TC Project: RAF9043
EB Project: NSRW14
ORIGINAL: English

INTERNATIONAL ATOMIC ENERGY AGENCY

REPORT OF THE

ORPAS

OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE

MISSION

To the

UNITED REPUBLIC OF TANZANIA

11 - 15 August 2014

OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE
Conducted under IAEA Extra-budgetary Project and Technical Co-operation Project on Occupational Radiation Protection

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY

DEPARTMENT OF TECHNICAL CO-OPERATION

OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE

REPORT TO

THE GOVERNMENT OF UNITED REPUBLIC OF TANZANIA

Mission date: 11th August – 15th August 2014
Facilities and services: End-Users and Technical Service Providers
Location: Dar Es Salaam and Arusha

Organised by: IAEA
ORPAS Team:

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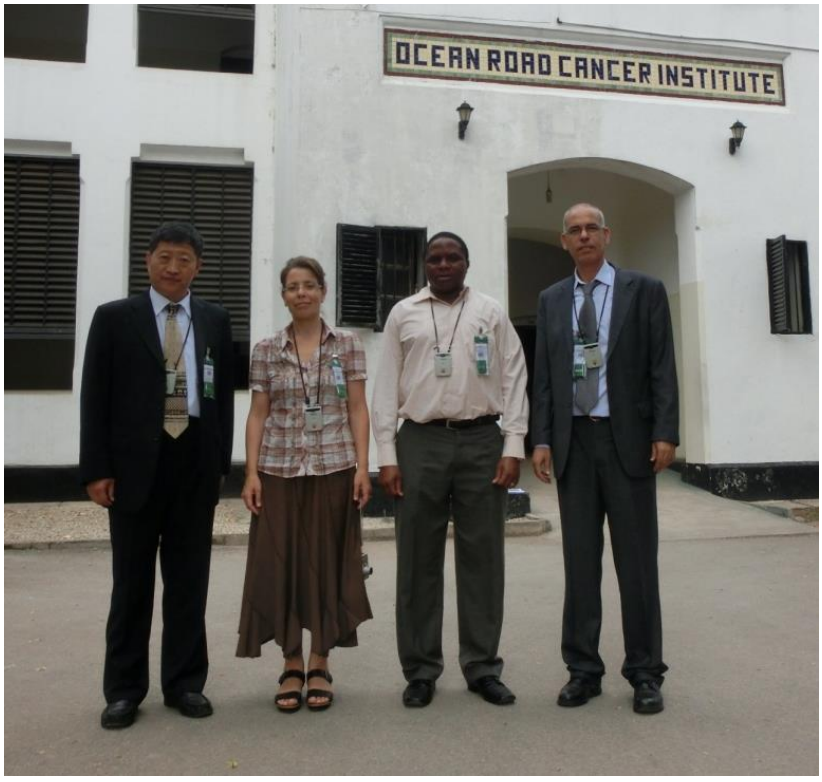

This mission was conducted under the Technical Cooperation Programme, using funds from the TC project RAF9043 - Strengthening the Transfer of Experience Related to Occupational Radiation Protection of the Nuclear Industry and Other Application Involving Ionizing Radiation (TSA2) and the IAEA Extra Budgetary Project financed from Japanese government: NSRW14: Strengthening capabilities for radiation protection of workers in emergency situation and occupational radiation protection appraisal services.

The number of recommendations, suggestions and good practices is in no way a measure of the occupational radiation protection status and arrangements of participating organisations in the hosting country.
Comparisons of such numbers between ORPAS reports from different countries should not be attempted.

EXECUTIVE SUMMARY

At the request of the Government of United Republic of Tanzania addressed to the International Atomic Energy Agency (IAEA) to conduct an Occupational Radiation Protection Appraisal Services (ORPAS) mission, the Agency organised the ORPAS in the United Republic of Tanzania during 11-15 August 2014 with a Team of three international experts that include a Team Leader and an Agency Coordinator. The Tanzania Atomic Energy Commission (TAEC) acted as the national contact point for the mission.

The purpose of this mission was to appraise the regulatory and practical implementation of the occupational radiation protection arrangements in Tanzania. Prior to this mission, a pre-mission was conducted to determine the participating organizations, arrange for a self-assessment by those organizations using the ORPAS questionnaires prepared by the Agency, and to agree upon the scope and dates of the mission. Accordingly, the organizations participated in the ORPAS mission were; the TAEC (national regulatory authority), one dosimetry service provider (TAEC), one Secondary Standard Dosimetry Laboratory (SSDL) (TAEC), various end-users including , a non-destructive testing company, four hospitals and the maintenance and training services in TAEC.

The review compared the Tanzania's arrangements for occupational radiation protection against the IAEA Safety standards as the international benchmark for protection and safety. The mission was also used to exchange information and experience between the Team members and the Tanzania's counterparts. TAEC provided the review team with advance materials that are relevant to the mission including the self-assessment carried out by the participating organizations.

This report provides the main findings, recommendations, and good practices identified during the mission. Detailed findings for individual facilities or service providers are provided in the Appendices.

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1. INTRODUCTION

1.1. BACKGROUND

The International Atomic Energy Agency (IAEA) is authorized by its Statute to establish international standards for the safety and protection of health, environment and property against ionizing radiation. This has led to the publication, inter alia, of the International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources (IAEA GSR Part 3). The IAEA has also a statutory responsibility to provide assistance for the application of these Basic Safety Standards (BSS) in Member States. To check whether the application of the standards is appropriate, the IAEA carries out appraisal reviews. This document is intended to assist in the appraisal of one area of application of the BSS, namely Occupational Radiation Protection (ORP).

To assist Member States in occupational radiation protection, the IAEA has published safety guides which are jointly sponsored by the IAEA and the International Labour Organization (Annexe I). The IAEA has also published additional technical information on particular techniques. These are the specific publications against which the appraisal described in this document is conducted.

1.2. CONCEPT OF APPRAISAL

An evaluation, or appraisal, of occupational radiation protection arrangements following a development and implementation programme, and periodically thereafter, is an effective way to ensure that those arrangements are optimized and effective. An appraisal provides an opportunity for a Member State to have its occupational radiation protection programme independently assessed and evaluated. An independent assessment is often useful to maintain or enhance the effectiveness of the programme and to identify in an objective and unbiased manner the areas where improvements may be required. A secondary benefit is that an independent appraisal allows information on best practices from the host country to be made available to other Member States. It is also the intention that in due course, countries will be able to carry out their own self-assessment using similar procedures to those described in this document.

1.3. SCOPE

This document is a report of an appraisal team's mission to the UNITED REPUBLIC OF TANZANIA, primarily to check the regulatory and practical implementation of occupational radiation protection arrangements. It includes some background as to the appraisal methods that were used. Conclusions and recommendations are made for the Republic of Tanzania, but the document also includes recommendations to the IAEA with regard to the structure and conducts of future such appraisals.

1.4. STRUCTURE

The document consists of six chapters of main text, supported by 13 Annexes that mostly provide the detailed findings of the mission.

2. OCCUPATIONAL RADIATION PROTECTION APPRAISAL

2.1. Key objectives

The purpose of the appraisal is to check the regulatory and practical implementation of occupational radiation protection arrangements. In other words, the review tries to answer the question "are the arrangements adequate and will they work?" given the national context in which they are applied. An appraisal also aims at identifying specific strengths and best practices that can be shared with other Member States. Finally, an appraisal provides a basis for determining where improvements may be required and for recommending actions to make such improvements.

In support of the purpose, the key objectives of the appraisal are to:
- provide the United Republic of Tanzania with an objective assessment of the provisions for occupational radiation protection;

- identify areas where performance should be improved to meet international standards;

- make recommendations on actions to be taken to achieve such improvements; and

- identify the strengths in the host country which are unique and worthy of bringing to the attention of others.

2.2. Methodology and evaluation criteria

The evaluation criteria applied are based on the performance requirements as set out in the following three Safety Requirements and Guides:

- Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (IAEA General Safety Requirements Part 3 No. GSR Part 3, 2014);
- *Occupational Radiation Protection* (IAEA Safety Standards Series No. RS-G-1.1, 1999)

- *Assessment of Occupational Exposure due to Intakes of Radionuclides* (IAEA Safety Standards Series No. RS-G-1.2, 1999);

- *Assessment of Occupational Exposure due to External Sources of Radiation* (IAEA Safety Standards Series No. RS-G-1.3, 1999).

- Draft safety guide on Occupational Radiation Protection - DS453 (currently under publication)

- The Management System for Technical Services in Radiation Safety (IAEA Safety Standards Series No. GS-G-3.2, 2008).

Accordingly, questionnaires have been developed by the IAEA for the purpose of gathering the necessary information against which to judge the appraised country's provisions for occupational radiation protection. The questionnaires were developed from the BSS and the supporting safety guides. Prior to the mission, these questionnaires were made available to all persons and organizations involved in the mission for their self-assessment.

2.3. Evaluation of findings - strengths worthy of special merit

It is far easier to criticize and point out failures than it is to identify aspects that represent best practice or are particularly good. However, throughout the mission, the appraisal team was careful to identify those aspects that they considered to be representative of good practice in particular areas. In this context, **good practice** was considered to be an approach, methodology or system which, within the framework of the overall occupational radiation protection programme, was highly likely to achieve the required objective.

2.4. Evaluation of findings - weaknesses and consequent recommendations

Identified deficiencies were assessed according to their perceived impact on the protection of workers, and recommendations for improvements have been made to the United Republic of Tanzania.

The appraisal team considered the actual or potential consequences arising from each identified area of limited effectiveness, and has reflected this in the prioritization of the associated recommendations. The following priority categories have been used:

Essential, meaning that a delay in implementation could result in a substantial and immediate hazard to health, and/or that the recommendation addresses a serious deficiency in the occupational radiation protection programme.

Important, meaning that until the situation is corrected; occupational radiation protection effectiveness in a certain area is significantly compromised.

Advised, meaning that the recommendation identifies a relatively minor deficiency.

This system of prioritization is coupled to the following guidelines for the suggested timing of the implementation of the recommendations:

Priority	Timing of Implementation
Essential	Should be immediate, certainly without undue delay.
Important	Should be as soon as can be reasonably achieved.
Advised	Implementation enhances effectiveness but may be delayed.

3. APPRAISAL PROCEDURE

3.1. TANZANIAN request, IAEA response

The United Republic of Tanzania requested the IAEA, in accordance with Milestone 2 of the model project on upgrading radiation protection infrastructure, to carry out a review of the occupational exposure control in the country. The National counterpart for the mission was the Tanzanian Atomic Energy Commission (TAEC). The IAEA Coordinator contacts the host country in order to arrange a date for the preparatory meeting to discuss the scope and expectations for the ORPAS self-assessment in preparation for the review mission.

3.2 Pre-mission visit and outcome

A pre-mission visit to United Republic of Tanzania was conducted from 16 to 18 December 2013 by Ms. Latifa Ben Omrane (CNRP, Tunisia) expert on behalf of the IAEA and Mr Jizeng MA, Unit Head Section of Radiation Safety and Monitoring, IAEA Division of Radiation, Transport and Waste Safety as the IAEA coordinator for the mission.

The mission was held in the facilities of the National counterpart at the TAEC headquarters in Arusha. The mission objectives were to:

- discuss the scope of the full ORPAS mission,
- visit all potential facilities,
- provide a set of documents and tools for the self-assessment,
- and to plan with the main counterpart and prepare a schedule for the subsequent appraisal mission.

The duration of the appraisal mission, the provisional schedule and the starting date were discussed with the host country, based on the availability of the participants and the completed questionnaires prior to the mission. Thus, one week mission during August 2014 was suggested. It was intended that participating organizations should complete their questionnaires and return them to the IAEA by June 2014 so that briefing material could be prepared for the mission team members.

Discussions and visits were made to the potential participating facilities in Arusha:

- TAEC – Radiation Protection Regulatory Body
- TAEC – TSOs (Personal Dosimetry Laboratory, SSDL, Maintenance Service and Radiation Protection Training)
- "Arusha Lutheran Medical Center" (End User - private hospital, with one Radiology department)
- "Aga Khan Hospital" (End User - private hospital, with one Radiology department)
- "Mount Maru Regional Hospital" (End User - public hospital, with one Radiology department)

3.3. Agreed scope

During the pre-mission visit it was agreed that the mission should involve appraisals of service providers (TSOs) and of practices (i.e. End Users of radiation). A provisional list of organizations was drawn up including some facilities in Arusha (paragraph 3.2) and in Dar Es Salaam, like:

- "Ocean Road Cancer Research Institute" (End User - Radiotherapy department, Nuclear Medicine, Radiology department and Catheterisation Laboratory
- A company in Non-Destructive Testing (NDT) in the industrial sector

3.4. Team

It was decided that the scope and duration of the appraisal required a team of four experts, including the IAEA coordinator, experienced specialists in ORP and technical service providers. The team members were recruited for the appraisal mission in accordance with IAEA procedures.

3.5. Mission planning

After receiving the relevant information and self-assessment by the counterpart, detailed planning for the mission took place during the period 11 - 15 August 2014. This included:

— detailed discussions with the IAEA coordinator,
— study of a large amount of relevant background information and material,
— creation of a guidance document for team members and for the UAE counterpart (including draft programme for the full mission), and
— Compilation of an information package that was sent to team members.

