INTERNATIONAL ATOMIC ENERGY AGENCY

OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE (ORPAS)

MISSION TO SRI LANKA

24 November – 2 December 2019
OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE (ORPAS)

REPORT TO SRI LANKA

INTERNATIONAL ATOMIC ENERGY AGENCY
ORIGINAL: ENGLISH

Mission date: 24 November - 2 December 2019
Location: Colombo / Sri Lanka

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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 host country.

Comparisons of such numbers between ORPAS reports from different countries should not be attempted.
EXECUTIVE SUMMARY

At the request of the Government of Sri Lanka through the Sri Lanka Atomic Energy Board (SLAEB) addressed to the International Atomic Energy Agency (IAEA) to conduct an Occupational Radiation Protection Appraisal Services (ORPAS) mission dated as 14 March 2019, the Agency organised the ORPAS review mission in Sri Lanka from 24 November to 2 December 2019 with a team of eight international experts that includes a Team Leader and an Agency Coordinator. The Sri Lanka Atomic Energy Board (SLAEB) 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 Sri Lanka. Prior to this mission, a preparatory meeting was conducted from 16 to 18 July 2019 in Colombo to determine the participating organizations (National Counterparts), to introduce and agree on 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 National Counterparts that participated in the ORPAS mission were the following:

REGULATORY BODY
– Sri Lanka Atomic Energy Regulatory Council

TECHNICAL SERVICE PROVIDERS
– Sri Lanka Atomic Energy Board
  o Personal Monitoring Services Laboratory
  o Secondary Standards Dosimetry Laboratory
  o Radiation Protection and Technical Services Division

OPERATORS
– Lanka Hospitals (Pvt) Ltd.
– Ceylinco Healthcare Services Ltd.
– National Hospital of Sri Lanka - Colombo
– National Centre for Non-Destructive Testing and the National Certification Body for Non-Destructive Testing
– Sri Lanka Gamma Centre
– Ceylon Petroleum Corporation
– Sri Lanka Atomic Energy Board, Central Disused Radioactive Source Storage Facility
– Lanka Mineral Sands Ltd. and Pulmudai Mineral Sand Factory

RESEARCH AND EDUCATION INSTITUTION
– Department of Nuclear Science, University of Colombo

The ORPAS mission compared Sri Lanka’s arrangements for occupational radiation protection against the IAEA Safety standards as the international benchmark for protection and safety of workers. The mission was also used to exchange information and experience between the team members and official national counterparts. The SLAEB 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, suggestions, and good practices identified during the mission conducted from 24 November to 2 December 2019. Detailed findings for individual organisations are provided in the Appendices.

In general, the occupational exposure control regime is covered in the regulatory framework of Sri Lanka. The framework is embodied in law and subsequent regulations, orders and rules. The Sri Lanka Atomic Energy Act, No. 40 of 2014 clearly identifies the independent regulator and the technical service provider and details their objectives, duties and powers. Furthermore, the Act includes all the necessary provisions for licensing, control and radiation protection of workers which is far more detail than is usually incorporated in such Acts.

The ORPAS team notes that the Sri Lanka Atomic Energy Regulatory Council (SLAERC) intends to replace the current regulations, which are based on the previous version of GSR Part 3 (BSS 115, 1996), with modern regulations based on the current requirements on occupational exposure control of GSR Part 3 for planned exposure situations. The draft Regulations should be published as soon as possible and cover all exposure situations (planned exposure situation, existing exposure situations and emergency situations) with provisions for a radiation protection programme (RPP) including radiation protection of itinerant workers. However, the ORPAS team is impressed with the request of the Government of Sri Lanka for ORPAS such a short time after the establishment of the SLAERC.

The ORPAS team also notes that the Act empowers the SLAERC and SLAEB to perform some of the same functions, which may lead to duplication and inefficiency in coordination, cooperation and consultation.

