NRC</td>
<td>IAEA</td>
</tr>
<tr>
<td>Phosphate mine</td>
<td>5339 (^1)</td>
<td>6720 (^1)</td>
</tr>
<tr>
<td>Coal mine</td>
<td>72 (^1)</td>
<td>-</td>
</tr>
<tr>
<td>Cement industry</td>
<td>52 (^1)</td>
<td>-</td>
</tr>
<tr>
<td>NRC premises</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

\(^1\) as measured in 1992  
\(^2\) as determined in 1996
Despite the success of the existing radiation protection infrastructure, some constraints have also been experienced. The law needs revision particularly on some administrative and technical issues. For instance, the application of the present law is restricted only to mainland Tanzania and does not cover the Zanzibar isles. Further to this, the law does not address some of technical issues such as the sale or lease of the radioactive materials or radioactive devices; and the more uptodate International Basic Safety Standards. Equally important, the monetary penalties for offenses need also be updated for inflationary trends.

4. CONCLUSIONS

The experience gathered in controlling low radiation doses from ionizing radiation exposures has been so far encouraging. Generally, Tanzania has experienced low dose levels to the workers and members of public which are well below the recommended dose limits. The present radiation exposure status suggests that the regulatory system of dose control is fairly effective. Despite of this achievement, the need for further improvements as already been mentioned is still required. Behind this achievement has been the generous technical assistance of IAEA given to NRC in the upgrading of national radiation protection infrastructure.

REFERENCES


[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Recommendations for the Safe use and Regulation of Radiation Sources in Industrial, Medicine, Research and Teaching, Vienna (1990)