3.6. Mission programme

The draft mission programme required slight amendments and the following programme was followed (Annex II):

Date & time	Event	Participants
10 August 2014	Initial team briefing - Dar Es Salam	ORPAS Team members
11August 2014	Visit to the Ocean Road Cancer Institute - Dar Es Salam	ORPAS Team
12 August 2014	Visit to Muhimbili National Hospital	ORPAS Team
12 August 2014	Visit to TANZANIA STEEL PIPES	ORPAS Team

12 August 2014	Transportation from Dar Es Salam to Arusha	ORPAS Team
13 August 2014	Briefing meeting with representatives of TAEC - Arusha	All
13 August 2014	Visit to Dosimetry Section - TAEC	Ms L. Ben Omrane
13 August 2014	Visit to Radiology Departments Arusha	Mr Ben Yedder & Mr. Wilbroad
13 August 2014	Visit to Maintenance Service - TAEC	Mr. MA
14 August 2014	Visit to NCL (SSDL) - TAEC	ORPAS Team
14 August 2014	Visit to Training Service - TAEC	ORPAS Team
15 August 2014	Team meeting, preparation for Exit Briefing	ORPAS team
15 August 2014	Exit Briefing with representatives from TAEC	All
15August 2014	Final team meeting	ORPAS team

3.7 Conduct of visits

It was agreed at the initial team meeting that visits would focus on the compilation of information and data necessary to complete the questionnaire that was relevant to the purpose of the visit. Prior to each visit, the team members had the opportunity to evaluate the pre-mission questionnaires provided by each participating organization. This was valuable in pre-planning aspects of each visit and concentrating on important issues. However, time and distances between the two important cities was a limiting factor for practically all the visits.

Visits included a tour of each facility as an aid to obtaining a full understanding of the information being gained

During each visit, the opportunity was taken to collect readily available documentation that would be of value in the subsequent evaluation of the findings. As appropriate to each individual visit, these documents included:

- Regulations and regulatory guidance material, such as codes of practice;
- Procedures for dosimetry laboratories such as calibration protocols;
- Annual or other reviews of occupational exposures;
- Results of performance tests or intercomparisons;
- Quality assurance documentation;
- Examples of optimization or 'ALARA' studies;
- Examples of local rules etc.; and
- Investigation reports on overexposures.

3.8 Reports

The report is divided in two parts. The first part is to be available for all participating institutions. This part of the document provided general findings, conclusions and recommendations that apply to all the institutions. There is also a general conclusion for the National Counterpart. The Appendices include a list of international standards applied during the mission, the list of interviewees and the schedule of the visit.

The second part contains reports specific to each participating institution. As they are to be considered confidential documents, each participating institution will only receive their own

individual report. Each individual report will detail the findings observed during the visit, linked with the respective international standard requirements. Also included are conclusions of the visit and recommendations specific to the institution.

The basic structure of the report includes:

a) Details of the Establishment: General information about the institutions including, Type of Institution (Private or Public), number of employees occupationally exposure, types of radiations sources and/or equipment used in the service;

b) Appraisal findings: this section provides information obtained from the questionnaire, interviews with the workers and observations during the visits. Documentary evidence is used wherever possible. When a process is implemented in an institution/establishment but it is not documented, the report will consider that this process is not already in place because there is no EVIDENCE;

c) Conclusions and Recommendations: these are drawn from the appraisal findings and related to the international standards; and

d) Appendices: Documents provided by the institution as evidence and photographs taken during the mission.

4. PARTICIPATING ESTABLISHMENTS

4.1. End Users

The following establishments with the corresponding practices were visited:

Establishment	Practices
OCEAN ROAD CANCER Institute – Dar Es Salam	Radiotherapy & Nuclear Medicine
MUHIMBILI National Hospital – Dar Es Salam	Interventional Cardiology & Radiology
TANZANIAN STEEL PIPES LIMITED – Dar Es Salam	Industrial Radiography
MONT MERU Regional Hospital - Arusha	Radiology
ARUSHA LUTHERAN MEDICAL CENTER - Arusha	Radiology

4.2. Technical Services

Establishment	Services
Dosimetry Section – TAEC Arusha	**External Dosimetry**

NCL (SSDL) - TAEC	**Calibration**
Maintenance Section - TAEC	**Maintenance**
Education and Training - TAEC	**Training in RP**

5. BRIEF DESCRIPTION OF THE FACILITIES

The Institutions were classified as End-Users and Technical Service Providers.

Most of the End-Users carry out work involving the use of ionising radiation in medical practices: radiotherapy, nuclear medicine, radiology and interventional cardiology. However there is also one institution carrying out industrial radiography with fixed x-ray unit. These establishments were located at Dar Es Salam. Two radiology departments, one in private sector and another in the public sector were located at Arusha.

The Technical Service Providers group included: one external dosimetry services, one calibration service, one service for maintenance and one service for education and training in Radiation Protection. These services are provided by TAEC which is the Regulatory Authority, responsible for all licensing and authorisation processes and inspections, and also the issuing of updated national regulations. TAEC is located at Arusha, which is at nearly 500 km far from Dar Es Salam.

6. GENERAL CONCLUSIONS AND RECOMENDATIONS OF THE APPRAISAL

On 15th August 2014 the ORPAS Team presented the broad conclusions and recommendations of the appraisal to the TAEC Coordinator:

1. There is a general lack in the provision of an appropriate and comprehensive Radiation Protection Programmes for all radiation facilities. The implementation of radiation protection in practices is generally provided without written document and measures on radiation protection and safety.
2. There is a general lack of implementation of Quality Management Systems to ensure the continued availability of appropriate and updated radiation protection instruction, information and record-keeping systems for all staff carrying out work involving ionising radiation.
3. Dosimetry and Calibration Service Providers are generally working to an acceptable standard but further resources are required to ensure the continued accuracy and traceability of reported dose results and calibrations.
4. Some radiation safety training is available for specific practices involving ionising radiation exposure, however a national policy and framework is not in place to provide initial and ongoing training to all workers who need it.
5. No workplace monitoring programme based on regulatory requirements for radiation safety in normal and emergency situations was provided for all the radiation facilities.
6. There was no co-operation or agreement between employers to ensure the safety or to collect the dose records of employees who are exposed to radiation sources in other practices or in other places.
7. No written arrangements in place to ensure that necessary health surveillance and health services are provided to assess initial and continuing fitness of workers occupationally exposed to ionising radiation
8. No Reference Levels, Investigation Levels implemented by all the radiation facilities

Recommendations

1. The management of all radiation facilities should comply with all national and international standards in ensuring the radiation protection of workers by the provision of appropriate financial and staff resources and the implementation of appropriate Radiation Protection Programmes with procedures and measures on radiation protection and safety for both normal operation and emergency situations, together with the allocution of responsibilities for it implementation within an organization, from the top management to workers involved in specific tasks.
2. The management of radiation facilities should implement Quality Management Systems to ensure that all appropriate documentation for radiation safety is made available, and is maintained and updated as necessary.
3. Dosimetry and Calibration Service Providers should ensure the continued provision of accurate and traceable dosimetry and calibrations, and to participate in national and international inter-comparisons.
4. It is recommended to provide a clear allocation and documentation of the responsibilities of the Licensee to ensure the safety of employees of another employer as service engineers

carrying out checks on radiation equipment or maintenance of the ventilation system. The radiation protection programme should be clearly defined in the maintenance contract.

5. Implementation of dose constraint, reference levels and investigation levels for optimization purposes

Recommendations to the Regulatory Body

1. The TAEC to review the overexposure procedure in the regulation, its real implementation by the end users, the dosimetry services and the Occupational Health Physician and follow up actions.
2. The TAEC may provide a structured scheme and organization of Health Surveillance for the Occupationally Exposed Workers and draw up formal plan to deal with situations in which workers might be overexposed.
3. The TAEC to ask for the radiological evaluation and risk assessment and shielding calculation during the design of the installations prior to the construction of the building before approval.
4. The TAEC should establish a national policy and framework of available radiation protection training, including update training, for all workers who are occupationally exposed to ionising radiation.
5. The TAEC should establish appropriate mechanisms for approving the external dosimetry, the record keeping, the NCL and the training Section.
6. TAEC should make arrangements for the establishment of a National level Dose Registry

DETAILED FINDINGS

APPENDIX I – OCEAN ROAD CANCER INSTITUTE

RADIOTHERAPY DEPARTMENT

Facilities and services:	Ocean Road Cancer Institute –Radiotherapy Department
Location:	Dar Es Salaam
Mission date:	11 August 2014
ORPAS Team:	Latifa BENOMRANE, Abdelkader BENIDER ,Wilbroad Muhogora, Jizeng MA
Report prepared by:	Abdelkader BENIDER
People met:	Julius Mwaiselage, Jumaa Dachi, Hemed Myanza and Anna M. Muslumbu

GENERAL INFORMATION

The Ocean Road Cancer Institute has tree department: (1) Diagnostic radiology department using X-ray generators for simulation and for diagnostic purpose, (2) radiotherapy department using Co-60 for treatment (Two Co-60 sources); brachytherapy HDR using Co-60 for treatment (two Co-60 sources) (3) nuclear medicine using Tc-99m for diagnostic purpose and I-131 for therapeutic purpose.

This report is subject only to the ORPAS mission of radiotherapy department.

APPARAISAL CONDUCTION

Prior to the mission, the IAEA provided the National counterpart pre-appraisal questionnaires to be distributed to the staff of the radiotherapy department to carry out a self-assessment and to help to the preparation of the mission. However, these questionnaires were incomplete and sometimes difficult to be evaluated before the mission.

The conduction of the appraisal was based on the discussions with the staff and the visit of the department, the observation of the activities undertaken during the visit and the existence of documents showing evidence on the implementation of a process.

Prior to the visit, the discussions have been initiated with the Doctors responsible and the Medical Physicists in the radiotherapy and the Nuclear Medicine departments and the RSO (Annex III).

The visit of the radiotherapy Department was conducted by the RSO and the Medical Physicist, without any activity.

APPRAISAL FINDINGS

1. AUTHORIZATION DETAILS

The radiotherapy department is licensed by TAEC to possess and use the radiation sources for medical purpose in accordance with the national regulations. The TAEC gives the expiry date for each license. It seems that renewal of license requires new assessment of the radiation safety especially on occupational radiation protection.

2. MANAGEMENT STRUCTURE

The radiotherapy department appears that its structured to ensure the safety of workers from ionizing radiation and the director manager is also aware of their obligations to ensure the safety of workers from ionizing radiation but the organization chart specifying the responsibilities and duties for their staff for radiation safety in both normal operation and emergency situations are still planed and there is not a specific budget to achieve the objectives of the occupational radiation protection.

Therefore, the Radiation Safety Officer is nominated and some documents related to job description for radiotherapy manager and standard operating procedures are provided but there are not the documentation detailing the implementation of the management requirements for radiation safety and their periodic assessment.

3. RADIATION PROTECTION PROGRAMME

Responsibilities

The radiotherapy department did not have in place a documented Radiation Protection Programme, containing a manual for procedures and instructions; together with the allocation of responsibilities for it implementation within an organization, from the top management to workers involved in specific tasks.

However, an example of good practice, as a general job description including radiation protection, was found documented as an agreement between the radiotherapist manager and the radiographer in radiotherapy.

In absence of documentation related to the Radiation Protection Programme and Measures, it cannot however be assumed that the expected magnitudes and likelihood of exposures in normal operation has been determined; an assessment of potential exposures has been made or the protection measures needed to optimize protection and safety has been identified for both normal operation and emergency situations.

Prior radiological evaluation and safety assessment

The department did not have in place a radiological evaluation and risk assessments of the potential radiation doses and risks to staff, and of the required shielding for the walls and doors, established and approved by the radiation protection regulatory body prior to the construction of the building.

This evaluation is mandatory for the practice of radiotherapy and especially for Linacs as the energy used is very important and consequently commensurate with the relative radiation risk, for the staff operating the equipment, for the public and the patient.

4. CONTROL AND ACCOUNTABILITY OF RADIOACTIVE SOURCES

The radiotherapy department has radioactive sources and radiation generator but there was not an update accountability system for each of them. It appears that the measures to ensure the safe management of and control over the radioactive sources; to keep radioactive sources under control so as to prevent loss or damage and to prevent any unauthorized person were in place but there were no written documents related to these measures in place.

The inventory of radiation sources seems that it is conducted periodically to confirm that they were in their assigned locations and were under control but no documents have been provided.

5. RADIATION PROTECTION MEASURES

Protection by engineered controls

The most important engineered controls to be considered in radiotherapy department are designed prior to the building construction are approved by the regulatory body during the radiological dose and risk assessment, like:

- The shielding of the bunkers, with an adequate thickness of the shield material provided to give acceptable level of protection to the workers during normal as well as abnormal situations.

- The conception of an entrance maze reducing the dose at the entrance door

- Ducks, ventilation system, interlocks

Use of personal protective

The radiotherapy department use the X ray generator as simulator for diagnostic purpose but it seems there were no an appropriate personal protective equipment (PPE) in place as lead aprons.

Many protection measures related to safety and security of radioactive sources were implemented but not documented. There are a good practices and the staff are aware of radiation risk.

Provision of administrative controls

Controlled and Supervised Areas were found to have been designated and they were demarcated by using signs to declare their status. However, there was insufficient evidence that the designation had been clearly determined as a result of a prior radiological evaluation (risk assessment).

No documentation about the rules and supervision of these areas.

6. WORKPLACE MONITORING PROGRAMME

The radiotherapy department has a portable survey meter for assessment of ambient dose in the workplace that they used to evaluate and identify of the major radiation hazards and some detectors were installed into the treatment rooms but workplace monitoring programme based on regulatory requirements for radiation safety in normal and emergency situations was not provided.

7. INDIVIDUAL MONITORING PROGRAMME

Staff was monitored using TLD dosimeters provided by Radiation Protection Services of the Tanzania Atomic Energy Commission in accordance with the national regulations. However, there were no evidences that the decision to carry out such monitoring had been taken as a result of a prior radiological evaluation.

The individual monitoring was managed by the RSO for the whole staff of the establishment (60 to 80 people).The dosimetry results report was presented without staff distinction in the different departments (radiotherapy, nuclear medicine and diagnostic radiology). The records demonstrated that the received doses were low.

The dose record reports were classified by year and maintained in a register. However, their number was not corresponding to the frequency of 3 months adopted for individual monitoring (TAEC record dose report).

The instructions on how to take care and how to use the personal dosimeter were posted on the notice board of the radiotherapy department and not in the nuclear medicine department.

No written document on reference levels and associated actions for each separate dosimeter result; for doses accumulated over specified periods and actions to be taken in the event that a dosimeter result is lost.