The ORPAS Team notes that SLAERC has limited resources and recommends that it limits its activities to regulatory functions and allocate its resources in accordance with a graded approach. It should also be noted proper implementation of regulations and guidance can only be achieved by qualified and competent staff.

In general, regulations should be supported by regulatory guidance materials and authorized facilities would benefit from guidance from SLAERC to properly implement the regulations, e.g. guidance on the establishment and maintenance of the RPP by the employers, registrants and licensees, harmonization of health surveillance program of workers, and establishment of dose constraints.

It is observed that SLAERC concentrates on the regulation of artificial sources and authorization of individuals. However, the overall arrangement for the control of occupational exposure requires oversight of occupational doses from all exposure situations, which can only be provided through a national dose registry. SLAERC should consider the necessary arrangements for the establishment and maintenance of a national dose registry.

Stakeholder involvement is paramount for any regulatory activity and SLAERC should establish mechanisms for the necessary consultation, cooperation and coordination with relevant entities.

The ORPAS team notes that Sri Lanka has limited resources available for training for radiation protection and suggests that SLAERC and the SLAEB should consider cooperating to ensure
that limited resources are used effectively and efficiently to ensure employers have sufficient access to radiation protection training services.

The Sri Lanka Atomic Energy Act, No. 40 of 2014, specifically empowers the SLAEB to provide radiation protection services, dosimetry services and calibration services. Therefore, SLAERC should authorize SLAEB as a technical service provider for calibration, workplace monitoring and individual monitoring to ensure that SLAEB has complied with the requirements stated in the Act and the Regulations.

The SLAEB is accredited according to IEC/ISO 17025:2005 to provide dosimetry services and calibration services and is well equipped to provide such services. SLAEB is also capable of providing workplace monitoring and radiation protection training services.

The ORPAS team recommends that the SLAEB pursues recognition as the national laboratory for ionising radiation metrology and that it retains personal dose records for the period recommended in GSR Part-3.

The SLAERC should recommend the calibration period for all workplace monitoring instruments.

In order to improve its services, SLAEB is encouraged to change its monitor (dosimeters) distribution paperwork to ensure that the Radiation Protection Officer (RPO) accepts responsibility for correctly distributing the monitors to the workers. In addition, the SLAEB should consider changing its charging policy to remove the financial disincentive for government hospitals to monitor workers. Treating all users equally would also enable more efficient use of the limited stock of TLD cards available. The SLAEB should consider reporting the Hp (0.07) dose recorded on each monitor. The SLAEB should consider implementing extremity monitoring and internal dose monitoring for workers.

As a general principle, the employers, registrants and licensees and SLAERC should ensure that a safety assessment is conducted as the basis for the establishment of the RPP in the respective facilities. The RPP should include the necessary arrangements for the control, monitoring and recording of occupational exposures.

The license holders should make arrangement to define the boundaries of classified areas, taking into account the magnitude of the exposures expected in normal operation, the likelihood and magnitude of exposures in anticipated operational occurrences and in accident conditions, and the type and extent of the procedures required for protection and safety.

It is observed that all hospitals are licensed to use radiation sources by SLAERC. The license holders should provide internal dosimetry, double dosimeter and extremity monitoring to the relevant workers depending on the exposure pathway.

The employers, registrants and licensees should provide appropriate training in protection and safety, including emergency response arrangement with a primary focus on emergency worker
protection, as well as periodic retraining as required to ensure the necessary level of competence.

Furthermore, to improve their practice, nuclear medicine departments should consider using portable protective shields that would protect staff from radiation exposure following application of radiopharmaceuticals to patients.

In Sri Lanka, non-destructive testing (NDT) training and certification is based on international standards, which include training on radiation protection.

To improve worker protection, NDT license holders should:
- review the design of the shielded enclosure;
- include rehearsal of emergency plans and refresher training in their training programme;
- provide direct reading doseimeters (active / alarm personal dosimeters) to all radiographers and assistants;
- implement an inspection and maintenance programme.