8. STAFF SELECTION, INFORMATION AND TRAINING

All staff was aware of radiation risk and had specific radiation safety training but the training certificates were not provided.

The radiotherapy department didn't have in place a formal set of procedures detailing the qualification requirements for workers, and the required training and information to be provided to workers for radiation safety.

9. CO-OPERATION TO ENSURE THE SAFETY OF EMPLOYERS OF ANOTHER EMPLOYER

A clear allocation and documentation of the responsibilities of the Licensee to ensure the safety of employers of another employer as service engineers carrying out checks on radiation equipment were not provided and it seems that the maintenance contract was not covered by a radiation

protection programme. However, the external staff was monitored by personal dosimetry under the responsibility of their employer, without any co-operation between employers.

There was no co-operation or agreement to ensure the safety or to collect the dose records of employees who are exposed to radiation sources in other practices or in other places.

10. EMERGENCY ARRANGEMENTS (EMERGENCY PLANS)

Although there was some evidence of written basic instruction to staff for incidents and emergencies, almost universally these were not developed as a result of the prior radiological assessment and safety assessment indicating the need for an emergency plan.

The radiotherapy department has some emergency equipment but it is not documented.

There was no evidence on formal plan on how to deal with situations in which workers might be overexposed.

11. HEALTH SURVEILLANCE PROGRAMME

It seems that the general principles of occupational health were implemented to assess initial fitness for workers in general but there were no written arrangements in place to ensure that necessary health surveillance and health services are provided to assess initial and continuing fitness of workers occupationally exposed to ionising radiation (no occupational physician).

For, the situations in which workers might be overexposed, it seems that the plans have been prepared to deal with these situations but it was not provided.

12. QUALITY ASSURANCE PROGRAMMES

There was no evidence of documented quality assurance programme to ensure the optimisation and continued function of radiation protection measures and procedures, and the safety of staff. Furthermore, only the quality control testing was being carried out on radiation equipment (Co-60 sources).

CONCLUSIONS

Most of measures related to radiation safety and security of radioactive sources were implemented in the radiotherapy department to ensure the radiation protection of workers and the security of radioactive sources but there were no written programme of radiation protection and safety for both normal operation and emergency situations to comply with the national regulations and international standards.

The Radiation Safety Officer plays an important role in the development and implementation of the programme.

RECOMMENDATIONS

Important

1. It is recommended to proceed to the radiological evaluation and risk assessment and shielding calculation during the design of the future Linac prior to the construction of the building. This evaluation should be addressed to the TAEC for approval.
2. The Radiotherapy Department is recommended to implement a routine workplace monitoring programme.
3. It is recommended to review, the organization chart specifying the responsibilities and duties for the staff for radiation safety in both normal operation and emergency situations.
4. It is recommended to provide the Radiation Safety Officer with the necessary resources to accomplish its mission;
5. It is recommended to establish and to implement an appropriate written programme and measures on radiation protection and safety for both normal operation and emergency situations, together with the allocution of responsibilities for it implementation within an organization, from the top management to workers involved in specific tasks.
6. It is recommended to maintain a record book for notifying the incidents of occupationally exposed workers.
7. It is recommended to implement the reference levels and the investigation levels for dosimetry results and for accumulated doses over periods. Results exceeding these values should be investigated to determine whether or not doses are optimized.
8. It is recommended to establish an appropriate written programme for the training of staff in the different tasks and specific trainings and refresher training on occupational radiation protection for the Medical Physicist and the RSO.
9. It is recommended to maintain an updated inventory for the radiation sources

Recommendations to the Regulatory Body

1. The RB to review the overexposure procedure, its real implementation by the end users, the dosimetry services and the Occupational Health Physician and follow up actions.
2. The RB may provide a structured scheme and organization of Health Surveillance for the Occupationally Exposed Workers and draw up formal plan to deal with situations in which workers might be overexposed.
3. The RB to ask for the radiological evaluation and risk assessment and shielding calculation during the design of the installations prior to the construction of the building before approval.

Advised

1. It is recommended to provide a clear allocation and documentation of the responsibilities of the Licensee to ensure the safety of employees of another employer as service engineers carrying out checks on radiation equipment or maintenance of the ventilation system. The radiation protection programme should be clearly defined in the maintenance contract.

2. It is recommended to establish a quality assurance programme to ensure the optimization and continued function of radiation protection measures and procedures, and the safety of staff.

Good Practice

1. A general job description including radiation protection was found documented as an agreement between the radiotherapist manager and the radiographer in radiotherapy.

APPENDIX II– OCEAN ROAD CANCER INSTITUTE

NUCLEAR MEDICINE DEPARTMENT

Facilities and services:	Ocean Road Cancer Institute –Radiotherapy Department
Location:	Dar Es Salaam
Mission date:	11 August 2014
ORPAS Team:	Latifa BENOMRANE, Abdelkader BENIDER ,Wilbroad Muhogora, Jizeng MA
Report prepared by:	Latifa BENOMRANE
People met:	Julius Mwaiselage, Lulu Sahap, Kalolo Tegemea and Anna M. Muslumbu

GENERAL INFORMATION

The Ocean Road Cancer Institute has three departments: (1) Diagnostic radiology department using X-ray generators for simulation and for diagnostic purpose, (2) radiotherapy department using Co-60 for treatment (Two Co-60 sources); brachytherapy HDR using Co-60 for treatment (two Co-60 sources) (3) nuclear medicine using Tc-99m for diagnostic purpose and I-131 for therapeutic purpose.

This report is subject only to the ORPAS mission of Nuclear Medicine Department.

Equipment: 2 Gamma Camera, Hot Cell, Tc99m generator

Staff: Nuclear Medicine Physicians, Medical Physicist, Technicians (nearly 11 according to the dosimeters dispatch note)

Department structure: 2 Gamma Camera rooms, Nuclear Medicine Doctor Room, hot lab and injection room, radioactive waste room, waiting area, emergency kit storage room, corridor and a big isolated room for iodine therapy.

Sources used: Tc-99m for diagnostic and I-131 for therapeutic purposes

Workload: 900 patients/year for diagnostic and 10 to 12 patients/year for therapeutic

APPARAISAL CONDUCTION

Prior to the mission, the IAEA provided the National counterpart pre-appraisal questionnaires to be distributed to the staff of the Nuclear Medicine department to carry out a self-assessment and to help to the preparation of the mission. However, these questionnaires were incompletes and sometimes difficult to be evaluated before the mission.

The conduction of the appraisal was based on the discussions with the staff and the visit of the department, the observation of the activities undertaken during the visit and the existence of documents showing evidence on the implementation of a process.

Prior to the visit, the discussions have been initiated with the Doctors responsible and the Medical Physicists in the radiotherapy and the Nuclear Medicine departments and the RSO (Annex III).

The visit of the Nuclear Medicine Department was conducted by the RSO and the Medical Physicist, without any activity due to the absence of radioactive sources.

APPRAISAL FINDINGS

1. AUTHORIZATION DETAILS

The Nuclear Medicine department is licensed by TAEC to possess and use unsealed radioactive material for medical purpose in accordance with the national regulations. The TAEC gives the expiry date for each license. At the time of the visit, the previous license and the new one were seen. A delay of nearly 2 months was noticed between the starting date, the issuing date and the receipt date.

2. MANAGEMENT STRUCTURE

The Director General of the Hospital was aware of his obligations to ensure the safety of workers from ionizing radiation but the organization chart specifying the responsibilities and duties for the staff for radiation safety in both normal operation and emergency situations were steel planed and there was not a specific budget to achieve the objectives of the occupational radiation protection.

Therefore, the Radiation Safety Officer was nominated and some documents related to job description either for radiotherapy or for Nuclear Medicine department's managers and standard operating procedures were provided but there was not the documentation detailing the implementation of the management requirements for radiation safety and their periodic assessment.

The medical physicist is also appointed in each department with charges in occupational radiation protection but without any documentation on job description related to that.

3. RADIATION PROTECTION PROGRAMME

Responsibilities

The Nuclear Medicine department did not have in place a documented Radiation Protection Programme, containing a manual for procedures and instructions; together with the allocution of responsibilities for it implementation within an organization, from the top management to workers involved in specific tasks.

Prior radiological evaluation and safety assessment

The Nuclear Medicine department has not a structure or design which optimizes occupational and public radiation protection, with an organization of the areas from cold to hot zone (from non-radioactive zone to the radioactive one). A corridor crosses the department for public and staff access from the outside to the simulator and the X ray department. The waiting room was an area separated from the corridor by a screen. Inside, 6 chairs were reserved for injected patients and 4 chairs for non-injected patients. No suitable locker room and no shower for radioactive decontamination were available. The floor was not washable and impermeable to avoid the spread of contamination. The room dedicated to patient treatments with Iodine 131 (solution or capsule) is independent from the nuclear medicine department and seems to be isolated from public access. However, its conception was not adapted for such activity and do not guarantee the radiation protection, the safety and security requirements for occupational, patient and public exposures (beds, windows, floor).

The department did not have in place a radiological evaluation and risk assessments of the potential radiation doses and risks to staff, and of the required shielding for the walls and doors, established and approved by the radiation protection regulatory body prior to the construction of the building.

4. CONTROL AND ACCOUNTABILITY OF RADIOACTIVE SOURCES

The Nuclear Medicine Department is authorized to use and possess radioactive sources (Tc 99m generator and Iodine 131 for diagnosis and therapeutic purposes respectively, received from South Africa. Registries were found in place to account for the receipt of the radioactive materials and the activities used.

5. RADIATION PROTECTION MEASURES

Protection by engineered controls

The most important engineered control for a Nuclear Medicine Department is shielding, drainage system and ventilation system:

- There was not a shielding assessment for the walls and the doors during the design of the department (shielding should be approved by the regulator before the construction).

- No precision about the drainage system and the installed engineered controls to collect the contaminated liquid waste to a controlled collection point or to temporary drains, either for the diagnostic unit or the therapeutic isolated room. This physical design feature should be also submitted to the approval of the regulator before the construction of the department.

- The ventilation system seems to be not adapted for the activity of Nuclear Medicine:

    - ✓ Ventilation system for the hot cell but not for the hot lab, without any documentation or information from the maintenance staff about the ventilation rates, the height of

discharge of the exhaust air, existence of HEPA filtration. No ventilation in the hot lab.

- ✓ Ventilation system in the injection room was not clear about the movement of fresh air.
- ✓ Air conditioning instead of ventilation system in the Gamma Camera rooms.

Use of personal protective equipment

Some adapted and suitable collective protection equipment was available in the hot lab, like a screen with leaded glass for the preparation of the radiopharmaceutical, a syringe shield for the administration of the patient's injection, tongs to handle radioactive sources and leaded trash a hand wash unit.

However, it seems there were no an appropriate personal protective equipment (PPE) at hot lab to avoid the risk for internal exposure, like protective clothing, latex gloves, overshoes, cover cut and wounds and the documented hygiene rules (eating, drinking, applying cosmetic, smoking, washing hands).

The local rules, PPE and written procedures for protection and safety of workers, specifically for radioiodine therapy were inexistent.

Provision of administrative controls

Controlled and Supervised Areas were found to have been designated and they were demarcated by using signs to declare their status. However, there was insufficient evidence that the designation had been clearly determined as a result of a prior radiological evaluation and risk assessment (for example the control unit of the Gamma Camera on a desk inside the room without any screen.

No documentation about the rules and supervision of these areas.

On another hand, job rotation was used as an administrative control to restrict the exposure of individual workers for radioiodine therapy, but there was a lack of evidence supporting that the management of the activities between imaging, preparation, administration in the diagnostic procedures and radioiodine activities were based on a dose assessment.

6. WORKPLACE MONITORING PROGRAMME

The Nuclear Medicine department has 2 portable survey meters:

- Thermo Scientific α, β, γ Survey Meter received in March 2014 from IAEA
- Thermo Mini Rad 1000 Survey Meter calibrated in 2007, not recalibrated and without a calibration certificate.

Workplace monitoring seems to be conducted in the different areas of the department but without any recording or evidence.

No evidence about the control and the waste management procedure.

No appropriately documented workplace monitoring programme based on regulatory requirements for radiation safety could be found in place and no contamination monitoring were conducted in the department, either in normal or in emergency situations.

7. INDIVIDUAL MONITORING PROGRAMME

Staff was monitored using TLD dosimeters provided by the Radiation Protection Services – Dosimetry Section of the Tanzania Atomic Energy Commission in accordance with the national regulations. However, there were no evidences that the decision to carry out such monitoring had been taken as a result of a prior radiological evaluation.

The individual monitoring was managed by the RSO for the whole staff of the establishment (60 to 80 people). The dosimetry results form was presented without staff distinction in the different departments (radiotherapy, nuclear medicine and diagnostic radiology). The records demonstrated that the received doses were low, even for the nuclear medicine activity (probably due to the workload).

The dose record reports were classified by year and maintained in a register. However, their number was not corresponding to the frequency of 3 months adopted for individual monitoring (TAEC record dose report).

The instructions on how to take care and how to use the personal dosimeter were posted on the notice board of the radiotherapy department and not in the nuclear medicine department.

It seems that the individual monitoring programme includes reference levels and associated actions for each separate dosimeter result; for doses accumulated over specified periods and actions to be taken in the event that a dosimeter is lost but this programme was not provided.

There is no a service in Tanzania to provide internal intake. The necessity of such assessment is dependent on the handled quantities of 131 for therapy.

8. STAFF SELECTION, INFORMATION AND TRAINING

All staff was aware of radiation risk and had specific in house radiation safety training but the training certificates were not provided.

The Nuclear Medicine department didn’t have in place a formal set of procedures detailing the qualification requirements for workers, and the required training and information to be provided to workers for radiation safety.

9. CO-OPERATION TO ENSURE THE SAFETY OF EMPLOYERS OF ANOTHER EMPLOYER

A clear allocation and documentation of the responsibilities of the Licensee to ensure the safety of employers of another employer as service engineers carrying out checks on radiation equipment were not provided and it seems that the maintenance contract was not covered by a radiation protection programme. However, the external staff was monitored by personal dosimetry under the responsibility of their employer, without any co-operation between employers.

There was no co-operation or agreement to ensure the safety or to collect the dose records of employees who are exposed to radiation sources in other practices or in other places.

10. EMERGENCY ARRANGEMENTS (EMERGENCY PLANS)

Although there was some evidence of written basic instruction to staff for incidents and emergencies especially for contamination, almost universally these were not developed as a part of a more comprehensive emergency plan.

The Nuclear Medicine department has an emergency kit for decontamination but without any documentation and training on how to use it by the staff.

There was no evidence on formal plan on how to deal with situations in which workers might be contaminated or overexposed.

Without a washroom and a locker room in the design of the department, it seems to be difficult to control the spread of the radioactive contamination.

11. HEALTH SURVEILLANCE PROGRAMME

It seems that the general principles of health surveillance were implemented to assess initial fitness for workers in general but there were no written arrangements in place to ensure that necessary health surveillance and health services are provided to assess initial and continuing fitness of workers occupationally exposed to ionising radiation (no occupational physician).

For, the situations in which workers might be overexposed, it seems that the plans have been prepared to deal with these situations but it was not provided.

12. QUALITY ASSURANCE PROGRAMMES

There was no evidence of documented quality assurance programme to ensure the optimisation and continued function of radiation protection measures and procedures, and the safety of staff. Furthermore, only the quality control testing was being carried out on the 2 Gamma Cameras.

CONCLUSIONS

The Nuclear Medicine Department does not fully comply with the Basic Safety Standard of the IAEA.

The interviewees were qualified and aware about radiation protection and safety and security in occupational exposure.

There were no prior radiological and risk assessment during design and prior to licensing by the regulatory body. The actual design does not guarantee the occupational radiation safety especially in case of an emergency and for radioiodine therapy.

There were no radiation protection programme in the department and no clear radiation protection responsibilities assigned by the manager.

The Radiation Safety Officer (RSO) was formally appointed

Some measures related to radiation safety and security of radioactive sources were implemented in the department but there were no written procedure for both normal operation and emergency situations to comply with the regulatory requirements and the IAEA's standards.

No programme and records for workplace monitoring

The individual monitoring was provided by an approved dosimetry service but with a frequency very scarce. No documentation about cumulative dose, action levels and overexposure management

No programme for training of the staff in radiation protection

No emergency plan for the department and no written procedure with the instruction supporting an overexposed or contaminated worker

Lack of occupational health surveillance specific to ionizing radiation

No quality assurance programme other than the quality control of the gamma camera

RECOMMENDATIONS

Important

1. It is recommended to review the design of the department specifically the ventilation system, the drainage system, the waiting area, the floor and the shower to comply with the IAEA's requirements.

2. It is recommended to review completely the radioiodine hospitalisation to ensure the radiation protection of the staff, the public and the patient according to the regulation in place and to the IAEA's standard.

3. The design review should be addressed to TAEC approval with a radiological and risk assessment

4. It is recommended to review, the organization chart specifying the responsibilities and duties for the staff for radiation safety in both normal operation and emergency situations.

5. It is recommended to provide the Radiation Safety Officer with the necessary resources to accomplish its mission;

6. It is recommended to implement a routine workplace monitoring programme.

7. It is recommended to establish and to implement an appropriate written programme and measures on radiation protection and safety for both normal operation and emergency situations, together with the allocution of responsibilities for it implementation within an organization, from the top management to workers involved in specific tasks.

8. It is recommended to maintain a record book for notifying the incidents of occupationally exposed workers.

9. It is recommended to implement the reference levels and the investigation levels for dosimetry results and for accumulated doses over periods. Results exceeding these values should be investigated to determine whether or not doses are optimized.

10. It is recommended to provide with a sufficient number of PPE to the staff of the department.

11. It is recommended to establish an appropriate written programme for the training of staff in the different tasks and specific trainings and refresher training on occupational radiation protection for the Medical Physicist and the RSO.

12. It is recommended to adopt a written emergency plan for the department with procedures and instructions supporting overexposed or contaminated workers.

Recommendations to the Regulatory Body

13. The RB to review the overexposure procedure, its real implementation by the end users, the dosimetry services and the Occupational Health Physician and follow up actions.
14. The RB may provide a structured scheme and organization of Health Surveillance for the Occupationally Exposed Workers and draw up a formal plan to deal with situations in which workers might be overexposed.
15. The RB to ask for the radiological evaluation and risk assessment and shielding calculation during the design of the installations prior to the construction of the building before approval.

Advised

16. It is recommended to provide a clear allocation and documentation of the responsibilities of the Licensee to ensure the safety of employees of another employer as service engineers carrying out checks on radiation equipment or maintenance of the ventilation system. The radiation protection programme should be clearly defined in the maintenance contract.
17. It is recommended to establish a quality assurance programme to ensure the optimization and continued function of radiation protection measures and procedures, and the safety of staff.

APPENDIX III – TANZANIA STEEL PIPES

NDT

Facilities and services:	Tanzania Steel Pipes –NDT
Location:	Dar Es Salaam
Mission date:	12 August 2014
ORPAS Team:	Latifa BENOMRANE, Abdelkader BENIDER ,Wilbroad Muhogora, Jizeng MA
Report prepared by:	Jizeng MA
People met:	Athuman Khalib, Fesio Temba and Elly Bohella

GENERAL INFORMATION

TANZANIA STEEL PIPES is a private NDT institution, which process industrial radiography to reveal weld defect in steel pipes. The company possesses one fixed x-ray machine functioning with a maximum of 4 mA and a high voltage of 140 kV. Three operators were affected to the x ray machine with a workload of 4 pipes per day and 15 min exposure time per pipe.

APPARAISAL CONDUCTION

Prior to the mission, the IAEA provided the National counterpart pre-appraisal questionnaires to be distributed to the staff of the NDT Company to carry out a self-assessment and to help to the preparation of the mission. These questionnaires were incomplete.

The conduction of the appraisal was based on the discussions with the staff and the visit of the company, the observation of the activities undertaken during the visit and the existence of documents showing evidence on the implementation of a process.

Prior to the visit, the discussions have been initiated with the Human Resources Manager, Quality Control Officer and the RSO (Annex III)

The visit of the Department was conducted by the RSO without any activities on the X ray machine.

APPRAISAL FINDINGS

1. AUTHORIZATION DETAILS

There is a license in the company for the use of radiation. The license has expired and the application for the renewing of the license was submitted three months ago.

2. MANAGEMENT STRUCTURE

The NDT Company has a fixed x-ray installation and it appears that it is structured to ensure the safety of workers from ionising radiation. The staffs are aware of their obligations to ensure the safety of workers from ionising radiation but the organization chart specifying the responsibilities and duties on radiation safety was not provided.

Therefore, the quality manager is responsible for all the safety issues and there is a Radiation Safety Officer responsible for radiation protection issues but their job description including radiation safety requirements was not established.

3. RADIATION PROTECTION PROGRAMME

Responsibilities

The Company has in place a documented Radiation Protection Programme, containing a manual for procedures and instructions. However, the allocation of responsibilities for it implementation within an organization, from the top management to workers was clearly distinguished for the workers. General safety rules and procedures were cited without an attribution of the responsibility for the RSO.

Prior radiological evaluation and safety assessment

There was no evidence about the existence of a radiological evaluation and risk assessments of the potential radiation doses and risks to staff during x-ray radiography, approved by the radiation protection regulatory body.

4. CONTROL AND ACCOUNTABILITY OF RADIATION GENERATORS

No evidence about an inventory that contains records of the location and description of each radiation generator.

5. RADIATION PROTECTION MEASURES

Protection by engineered controls

Radiation safety must be considered in the design of the irradiator. One of the most important engineered controls to be considered is the shielding of the irradiating area. The thickness of the wall protecting the controlled area seems to be adequate. No evidence provided concerning the adequacy of the shielding. It should be provided further a radiological evaluation and confirmed by workplace measurements. This report should be approved by the regulatory.

The entrance is a safety key to be considered in the design of the irradiating facility. One entrance was secured (left one). No precision on the right one and the entrance of the conveyor.

No details about the real existence of door interlock and it’s functioning during an exposure.

Safety Features

The facility has some safety features, like warning light during x-ray exposure and an audible alarm before starting irradiation.

It seems that there were not safety features terminating irradiation when the door is opened during exposure.

On another hand, 3 cameras were disposed to control the irradiating facility, but with only one monitor. When the x-ray is on, the camera is switched to the pipe. There was not sufficient control against the intrusion of workers during an x-ray exposure.

The door inside the control unit was not sufficiently secured against the intrusion (upper part made with glass). This is a relevant remark if the x-ray unit is not equipped with a removable key to start its functioning.

Provision of administrative controls

Controlled Area has been designated with the signs and notices on radiation put on the wall of the irradiating area. However, there was insufficient evidence that the designation had been clearly determined as a result of a prior radiological evaluation (risk assessment).

Locale rules and safety procedures were documented and posted in the board of the control unit and on the machine.

6. WORKPLACE MONITORING PROGRAMME

The survey meter was available in the operation room of the x-ray machine, but there was no clear information about the calibration date.

Workplace monitoring is carried out twice a day and the results are recorded in the logbook but there was noworkplace monitoring programme based on regulatory requirements for radiation safety in normal and emergency situations.

7. INDIVIDUAL MONITORING PROGRAMME

Staff was monitored using TLD dosimeters provided by Radiation Protection Services of the Tanzania Atomic Energy Commission in accordance with the national regulations. However, there were no evidences that the decision to carry out such monitoring had been taken as a result of a prior radiological evaluation.

The individual monitoring was managed by the Quality Manager. No evidence provided on the dosimetry records.

The instructions on how to take care and how to use the personal dosimeter were posted on the notice board as a worker responsibility.

No evidence on reference levels and associated actions for each separate dosimeter result; for doses accumulated over specified periods and actions to be taken in the event that a dosimeter result is lost or a dose level is exceeded.

8. STAFF SELECTION, INFORMATION AND TRAINING

The RSO receives training on radiation protection from TAEC but the training certificate was not provided.

The human resource manager (Chairman of occupational health manager) provides meeting on radiation risk awareness to the local workers, but without any documented programme.

The assigned workers to the irradiating facility have not received a formal training in radiation protection and specifically adapted to their activities.

9. CO-OPERATION TO ENSURE THE SAFETY OF EMPLOYERS OF ANOTHER EMPLOYER

There was no external staff having activities in the NDT facility.

No information concerning the maintenance staff operating on the x-ray machine.

10. EMERGENCY ARRANGEMENTS (EMERGENCY PLANS)

There was no evidence on formal emergency plan on how to deal with situations in which workers might be overexposed.

Instructions were found relating mostly to safety procedures rather than scenario accidents and to emergency actions.

11. HEALTH SURVEILLANCE PROGRAMME

It seems that the general principles of occupational health were implemented to assess initial fitness and continuing fitness of workers but without covering the specific aspect of exposure to ionising radiation.

For, the situations in which workers might be overexposed; it seems that the plans have not been prepared to deal with these situations.

12. QUALITY ASSURANCE PROGRAMMES

There was no evidence of documented quality assurance programme to ensure the optimisation and continued function of radiation protection measures and procedures, and the safety of staff. Only the

quality control testing of the x-ray machine was carried as a daily check under the responsibility of the worker.

CONCLUSIONS

Most of measures related to radiation safety and security were implemented in the NDT irradiating facility to ensure the radiation protection of workers but there were some missing aspects in the programme of radiation protection and safety for both normal operation and emergency situations to comply with the national regulations and IAEA's safety standards.

The Radiation Safety Officer plays an important role in the development and implementation of the programme.

RECOMMENDATIONS

Important

1. It is recommended to review the safety features of the facility and to establish stricter countermeasure to prevent the intrusion of the staffs into the NDT area during operation (interlocks, camera, monitors, safety culture and training).
2. This review should be addressed to TAEC approval.
3. It is recommended to review, the organization chart specifying the responsibilities and duties for the staff for radiation safety in both normal operation and emergency situations.
4. It is recommended to provide the Radiation Safety Officer with the necessary resources to accomplish its mission;
5. It is recommended to implement a routine workplace monitoring programme.
6. It is recommended to establish and to implement an appropriate written programme and measures on radiation protection and safety for both normal operation and emergency situations, together with the allocution of responsibilities for it implementation within an organization, from the top management to workers involved in specific tasks.
7. It is recommended to maintain a record book for notifying the incidents of occupationally exposed workers.
8. It is recommended to implement the reference levels and the investigation levels for dosimetry results and for accumulated doses over periods. Results exceeding these values should be investigated to determine whether or not doses are optimized.
9. It is recommended to establish a programme for the specific training in radiation protection for the staff including the workers.

10. It is recommended to provide EPD for the persons who will enter into the NDT area.

11. It is recommended to adopt a written emergency plan for the facility with procedures and instructions supporting overexposed workers.

Recommendations to the Regulatory Body

12. The RB to review the overexposure procedure, its real implementation by the end users, the dosimetry services and the Occupational Health Physician and follow up actions.
13. The RB may provide a structured scheme and organization of Health Surveillance for the Occupationally Exposed Workers and draw up a formal plan to deal with situations in which workers might be overexposed.
14. The RB to ask for the radiological evaluation and risk assessment and shielding calculation during the design of the installations prior to the construction of the facility before approval.