The ORPAS team acknowledges a significant achievement has been made by the establishment of independent regulatory authority in Sri Lanka, empowered single technical service provider for dosimetry services and calibrations, but recognizes there remains considerable work ahead to develop the national occupational radiation protection programme.

A press release was issued after completion of the mission.
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1. INTRODUCTION

1.1 BACKGROUND

The IAEA Occupational Radiation Protection Appraisal Service (ORPAS) has been established to advise Member States on ways to strengthen and enhance the legislative and regulatory infrastructure for occupational exposure control, technical services relating to protection and safety, such as services for personal dosimetry and the calibration of monitoring and measuring equipment, and practical implementation of Member State’s occupational radiation protection (ORP) programme. The ORPAS is appropriate for all types of facilities and activities, and the process has been designed to cover technical service providers (technical support services or organisations) for protection and safety in respect to the assessment of occupational exposure from external sources of radiation and due to the intake of radionuclides, which includes individual monitoring, as well as workplace monitoring, education and training services for Radiation Protection Officers and advisory services for radiation protection. ORPAS promotes self-assessment, building radiation safety culture and establishment of quality systems at facilities and activities.

The IAEA Fundamental Safety Principles provide the basis for IAEA safety standards and safety related programmes. The IAEA has established safety standards in the area of the Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, GSR Part 3. Review against these particular safety standards is the core component of the ORPAS process.

Other requirements such as Governmental, Legal and Regulatory Framework for Safety, GSR Part 1 (Rev. 1), Leadership and Management for Safety, GSR Part 2 and Safety Assessment for Facilities and Activities, GSR Part 4 are also used in ORPAS review in order to cover all facilities and activities with clear links to control of occupational exposure.

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

The scope of the ORPAS includes regulatory body, functional technical service providers and operators. The appraisal is based on international standards and takes into account the specific conditions in the requesting member state. It also identifies specific national strengths, such as
good practices in occupational radiation protection, that could be shared with other Member States.

During an ORPAS mission, recommendations and suggestions may be offered to the host country. Recommendations are related to items of direct relevance to safety as referenced in IAEA Safety Requirements; Suggestions relate to items which, whilst not essential to ensure compatibility with IAEA Requirements for occupational exposure control, may enhance the effectiveness of the national occupational radiation protection programme against the guidance presented in IAEA General Safety Guide on Occupational Radiation Protection, GSG-7. Good Practices may also be documented for consideration by other Member States.

1.4 STRUCTURE

This report consists of four chapters of main text, supported by thirteen Appendices that mostly provide the detailed findings of the mission and five Annexes.
2. OCCUPATIONAL RADIATION PROTECTION APPRAISAL

2.1 OBJECTIVES

The general objectives of an ORPAS mission are to enhance ORP programme effectiveness by:

a) Providing an opportunity for continuous improvement of the ORP programme through an integrated process of self-assessment and review;

b) Determining whether the host country has made adequate arrangements for ORP and whether these arrangements are functioning to the extent that the practical provisions for ORP are effective and generally optimized;

c) Providing the host country (regulatory body, technical service providers and operators) with an objective evaluation of its ORP programme with respect to IAEA safety standards;

d) Providing key staff in the host country with an opportunity to discuss regulatory practices on occupational exposure control with ORPAS Reviewers who have experience of other regulatory practices in the same field;

e) Providing key staff in the host country with an opportunity to discuss occupational exposure monitoring practices with ORPAS Reviewers who have experience of monitoring modalities in the same field;

f) Providing key staff in the host country with an opportunity to discuss arrangements under the radiation protection programme and operational experiences with ORPAS Reviewers who have experience in the same field;

g) Providing the host country with recommendations and suggestions for improvement;

h) Promoting the sharing of experience and exchange of lessons learned among senior experts;

i) Providing other States with information regarding good practices identified in the course of the review;

j) Providing ORPAS Reviewers from Member States and IAEA staff with opportunities to observe different approaches to occupational exposure control, monitoring and recording and to broaden their own experience (mutual learning process);

k) Contributing to the harmonization of approaches on occupational exposure control, monitoring and recording among States;

l) Promoting the application of IAEA safety standards;

m) Providing feedback on the use and application of IAEA safety standards.