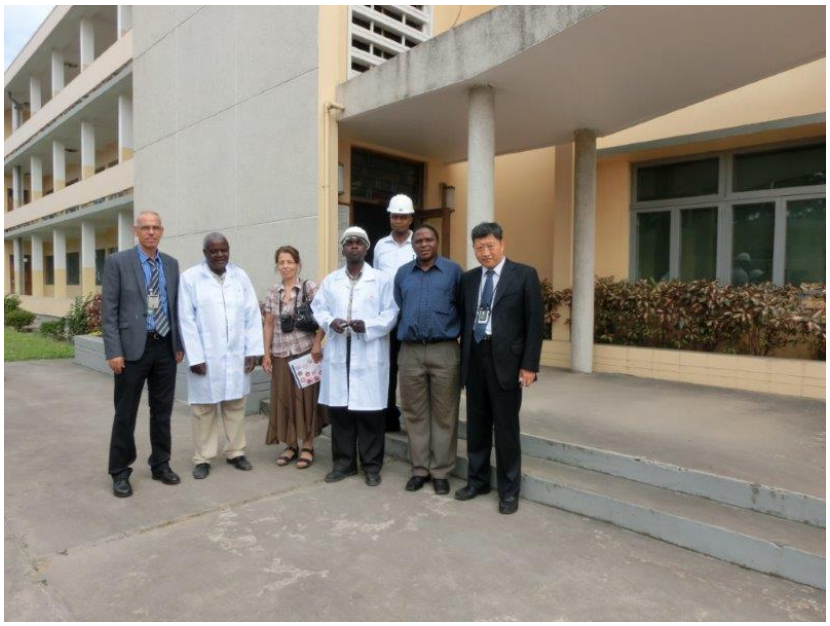
Advised

15. It is recommended to provide a clear allocation and documentation of the responsibilities of the Licensee to ensure the safety of employees of another employer as service engineers carrying out checks on radiation equipment or maintenance of the equipment. The radiation protection programme should be clearly defined in the maintenance contract.
16. It is recommended to establish a quality assurance programme to ensure the optimization and continued function of radiation protection measures and procedures, and the safety of staff.

Good Practice

17. The instructions on how to take care and how to use the personal dosimeter were posted on the notice board as a worker responsibility.

18. The human resource manager provide meeting on radiation risk awareness to the local workers.



APPENDIX IV – NUHIMBILI NATIONAL HOSPITAL

Cardiovascular Department

Facilities and services:	Nuhimbili National Hospital –Cath Lab
Location:	Dar Es Salaam
Mission date:	12 August 2014
ORPAS Team:	Latifa BENOMRANE, Abdelkader BENIDER ,Wilbroad Muhogora, Jizeng MA
Report prepared by:	Abdelkader BENIDER
People met:	Peter R. Kisenge, Ramdhani Selemani, Samuel Kimrou and Wilbard R. Siamga

GENERAL INFORMATION

The cardiovascular department has a catheterization laboratory with two X-ray sources used for cardiac catheterization and a C ARM Machine for interventional radiology/cardiology examinations

The catheterization laboratory has qualified staff: 38 (14 cardiologists; 10 Technicians; 6 Nurses and 8 doctors)

APPRAISAL FINDINGS

1. AUTHORIZATION DETAILS

It seems that the Cardiovascular Department is licensed by the TAEC but it was not provided.

2. MANAGEMENT STRUCTURE

The catheterization laboratory has new technology equipment with two X-ray sources for cardiac catheterization department and it appears that it is structured to ensure the safety of workers from ionising radiation. The director manager is aware of his obligations to ensure the safety of workers from ionising radiation but the organization chart specifying the responsibilities and duties for the staff on radiation safety was not provided.

Therefore, the Radiation Safety Officer was designated but his job description including radiation safety requirements was not established, yet.

3. RADIATION PROTECTION PROGRAMME

The catheterization laboratory didn't have a documented Radiation Protection Programme, containing a manual for radiation protection procedures and instructions, together with prior radiological evaluations (risk assessments) of the potential radiation doses and risks to staff around

the patient (into the room), and of the required shielding for the walls and doors of the radiation facilities.

Many protection measures related to radiation safety were implemented but not documented. The equipment is new and the staff is aware of radiation risk but, in absence of documentation related to the Radiation Protection Programme and Measures, it cannot however be assumed that the expected magnitudes and likelihood of exposures in planned exposure situations have been determined; an assessment of potential exposures has been made or the protection measures or operational procedures needed to optimize protection and safety have been identified.

Use of personal protective

The Catheterization laboratory has an appropriate personal protective equipment (PPEs) as lead aprons, thyroid protectors, protective lead curtains mounted on the patient table, ceiling suspended protective screens for protecting eyes and the thyroid, etc. but there was no evidence of information being provided to staff on the appropriate use and maintenance of PPEs.

Provision of administrative controls

Controlled and Supervised Areas were found to have been designated. However, they were not demarcated using appropriate signs to declare their status. Furthermore, there was insufficient evidence that the designation had been clearly determined as a result of a prior radiological evaluation (risk assessment), in particular into the room of the catheterization laboratory and there was no radiation safety specific information, procedures and local rules. This assessment need to be performed by an expert on radiation safety.

4. WORKPLACE MONITORING PROGRAMME

The Catheterization laboratory has not a portable survey meter for assessment of ambient dose in the workplace and didn't establish a workplace monitoring programme including regulatory requirements on radiation safety. The radiation safety officer plays an important role in the establishment and implementation of the programme.

5. INDIVIDUAL MONITORING PROGRAMME

Staff was monitored using TLD dosimeters provided by the Dosimetry Section of the Tanzania Atomic Energy Commission in accordance with the national regulations. However, there were no evidences that the decision to carry out such monitoring had been taken as a result of a prior radiological evaluation that need to be performed by Radiation Safety officer or an expert on radiation safety.

It seems that the individual monitoring programme was not established and they didn't establish the reference levels and associated actions for each separate dosimeter result; for doses accumulated over specified periods and action to be taken in the event that a dosimeter result is lost.

No EPDs and no extremity or eye lens dosimetry.

No local rules on how to use and to take care of the individual dosimeter provided to workers in the cath lab.

6. STAFF SELECTION, INFORMATION AND TRAINING

All staff is aware of radiation risk but they didn't have specific radiation safety training except for Radiation Safety Officer.

The Catheterization laboratory didn't have in place a formal set of procedures detailing the qualification requirements for workers on radiation safety, and the required training and information to be provided to workers for radiation safety. Most of staff didn't have the written job description related to radiation safety.

7. CO-OPERATION TO ENSURE THE SAFETY OF EMPLOYERS OF ANOTHER EMPLOYER

A clear allocation and documentation of the responsibilities of the Licensee to ensure the safety of employers of another employer as service engineers carrying out checks on radiation equipment were not provided and it seems that the maintenance contract was no covered by a radiation protection programme.

8. HEALTH SURVEILLANCE PROGRAMME

It seems that there were no written arrangements in place to ensure that necessary health surveillance and health services are provided to assess initial and continuing fitness of workers occupationally exposed to ionising radiation.

9. QUALITY ASSURANCE PROGRAMMES

There was no evidence of documented quality assurance programmes to ensure the optimisation and continued function of radiation protection measures and procedures, and the safety of staff.

CONCLUSIONS

Most of measures related to radiation safety were implemented in the cardiovascular department to ensure the radiation protection of workers and safety of the radiation source but there were no written programmes of radiation protection and safety to comply with the national regulations and international standards.

The Radiation Safety Officer plays an important role in the development and implementation of the programme.

RECOMMENDATIONS

Important

1. It is recommended to review, the organization chart specifying the responsibilities and duties for the staff for radiation safety in both normal operation and emergency situations.

2. It is recommended to provide the Radiation Safety Officer with the necessary resources to accomplish its mission;

3. It is recommended to implement a routine workplace monitoring programme.

4. It is recommended to establish and to implement an appropriate written programme and measures on radiation protection and safety for both normal operation and emergency situations, together with the allocution of responsibilities for it implementation within an organization, from the top management to workers involved in specific tasks.

5. It is recommended to implement the reference levels and the investigation levels for dosimetry results and for accumulated doses over periods. Results exceeding these values should be investigated to determine whether or not doses are optimized.

6. It is recommended to establish a programme for the specific training in radiation protection for the staff, especially for the cardiologist.

Recommendations to the Regulatory Body

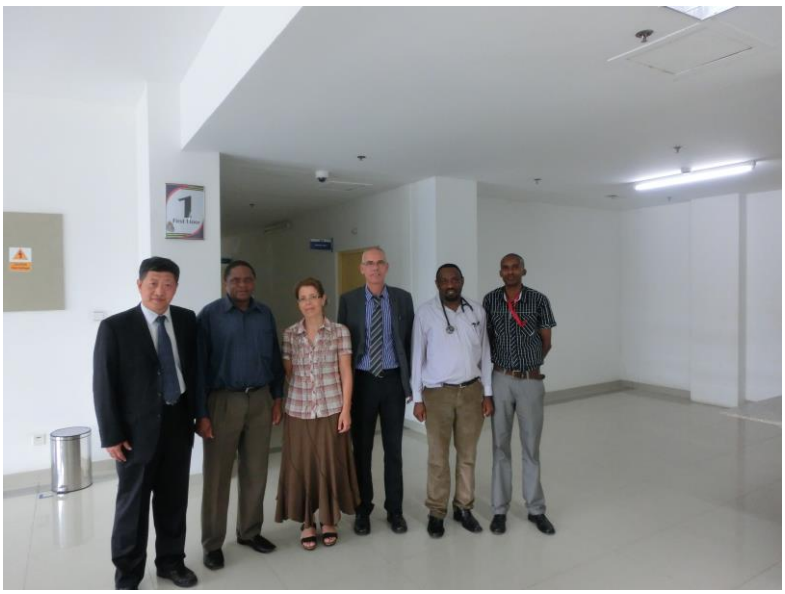
7. The RB to review the overexposure procedure, its real implementation by the end users, the dosimetry services and the Occupational Health Physician and follow up actions.
8. The RB may provide a structured scheme and organization of Health Surveillance for the Occupationally Exposed Workers and draw up a formal plan to deal with situations in which workers might be overexposed.
9. TAEC may organize a training programme for cardiologists on radiation protection of staff and patients.
10. The RB to ask for the radiological evaluation and risk assessment and shielding calculation during the design of the installations prior to the construction of the facility before approval.

<u>Advised</u>

11. It is recommended to provide EPD, extremity and eye lens dosimetry for the cardiologist.

12. It is recommended to provide a clear allocation and documentation of the responsibilities of the Licensee to ensure the safety of employees of another employer as service engineers carrying out checks on radiation equipment or maintenance of the equipment. The radiation protection programme should be clearly defined in the maintenance contract.

13. It is recommended to establish a quality assurance programme to ensure the optimization and continued function of radiation protection measures and procedures, and the safety of staff.



APPENDIX V– NUHIMBILI NATIONAL HOSPITAL

Radiology Department

Facilities and services:	Nuhimbili National Hospital – Radiology Department
Location:	Dar Es Salaam
Mission date:	12 August 2014
ORPAS Team:	Latifa BENOMRANE, Abdelkader BENIDER ,Wilbroad Muhogora, Jizeng MA
Report prepared by:	Wilbroad Muhogora
People met:	Musa Ndukeke and Lwidiko Mbembati

GENERAL INFORMATION

Muhimbili National Hospital (MNH) is a public hospital, which is located in Tanzania's commercial capital of Dar es Salaam. The department possesses two functioning G100C RAD x-ray machines and one 6-slice Philips Brilliance CT scanner. There are non-functioning x-ray equipment including one radio-fluoroscopic machine, Philips Duo diagnostic and two G100C RAD x-ray machines. The department has a total of 40 staff members (8 radiologists and 32 radiographers) that are occupationally exposed. In addition, it has 6 staff (2 nurses and 4 technicians), who may be exposed to x-rays for short periods as a result of their work carried in the department.

APPRAISAL CONDUCTION

Prior to the mission, the IAEA provided the National counterpart pre-appraisal questionnaires to be distributed to the staff of the radiotherapy department to carry out a self-assessment and to help to the preparation of the mission. However, these questionnaires were not returned from this department.

The conduction of the appraisal was based on the discussions with the staff and the visit of the department, the observation of the activities undertaken during the visit and the existence of documents showing evidence on the implementation of a process.

Prior to the visit, the discussions have been initiated with the Doctor responsible (Radiologist), head of the department.

The visit of the Department was conducted by the head of the radiologists (Annex III) with the presence of patients.

APPRAISAL FINDINGS

1. OBSERVATIONS

1.1. Strengths

(a) There is a core of qualified experts (radiologists and radiographers), majority of whom has already participated in training courses organized by the Regulatory Authority. However, evidence for this participation was not available;

(b) There is a qualified Radiation Safety Officer (RSO) to oversee radiation protection program (RPP) at the department;

(c) There is good engineering control i.e. adequate shielding;

(d) There are some protective gears although it appears that they are not adequate as some are shared between rooms (Figure 2);

(e) There is a radiation warning symbol and a posted notice to warn members of public against potential radiation exposure near one of CT scanner room's door (Figure 3);

(f) Some workers were wearing thermoluminecsent dosimeters (TLDs).

(g) For staff working at other hospitals on part time basis wear dosimeters designated by service provider at each hospital.

1.2. Weaknesses

(a) The x-ray facility was not licensed by the Regulatory Authority to operate x-ray service

(b) The job description of RSO also indicating his responsibilities on radiation protection issues is not documented and therefore not evidenced;

(c) The structure of radiation protection in management structure is not clear. Policies and procedures are not documented. The budget allocated for radiation protection seems to be not sufficient;

(d) Despite that Acting Head of Radiology Department and RSO explained ongoing radiation protection activities, the radiation protection program (RPP) is not documented;

(e) No registry of radiation generators especially the non-functioning equipment was important;

(f) No evidence about the shielding evaluation for the walls and doors, approved by the radiation protection regulatory body;

(g) The number of personnel protective equipment (PPE) was insufficient and not stored at an adapted location. Moreover, the operators were not wearing these PPE,

(h) Except at one door of the CT scanner room, the controlled and supervised areas are not designated. All controlled areas have no warning symbol(s) ,

(i) Majority entrances to controlled areas have no warning notice(s);

(j) Local rules and supervision were not provided at all working places; and it was difficult to distinguish between patients and operators as they were not wearing working clothes (apron),

(k) Some workers and students were found working without wearing TLD(s). It was reported that the hospital receives inadequate number of TLDs from the service providers. There was no evidence of hospital request to the service provider to get more dosimeters;

(l) No evidence about reports of dose records provided by dosimetry service of TAEC, and about reference and action levels to be undertaken by the RSO;

(m) No documentation on the instructions on how to wear and how to take care of the personal dosimeter,

(n) There is no radiation survey instrument and therefore workplace monitoring programme is not implemented;

(o) It was reported that not all workers have participated in radiation protection training courses due to financial constraints; and no programme for radiation protection adopted;

(p) There is no cooperation between employers to ensure the safety of employees as it was reported that some radiology staff e.g. radiologists and radiographers at the hospital work also at other hospitals on part time basis;

(q) Health surveillance program is not available and so is the formally designated Occupational Health Physician;

(r) Quality Assurance is not documented.

2. RECOMMENDATIONS

2.1. Essential

(a) The hospital should apply for authorization to operate x-ray services;

2.2 Important

(a) The management structure for radiation protection should be formally established. This will involve creating the position of radiation protection in the organogram of the hospital. Policies and procedures should be documented;

(b) The job description of RSO also indicating his responsibilities on radiation protection matters should be documented and available in the department;

(c) Radiation Protection Program should formally be established and implemented;

(d) Radiation protection training programme should be adopted and training should be provided to some staff members who have not yet been trained;

(e) Personal dosimeters should be provided by TAEC to the occupationally exposed workers and the wearing should be supervised by the RSO;

(f) Dose records should be maintained by the RSO and the occupational physician;

(g) Reference levels and the investigation levels for dosimetry results and for accumulated doses over periods. Results exceeding these values should be investigated to determine whether or not doses are optimized.

(h) Controlled and supervised areas should be designated with appropriate radiation symbols and appropriate warning notices translated in Swahili and English languages;

(i) Local rules and supervision procedures should be established and implemented; especially for the control of access to controlled area.

(j) Acquisition of additional and adequate protective gears;

(k) Periodic maintenance of PPEs

(l) Radiation survey instrument should be acquired, calibrated and used in work place monitoring to be conducted according to an established programme;

Recommendations to the Regulatory Body

(m) The RB may provide a structured scheme and organization of Health Surveillance for the Occupationally Exposed Workers and draw up a formal plan to deal with situations in which workers might be overexposed.

(n) TAEC may organize a training programme for occupational radiation protection of staff and patients.

(o) The RB for the authorization to operate x-ray services.

2.3 <u>Advised</u>

(p) Formal cooperation between the management of this hospital and that of others where some staff members work on part time basis established and documented;

(q) Quality assurance program should be formally established, monitored and documented.

(r) Good housekeeping should be exercised and maintained as its inadequacy can be an indicator for deteriorated radiological protection conditions.

(s) Adequate budget should be provided for radiation protection activities.

(t) Safety culture to be implemented especially in the respect of wearing work clothes and the supervision of access rules for patients and public in the radiology department.

APPENDIX VI – ARUSHA LUTHERAN MEDICAL CENTRE

RADIOLOGY DEPARTMENT

Facilities and services:	Arusha Lutheran Medical Centre – Radiology Department
Location:	Arusha
Mission date:	13 August 2014
ORPAS Team:	Abdelkader BENIDER and Wilbroad Muhogora
Report prepared by:	Wilbroad Muhogora
People met:	Isaac N. Mollel and Abel R. Nkya

GENERAL INFORMATION

Arusha Lutheran Medical Centre (ALMC) is a referral private hospital, which is located in Arusha, Tanzania. The department possesses one working GE x-ray machine and CT scanner, SOMATOM EMOTION 6 slice (see Figure 1). At this hospital, there is a computed radiography machine used in projection radiography. The department has a total of 3 staff members (1 radiology officer (Head) and 2 radiographers) that are occupationally exposed. In addition, one radiologist from Mount Meru Regional Hospital offers service on part time basis. There are 2 non-radiology staff members who can be exposed incidentally.

APPARAISAL CONDUCTION

Prior to the mission, the IAEA provided the National counterpart pre-appraisal questionnaires to be distributed to the staff of the radiotherapy department to carry out a self-assessment and to help to the preparation of the mission. These questionnaires were returned from this department and evaluated by the ORPAS team.

The conduction of the appraisal was based on the discussions with the staff and the visit of the department, the observation of the activities undertaken during the visit and the existence of documents showing evidence on the implementation of a process.

Prior to the visit, the discussions have been initiated with the Doctor responsible (Radiologist), head of the department and the RSO (Annex III).

APPRAISAL FINDINGS

1. OBSERVATIONS

1.1. Strengths

(a) The centre is licensed by Regulatory body to operate x-ray services

(b) There are qualified radiology staff members (radiologist (part time), radiology officer, and radiographers). Two staff members have already participated in training courses organized by the Regulatory Authority;

(c) There is a qualified Radiation Safety Officer (RSO) to oversee radiation protection program (RPP) at the department;

(d) There is good engineering control i.e. adequate shielding;

(e) Controlled areas are designated with radiation symbols posted as required.

(f) There are working warning lights on the door to x-ray rooms

(g) There is a warning notice posted on each door to x-ray facility

(h) There are sufficient number of personal protective equipment; having good quality and adequately stored.

(i) The centre participates in individual monitoring and the radiology officer and radiographer on duty were wearing thermoluminecsent dosimeters (TLDs);

(j) Personnel dose records are kept

(k) For a part time radiologist, he wears dosimeter designated to this hospital when on duty.

1.2. Weaknesses

(l) The job description of RSO also indicating his responsibilities on radiation protection issues is not documented and therefore no evidenced;

(m) The structure of radiation protection in management structure is not clear. Policies and procedures are not documented;

(n) Despite that the Head of Radiology Department and Acting RSO explained ongoing radiation protection activities, the radiation protection program (PPP) is not documented;

(o) There is no radiation survey instrument and therefore workplace monitoring programme is not implemented;

(p) There are no documented local rules and supervision

(q) No registry of radiation generators with all the details and the location of each equipment

(r) No evidence about the shielding evaluation for the walls and doors, approved by the radiation protection regulatory body;

(s) No evidence about reports of dose records provided by dosimetry service of TAEC, and about reference and action levels to be undertaken by the RSO;

(t) No documentation on the instructions on how to wear and how to take care of the personal dosimeter,

(u) no programme for radiation protection adopted for the occupationally exposed staff to ionizing radiation;

(v) There is no cooperation between employers to ensure the safety of employees as it was reported that some radiology staff at the hospital work also at other hospitals on part time basis;

(w) Health surveillance program is not available and so is the formally designated Occupational Health Physician;

(x) Quality Assurance is not documented.

2. RECOMMENDATIONS

2.1 Important

(a) The job description of RSO also indicating his responsibilities on radiation protection matters should be documented and available in the department;
(b) Radiation Protection Program should formally be established and implemented;
(c) The management structure for radiation protection should be formally established. This will involve creating the position of radiation protection in the organogram of the hospital. Policies and procedures should be documented ;
(d) Radiation Protection Program should formally be established and implemented;
(e) The programme for training on radiation protection should be established and implemented;
(f) It might be necessary to translate the warning notices in local (Swahili) language;
(g) Radiation survey instrument should be acquired, calibrated and used in a planned and documented work place monitoring;
(h) Dose records should be maintained by the RSO and the occupational physician;
(i) Reference levels and the investigation levels for dosimetry results and for accumulated doses over periods. Results exceeding these values should be investigated to determine whether or not doses are optimized

Recommendations to the Regulatory Body

(j) The RB may provide a structured scheme and organization of Health Surveillance for the Occupationally Exposed Workers and draw up a formal plan to deal with situations in which workers might be overexposed.

3.3 Advised

(k) Formal cooperation between the management of this hospital and that of others where some staff members work on part time basis should be established and documented;
(l) Quality assurance program should be formally established, monitored and documented.
(m) Further improvement in good housekeeping observed is possible.
(n) Adequate budget should be provided for radiation protection activities;

APPENDIX VII– MOUNT MERU REGIONAL HOSPITAL

RADIOLOGY DEPARTMENT

Facilities and services:	Mount Meru Regional Hospital – Radiology Department
Location:	Arusha
Mission date:	13 August 2014
ORPAS Team:	Abdelkader BENIDER and Wilbroad Muhogora
Report prepared by:	Wilbroad Muhogora
People met:	Hassan Kivuyo, Mathayo and E. Mbis

GENERAL INFORMATION

Mount Meru Regional Hospital (MMRH) is a public hospital, which is located in Arusha, Tanzania. The department possesses two working x-ray machines, Philips Duodiagnostic and Philips MRS (see Figure 1). The department has a total of 8 staff (1 radiologist, 1 radiology officer (Head) and 6 radiographers) occupationally exposed. There is no any staff member who can be exposed incidentally.

APPRAISAL CONDUCTION

Prior to the mission, the IAEA provided the National counterpart pre-appraisal questionnaires to be distributed to the staff of the radiotherapy department to carry out a self-assessment and to help to the preparation of the mission. However, these questionnaires were not returned from this department.

The conduction of the appraisal was based on the discussions with the staff and the visit of the department, the observation of the activities undertaken during the visit and the existence of documents showing evidence on the implementation of a process.

Prior to the visit, the discussions have been initiated with the Doctor responsible (Radiologist), head of the department and the RSO, head of the radiographers (Annex III).

APPRAISAL FINDINGS

1. OBSERVATIONS

1.1. Strengths

(a) There is adequate number of qualified radiology staff members (radiologist, radiology officer, and radiographers), majority of whom has already participated in training courses organized by the Regulatory Authority;

(b) There is a qualified Radiation Safety Officer (RSO) to oversee radiation protection program (RPP) at the department;

(c) There is good engineering control i.e. adequate shielding;

(d) Radiographers on duty were wearing thermoluminecsent dosimeters (TLDs). There are working warning lights on the door to x-ray rooms

(e) There is a warning notice posted on door to Philips Duodiagnost x-ray room;

(f) There are protective gears;

(g) For staff working at other hospitals on part time basis wear dosimeters designated by service provider at each hospital;

(h) Personnel dose records are available;

1.2. Weaknesses

(i) The x-ray facility was not licensed by Regulatory Authority to operate x-ray service ;

(j) The job description of RSO also indicating his responsibilities on radiation protection issues is not documented and no evidenced;

(k) The structure of radiation protection in management structure is not clear. Policies and procedures are not documented. The budget allocated for radiation protection seems to be not sufficient;

(l) No registry of radiation generators especially that the non-functioning equipment was important;

(m) No evidence about the shielding evaluation for the walls and doors, approved by the radiation protection regulatory body;

(n) Despite that the Head of Radiology Department and RSO explained ongoing radiation protection activities, the radiation protection program (PPP) is not documented;

(o) Controlled and supervised areas are not designated and no radiation symbols are posted;

(p) Local rules and supervision are not provided at all working places;

(q) There is no radiation survey instrument and therefore workplace monitoring programme is not implemented;

(r) No programme for radiation protection adopted;

(s) No evidence about reports of dose records provided by dosimetry service of TAEC, and about reference and action levels to be undertaken by the RSO;

(t) No documentation on the instructions on how to wear and how to take care of the personal dosimeter,

(u) There is no cooperation between employers to ensure the safety of employees as it was reported that some radiology staff at the hospital work also at other hospitals on part time basis;

(v) No evidence about emergency arrangements (plans) and how to deal with overexposures

(w) Health surveillance program is not available and so is the formally designated Occupational Health Physician;

(x) Quality Assurance is not documented.

2. RECOMMENDATIONS

2.1. Essential

(a) The hospital should apply for authorization to operate x-ray services;

2.2 Important

(b) The management structure for radiation protection should be formally established. This will involve creating the position of radiation protection in the organogram of the hospital. Policies and procedures should be documented;

(c) The job description of RSO also indicating his responsibilities on radiation protection matters should be documented and available in the department;

(d) Radiation Protection Program should formally be established and implemented;

(e) Radiation protection training programme should be adopted and training should be provided to some staff members who have not yet been trained;

(f) Controlled and supervised areas should be designated with appropriate radiation symbols and appropriate warning notices translated in Swahili and English languages;

(g) Local rules and supervision procedures should be established and implemented;

(h) Radiation survey instrument should be acquired, calibrated and used in work place monitoring;

(i) Dose records should be maintained by the RSO and the occupational physician;

(j) Acquisition of additional and adequate protective gears;

(k) Periodic maintenance of the PPEs

(l) Reference levels and the investigation levels for dosimetry results and for accumulated doses over periods. Results exceeding these values should be investigated to determine whether or not doses are optimized

Recommendations to the Regulatory Body

(m) The RB may provide a structured scheme and organization of Health Surveillance for the Occupationally Exposed Workers and draw up a formal plan to deal with situations in which workers might be overexposed.

(n) The RB for the authorization to operate x-ray services.

2.3. <u>Advised</u>

(a) Adequate budget should be provided for radiation protection activities;

(b) Formal cooperation between the management of this hospital and that of others where some staff members work on part time basis should be established and documented;

(c) Quality assurance program should be formally established, monitored and documented.

APPENDIX VIII– RADIATION PROTECTION SERVICES

DOSIMETRY SECTION - TAEC

Facilities and services:	Dosimetry Section – TAEC
Location:	Arusha
Mission date:	13 August 2014
ORPAS Team:	Latifa Ben Omrane
Report prepared by:	Latifa Ben Omrane
People met:	Dennis Mwalongo and Sarah Lema

The scope of the appraisal at the External Dosimetry Section as service provider was to evaluate the occupational radiation protection programme by the assessment of the monitoring programme for external exposure according to the IAEA publications (in particular those listed in Annex I);with regards to:

- ✓ Dosimetry of individual monitoring for exposure to external radiation sources;
- ✓ Dose record keeping
- ✓ Service management;
- ✓ calibration procedures;
- ✓ performance testing and type testing;
- ✓ Quality Assurance.

At the end of the mission, to provide an appraisal report incorporating findings, conclusions and recommendations for strengthening the occupational radiation protection programme at the Dosimetry Section in accordance with international standards and relevant IAEA documents.

APPARAISAL CONDUCTION

Prior to the mission, the IAEA provided the National counterpart pre-appraisal questionnaires to be distributed to the staff of the NCL department to carry out a self-assessment and to help to the preparation of the mission.

The conduction of the appraisal was based on the discussions with the staff and the visit of the Laboratory, the observation of the activities undertaken during the visit and the existence of documents showing evidence on the implementation of a process.

The visit and discussions were conducted by the two persons affected to the Individual Monitoring Service (IMS) or the Dosimetry Section (Annex II) of TAEC.

GENERAL INFORMATION

The Dosimetry Section of TAEC (or IMS) has the following equipment:

- TLD reader Harshaw 4500 installed in 2002;
- Irradiator Thermo 2210;
- TLD dosimeters 0110 (TLD100), 3 types of holders

- Winrems software on windows 7
- UPS;
- Nitrogen generator (not functioning);
- Nitrogen bottles

The Dosimetry section of TAEC was established to perform the personal dosimetry of exposed workers for external photon dosimetry in terms of the operational quantities Hp(10) and Hp(0.07).

APPRAISAL FINDINGS

APPROVAL

1. The Dosimetry Section didn't have a formal approval or an accreditation certificate to perform the service of individual monitoring. Part IX of the Atomic Energy Act promulgated in 2003 mentions some requirements to be met by providers of dosimetry and calibration services.

HUMAN RESSOURCES

2. The Dosimetry Section has two qualified and trained professional (Annex III), by IAEA's fellowships and training courses. The Technician is working full time and the senior a part time between the Dosimetry section, NCL, training and NORM activities.

EQUIPMENT

1. The Dosimetry Section has one manual reader for more than one thousand workers to be monitored and aging for more than 10 years. The equipment is no more adapted for the monitoring needs of the country.
2. The Nitrogen generator was defective and the staff noticed some difficulties with Nitrogen in bottles (quality and access of the supplier). Moreover, the position of the bottles near the reader is not recommended.
3. The dosimetry section routinely monitors approximately 1200 workers and the average coverage is about 79%. However the number of dosimeters in the stock is approximatively 1400 and is not sufficient to ensure the correct functioning of the service.
4. A regular dosimeter acquisition is performed directly from the supplier. The last one was in 2012 and the requested number (100) is insufficient ensure the maximum coverage of workers to be monitored.

MANAGEMENT OF THE MONITORING PROGRAMME

Administrative management

1. The dosimetry Section provides dosimeters to the subscriber further to the inspection staff of the regulatory body (TAEC). It seems to be difficult to update the list of workers to be monitored in the absence of the inspection.
2. The Dosimetry section has some organisational document for the management of the monitoring service, like the dosimeter request by the customer, the returned dosimeters, lost dosimeters.

3. It seems that the dosimetry service and hence the charge of lost dosimeters are provided without a contract between the Dosimetry Section and the subscriber. A general letter with minor instructions on how to wear and when to return the dosimeters is addressed to the customer
4. No customer information on the monitoring programme and on the technical specifications (document, flyers, note,…) is available to the subscriber.
5. The Dosimetry Section has established a list of the subscribing institutions to facilitate the dispatching of dosimeters by post. An excel sheet was also used for the management of the dispatched and the returned dosimeters.
6. No documentation on the organisation and the management of the monitoring service.
7. No documentation or customer information about the charges of subscribing and lost dosimeters according to national regulation.

Technical management

1. Monitoring of external radiation is done by measurement of exposure to photons to the whole body. No well documented information on the performance of the dosimetry system used
2. No beta radiation monitoring is performed
3. No extremity monitoring is performed
4. Calibration of the dosimetric system is provided by the NCL complying with the relevant standards (ISO 4037 and SR-16)
5. The dosimetric quantities for monitoring external radiation doses as recommended in RS-G-1.3 are used for calibration and reporting.
6. No written document on dose assessment procedure. Fading correction and background estimation are planned to be performed.
7. There are neither type testing nor performance test results available. No information is available on the verification of dosimeters, validation and uncertainty of the dosimetric system.
8. Reference levels are established for the Dosimetry Section.
9. The identification of dosimeters could lead to some errors as the labelling is realized manually by the subscriber (or the RPO) with the specification of the name and the number of dosimeter. The corresponding document is thereafter filled and returned to the Dosimetry Section for dose assessment.
10. The frequency is not respected (1 month for radiotherapy, Nuclear Medicine, NDT and 3 months for the others). Generally one to two dosimeters dispatching per year noticed in some dose reports.
11. The Dosimetry Section has no formal approval for record keeping service. Nevertheless the section keeps the records. Moreover, the transfer of records from the reader to the computer is done manually and does not prevent the potential modification of the records.
12. The backup system was not adapted and the access to the section documents (administrative and technical) was difficult.
13. No structured software used for the Dose Management System of the monitored workers, but just a simple excel file with manual actions leading to eventual errors.
14. Quality Management System is not in place at the service.
15. The Dosimetry Section participated to the inter-comparison of Hp(10) organized by IAEA on the project RAF9043. The results are satisfactory and confirm the reliability of the reported doses.

16. It seems that serious gaps exist in the treatment of an overexposure by the Dosimetry Section:
    - No systematic detection of readings corresponding to doses higher that the investigation level (eg. warning, marks,..)
    - If the overexposure is detected, second detector reading is performed and a formal letter is written to the licensee
    - No special register for overexposures
    - No confirmation on the receipt of the letter by the licensee
    - The licensee is requested to give information to help in the assessment of the dose (working habit, TLD storage,..), in one week by phone, email or fax
    - It seems that the dose corresponding to an overexposure is systematically recorded and archived as received dose.
    - no evidence on follow up for overexposure is provided.
    - No documented procedure in the service on the treatment of an overexposure.
    - Regulatory insufficiencies were found regarding the worker overexposure in part IX of the Atomic Energy Act of 2003 (warning to individual who have been or likely to be subject to overexposure)
17. The ORPAS expert performed an exercise of data retrieval, starting from the dose report sent to customer back to the dosimeter readout. It was difficult to retrieve data by the staff.

CONCLUSIONS

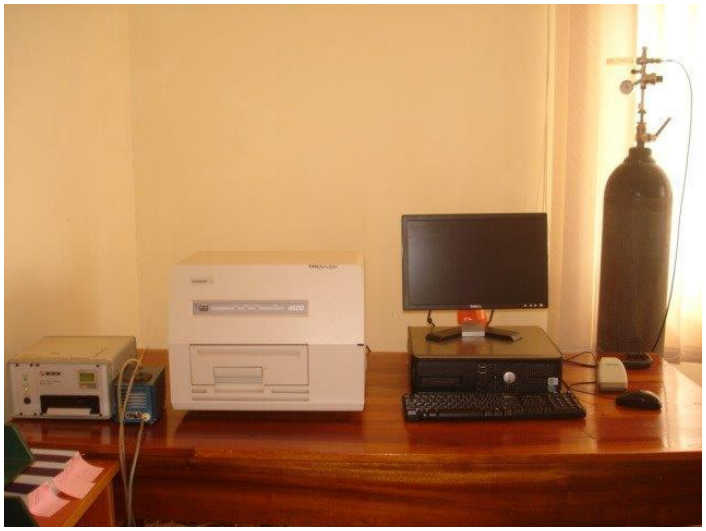
1. The human resources at Dosimetry Section are qualified but the staff is not sufficient to fulfil the need for monitoring all the occupationally exposed workers of the country.
2. The current system of individual monitoring for external dosimetry does not fully comply with the IAEA Safety Guide RS-G-1.3.
3. The equipment is not adapted for the number of workers to be monitored.
4. The manual DMS and the manual reader do not prevent the potential human errors.
5. The structure of the Laboratory is insufficient for all the activities of an individual monitoring service (one room).
6. The intercomparison results guarantee the reliability for the technical assessment of the personal dosimetry for the quantity Hp(10).
7. Nevertheless the administrative management of the monitoring programme does not fully comply with the IAEA Safety Guide 1-3.
8. No Quality Management System in place.

RECOMMENDATIONS

Important

1. The Quality Management System should be established and based on ISO 17025.
2. Procedures for type testing and performance testing should be implemented.
3. Participation in international inter-comparisons particularly for laboratories providing measurement services should be encouraged.
4. The Service should develop a formal monitoring programme/information to subscriber. The plan should cover all types of monitoring, frequency, quantities, location, equipment, reporting, investigation arrangement, etc.
5. The Dosimetry Section should review the overexposure investigation, follow up and process in the service.

6. The Dosimetry Section is encouraged to reach the customer to have an updated list of workers needing an individual monitoring, independently from the inspection of the regulatory body.
7. The implementation of an automated DMS
8. Training of the staff in quality assurance and type testing



Recommendations to the TAEC

1. The TEAC should strengthen the staffing of the Dosimetry Section to cover all the occupationally exposed workers of the country.
2. The TEAC should strengthen the capacity building of the Dosimetry Section by the renewal of dosimetry equipment: automated readers automated DMS, installation of Nitrogen (if needed) and a convenient number of dosimeters.
3. The TEAC should also strengthen the building of the Dosimetry Section, with an adapted structure for technical, administrative, documentation and archiving areas.
4. The TAEC should review the overexposure process and follow up in regulation.
5. The TAEC should establish appropriate mechanisms for approving the external dosimetry and the record keeping.
6. TAEC should make arrangements for the establishment of a National Dose Registry.

Advised

1. The Dosimetry Section may develop arrangements for extremity and eye lens dose measurements.

Good practice

1. Calibration is done routinely and the irradiation is carried out by the NCL.
2. good ‘housekeeping’ throughout the Dosimetry Section presented a very good impression of the general management of the service

APPENDIX IX– MAINTENANCE SECTION

TAEC

Facilities and services: Maintenance Section – TAEC
Location: Arusha
Mission date: 13 August 2014
ORPAS Team: Jizeng MA
Report prepared by: Jizeng MA
People met: Fadhlili Bakari Msumali

APPRAISAL FINDINGS

1. There is a Nuclear Instrument Maintenance Section under the Nuclear Technology department, TAEC.
2. The section was established in 1987. Currently there are 9 staff there.
3. The section provides services for the maintenance for the radiation equipment in the laboratories of TAEC, in hospital and in industry. Radiation protection equipment maintenance is also included in the services
4. The maintenance service has not been authorized from the national authority.
5. The task is included into the job description
6. Staff qualification: electronics or electrical engineering Bachelor degree with special training on nuclear instrumentation through internal and external training.
7. Receive IAEA fellows from foreign countries.
8. Staff from the Maintenance section was sent by IAEA as experts to provide assistance to some other Member States.
9. The maintenance services are provided upon the requests from the costumers. By telephone and email but no formal contract or IOM for both the outside and inside customers.

Conclusions

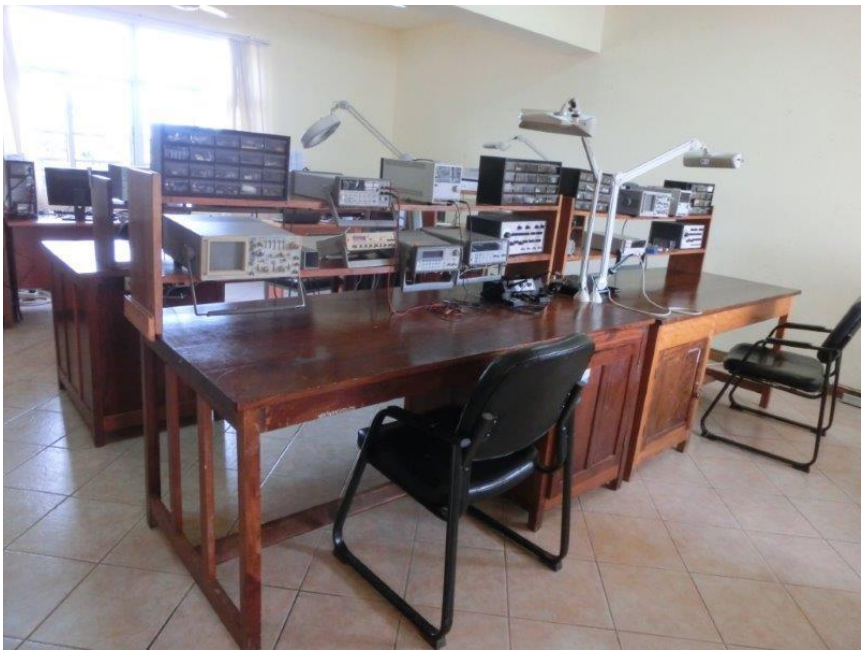
Very effective maintenance service can be provided in the country due to the qualified expert and well trained staff.

Recommendation

- Quality management system regarding the maintenance service including the document keeping needs to be strengthened.

- Maintenance service should be authorized by the national authority.

- Provision of continuously training for the Staff in the maintenance group to cope with the rapid development of the technology on nuclear instrument



APPENDIX X– NATIONAL CALIBRATION LABORATORY

SSDL - TAEC

Facilities and services:	National Calibration Laboratory – TAEC
Location:	Arusha
Mission date:	14 August 2014
ORPAS Team:	Latifa BENOMRANE, Abdelkader BENIDER ,Wilbroad Muhogora, Jizeng MA
Report prepared by:	Abdelkader BENIDER
People met:	Dennis Mwalongo

GENERAL INFORMATION

The National Calibration Laboratory (NCL) is a member of the IAEA/WHO Network of Secondary Standard Dosimetry Laboratories and has the following equipment:

- Co-60; Cs-137 and X ray Generator;
- Ionizing chambers for radiation protection levels : 1000cc; 600cc, 500cc with their dosimeters;
- Ionizing chambers for radiotherapy levels : 0,30cc and 60cc with their dosimeters
- Check sources for control of ionizing chambers;
- Barometers, thermometers;
- ISO water slab phantom and pillar phantom, and ISO PMMA rod phantom

The NCL was established to perform the calibration of photon radiation fields and instruments in terms of dose equivalent quantities: Area dosimeters or dose ratemeters in terms of the ambient dose equivalent, *H*(10),* or the directional dose equivalent, *H'(0.07) and* individual dosimeters or dose ratemeters in terms of Hp(10) and Hp(0.07).

APPRAISAL FINDINGS

APPRAISAL FINDINGS RELATED TO THE NCL AS END USER

1. The NCL has 2 calibration units with radioactive sources and an X-ray generator, but no evidence could be shown on the license. It seems that the Laboratory has an import license and not an authorization for using the sources. The Regulatory body is exempted.
2. It appears that the measures to ensure the safe management of and control over the radioactive sources; to keep radioactive sources under control so as to prevent loss or damage and to prevent any unauthorized person were in place but the written documents related to these measures were not provided.

3. A documented Radiation Protection Programme, describing the responsibilities, together with prior radiological evaluations (risk assessments) of the potential radiation doses and risks to staff, and of the required shielding for the walls and doors of the radiation facilities, were not provided (IAEA 1991). Many protection measures related to safety and security of radioactive sources were implemented, but need to be updated. There are good practices and safety measures and the staff is aware of radiation risk.
4. A radiological evaluation and risk assessment with shielding calculation should be approved by the regulatory body before the building of the new SSDL in TAEC.
5. Controlled and Supervised Areas were found to have been designated. The NCL established the radiation safety with specific information and local rules but it needs to be updated and to include the provision of administrative controls
6. The workplace monitoring programme including regulatory requirements for assessment of radiation safety during normal and emergency situations was not provided.
7. Staff was monitored using TLD dosimeters provided by the Radiation Protection Services of Tanzania Atomic Energy Commission in accordance with the national regulations. The Radiation Safety Procedures includes reference levels and associated actions for each separate dosimeter result but the action to be taken in the event that a dosimeter result is lost was not documented.
8. The NCL has a qualified staff aware of radiation risk and had specific radiation safety training, especially with the participation to the IAEA's technical cooperation programme.
9. The NCL receive the trainers for fellowship or for training course but the measures established on the Radiation Safety Procedures in the dosimetry laboratory need to be updated to include a clear allocation and documentation of the responsibilities or local rules to ensure the safety of students and visitors.
10. The Radiation Safety Procedures contains the emergency arrangements but there is no communication system as Tel/fax/Email.
11. There were no written arrangements in place to ensure that necessary health surveillance and health services are provided to assess initial and continuing fitness of workers occupationally exposed to ionising radiation and for the situations in which workers might be overexposed.

APPRAISAL FINDINGS RELATED TO THE TECHNICAL SERVICE PROVIDER

1. The NCL has a qualified staff and is capable of performing calibrations in terms of the ICRU operational quantities according to the national regulation requirements (the licensee should calibrate once a year their radiameters).
2. The NCL didn't have accreditation certificate to perform this service (formal approval).
3. The NCL has only one qualified and trained professional working part time. In practice they calibrate about 70 instruments per year and several personal dosimeters (TLD) including also the equipment received from outside of Tanzania.
4. The organization of the service is well performed between the customer and the NCL:
    - Fax, email, tel asking for the service
    - Proforma invoice
    - Ship to TAEC
    - Fill the form
    - Proceed to calibration
    - Fill form with results
    - Certificate

- Charge
- Send back to customer

However, the management system was not documented.

5. The administrative procedure for the management of the service is performed at the TAEC. It was difficult to access to some document (maintain of records, software, forms, customer details, working documents,) at the NCL.
6. Only perpendicular irradiations with the Cs-137 source are done. No angular irradiations are established thus limiting the range of performance testing for radiameters and dosimeters.
7. The X-ray generator was out of work and the Co-60 was decreased, so the test of energy response is not available.
8. Calibration of radiation protection instruments for beta and neutron radiation is not available.
9. Calibration of radiation protection instruments for surface contamination is not available.
10. The calibration reports establish by the NCL include the traceability and the calibration procedures with the Uncertainties in Measurements (good reports) but the certificates need to be reviewed and updated in compliance with the international standards *(indication of details of reference sources and reference instruments used; Standard test conditions, reference conditions, etc. These information need to be included in the certificates)*
11. There was no evidence of documented quality assurance programme or quality management system in place. Furthermore, only the quality control testing was being carried out on radiation equipment (Cs-137 source).
12. The NCL participate to the IAEA/WHO TLD postal dose quality Audit Service for SSDL, for radiotherapy-level dosimetry (run of 2011).
13. The NCL participate to the IAEA's inter-comparison of air kerma (Cs-137) which is periodically organized by the Laboratory of Seibersdorf for the SSDL's network (no evidence).

CONCLUSIONS

1. Most of measures related to radiation safety and security of radioactive sources were implemented in the NCL to ensure the radiation protection of workers and the security of radioactive sources but there were no written programme of radiation protection and safety for both normal operation and emergency situations to comply with the national regulations and international standards. The Radiation Safety Officer plays an important role in the development and implementation of the programme.

2. The human resources at NCL are qualified but not sufficient to fulfil the need for calibration services in the country.

3. The management of the NCL is not optimized as the administrative issues are provided at TAEC and technical procedures at NCL.

4. NCL calibration procedures fully comply with IAEA and international standards. Traceability to the national reference instruments and to the international metrology system is established and in line with ISO4037-1, 2 and 3 and IAEA SR-16.

5. NCL calibration procedures guarantee reliability for the personal dosimetry and radiation protection measurements done by end-users.

6. Nevertheless no angular irradiations and no energy response are established for the existing radiation qualities. Verification of surface contamination monitors is not available, nor is irradiation to beta or neutron fields in place, thus limiting the range of performance testing for equipment and dosimeters.

7. No Quality Management System in place.

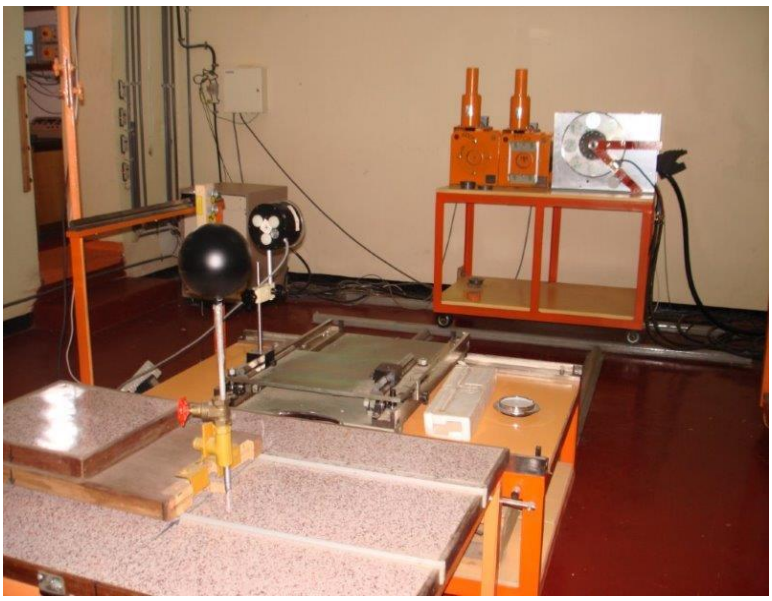
RECOMMENDATIONS

Important

1. It is recommended to establish and to implement an appropriate written programmes and measures on radiation protection and safety for both normal operation and emergency situations, including workplace monitoring to comply with national regulations and international standards.
2. The Quality Management System should be established and based on ISO 17025.
3. Calibrations certificate need to be updated including validation, traceability and a statement on uncertainties.
4. Procedures for angular irradiations should be implemented to allow for performance testing for equipment and dosimeters.
5. Reference X-ray Generator should be repaired and procedures established for the calibration of radiation protection instruments for energy responses.
6. Reference Co-60 radioactive source should be changed and procedures established for the calibration of radiation protection instruments for energy responses.
7. Reference planar sources should be purchased and procedures established for the calibration of radiation protection instruments for surface contamination.
8. Reference sources for beta radiations should be purchased and procedures established for the calibration of personal dosimeters and radiation protection instruments.
9. Participation in national and international inter-comparisons particularly for laboratories providing measurement services should be encouraged.

Recommendations to the TAEC

10. The TEAC should strengthen the staffing of the NCL to cover all calibrations and verification needs.
11. The TEAC should established appropriate mechanisms for approving the calibration/testing for radiation protection; and record keeping.
12. The TAEA is encouraged to accelerate the building of new laboratories for the future SSDL covering all calibration needs. The new facility should be approved and licensed by the Regulatory Body.



APPENDIX XI– TRAINING SERVIC ON OCCUPATIONAL RADIATION PROTECTION - TAEC

Facilities and services:	Training Service – TAEC
Location:	Arusha
Mission date:	14 August 2014
ORPAS Team:	Latifa BENOMRANE, Abdelkader BENIDER ,Wilbroad Muhogora, Jizeng MA
Report prepared by:	Jizeng MA
People met:	Lazaro Meza

APPRAISAL FINDINGS

1. Training on RPO and workers is included in the regulation of radiation protection.
2. The Coordination and Information Section is responsible for the training; the section is under the Coordination and Technical Services Division, Nuclear Technology Department, TAEC.
3. Training courses on RPOs are organized regularly by the training section of TAEC
4. TAEC assigns specific staff to take the responsibility for organizing the training.
5. The venue for the training is either one of the hotels in Arusha or at the premises of TAEC .
6. Most of the lecturers are from TAEC, depending on the topics, lecturers are also possible to be invited from outside mainly from IAEA.
7. A certificate is delivered to the participants after the training.
8. TAEC joins the working group on training under the umbrella of Forum of Nuclear Regulatory Bodies in Africa (FNRBA).
9. The training service has not been authorized from the national authority.

Conclusion

A training service system on radiation protection is existing. Regular training services are provided to the RSOs.

Further improvement on the quality of the training service is needed.

Recommendation

- Training for RSO should be strengthened.
- Quality management system of the training service should be improved. The lecturers should have qualification certificate delivered from the regulatory body. The training material should be developed.
- Training service should be authorized by the national authority

ANNEX I: REFERENCES

— Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (IAEA General Safety Requirements Part 3 No. GSR Part 3, 2014);

— Occupational Radiation Protection (IAEA Safety Standards Series No. RS-G-1.1, 1999);

— Assessment of Occupational Exposure due to Intakes of Radionuclides (IAEA Safety Standards Series No. RS-G-1.2, 1999);

— Assessment of Occupational Exposure due to External Sources of Radiation (IAEA Safety Standards Series No. RS-G-1.3, 1999);

— Calibration of Radiation Protection Monitoring Instruments – Safety Reports Series No. 16, STI/PUB/1074, ISBN 92-0-100100-2; Vienna: IAEA, 1999.

— The Management System for Technical Services in Radiation Safety (IAEA Safety Standards Series No. GS-G-3.2, 2008);

— IAEA-Safety Reports Series No. 38 : Applying Radiation Safety Standards in Radiotherapy ;

— Occupational Radiation Protection (IAEA Draft Safety Standards DS453, 2015).

ANNEX II: MISSION PROGRAMME

Occupational Radiation Protection Appraisals Mission
UNITED REPUBLIC OF TANZANIA
11 – 15 August 2014

Place	Facilities	Days
Dar Es Salam	Arrival	
Dar Es Salam	Initial team briefing	Sunday 10th , pm
Dar Es Salam	- Ocean Road Cancer Institute (public)	Monday 11th
Dar Es Salam	- Nuhimbili National Hospital (public) - Tanzanian Steel Pipes (private)	Tuesday 12th
Transportation from Dar Es Salam to Arusha		Tuesday 12th evening
Arusha	- Radiology department (private) - Radiology department (public) - Dosimetry Section (TAEC) - Maintenance Section (TAEC)	Wednesday 13th
Arusha	- National Calibration Laboratory (SSDL) (TAEC) - Training (TAEC)	Thursday 14th
Arusha	Report preparation	Thursday 14th pm, Friday 15th am
Arusha	Exit Meeting	Friday 15th pm
Arusha	departure	

ANNEX III: LIST OF PARTICIPANTS

Name	Function	Organisation
Mr. Jumaa Dachi Kisukari	Medical Physicist radiotherapy	ORCI
Mr. Shaid Yusuf	Medical Physicist radiotherapy	ORCI
Mr. Tegemea Kalolo	Medical Physicist NM	ORCI
Pr. Julus Mwaisilege	Manager Public Health Biomedical	ORCI
Ms. Anna M. Muslumbu	RSO	ORCI
Dr Lulu Sahap	Radiologist Manager (Nuclear Medicine Physician	ORCI
Mr. Kalolo Tegemea	Medical Physics (Nuclear Medicine)	ORCI
Mr. Athuman Khalib	Quality Control Officer	Tanzania Steel Pipes
Mr. Fesio Temba	RSO	Tanzania Steel Pipes
Mr. Elly Bohella	Human Resource Officer	Tanzania Steel Pipes
Dr Peter R. Kisenge	Cardiologist	Nuhimbili National Hospital
Mr. Ramdhani Selemani	Senior Support technique	Nuhimbili National Hospital
Mr. Samuel Kimrou	Radiographer and Radiation Safety Officer	Nuhimbili National Hospital
Wilbard R. Siamga	Biomedical Technologist	Nuhimbili National Hospital
Dr Musa Ndukeke	Acting Head of Department	Nuhimbili National Hospital
Mr. Lwidiko Mbembati	Assistant, Head Radiographer/Assistant RSO	Nuhimbili National Hospital
Dr Isaac N. Mollel	Head of Department	Arusha Lutheran Medical Centre
Mr. Abel R. Nkya	Acting Head Radiographer, Acting RSO	Arusha Lutheran Medical Centre
Mr. Dennis Mwalongo	NCL (SSDL) and Dosimetry Section	TAEC
Ms. Sarah Lema	Dosimetry Section	TAEC
Mr. Fadhlili Bakari Msumali	Nuclear Instrumentation Technician	TAEC
Mr. Lazaro Meza	Coordination and Information Unit	TAEC