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 Government of Sri Lanka 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;
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 Safety Requirement and Guides (extended list of IAEA safety standards used in this particular mission is given in Annex-I):

- Fundamental Safety Principles, Safety Standards Series No. SF-1, IAEA, Vienna (2006);
- Governmental, Legal and Regulatory Framework for Safety, IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), IAEA, Vienna (2016);
- Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014);
- Safety Assessment for Facilities and Activities, IAEA Safety Standards Series No. GSR Part 4 (Rev. 1), IAEA, Vienna (2016);

2.3 RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

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

The appraisal team considered the actual or potential consequences arising from each identified area of limited effectiveness and have reflected this in the prioritization of the associated recommendations. Recommendations are related to items of direct relevance to safety as referenced in IAEA Safety Requirements (e.g., GSR Part 3); Suggestions relate to items which, whilst not essential to ensure compatibility with IAEA Requirements for occupational exposure control, may enhance the effectiveness of the national occupational radiation protection programme against the guidance presented in IAEA General Safety Guide on Occupational Radiation Protection, GSG-7.

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 aspects that are representative of good practice(s) in particular areas.

In this context, good practice was considered to be an approach, methodology or system which, within the framework of the overall Radiation Protection Programme for occupational exposure, was highly likely to achieve the required objective.
3. APPRAISAL PROCEDURE

3.1 THE REQUEST OF SRI LANKA GOVERNMENT AND RESPONSE

The Government of Sri Lanka through the Sri Lanka Atomic Energy Board (SLAEB) requested the IAEA’s assistance to enhance the effectiveness of national occupational radiation programme with the implementation of an IAEA Occupational Radiation Protection Appraisal Service (ORPAS) mission on 14 March 2019.

3.2 PREPARATORY MEETING AND OUTCOMES

A preparatory meeting for ORPAS was conducted from 16 to 18 July 2019 by Mr. Stephen Long (ARPANSA, Australia) as the ORPAS Team Leader and Mr. H. Burçin Okyar, IAEA Division of Radiation, Transport and Waste Safety as the IAEA Coordinator for the mission (for agenda, see Annex-II). The preparatory meeting was supported by an IAEA Regional Technical-Co-operation Project on “Enhancing National Capabilities on Occupational Radiation Protection in Compliance with Requirements of the New International Basic Safety Standards (RAS/9/080)”.

Discussions and visits were made to:
- Sri Lanka Atomic Energy Regulatory Council;
- Sri Lanka Atomic Energy Board, Personal Monitoring Services Laboratory;
- Sri Lanka Atomic Energy Board, Secondary Standard Dosimetry Laboratory;
- Lanka Hospitals (Pvt) - Department of Radiology;
- Ceylinco Healthcare Services Ltd.;
- Sri Lanka Gamma Centre;
- National Centre for Non-Destructive Testing, National Certification Body for NDT.

The scope of the visits was to:
- Present the background, purpose and procedures of the ORPAS mission;
- Emphasise the self-assessment nature of the process;
- Present and explain the use of the questionnaires as well as supply the relevant set of questionnaires that need to be completed by the organisation or service provider;
- Identify the program timescales;
- View the facilities to obtain a preliminary understanding of their operations;
- Agree and sign the Terms of References of the mission (Annex-III).

The duration of the main (full) mission was set at 8 working days, and prior to the full mission, arrangements were made to provide each participating organization in Sri Lanka with copies of ORPAS questionnaires that were relevant to their participation. It was intended that participating organizations should complete their questionnaires and return them to the IAEA by October 2019 so that briefing material could be prepared for the ORPAS reviewers.

3.3 AGREED SCOPE

During the preparatory meeting, it was agreed that the mission should involve appraisals of the regulatory authority, as well technical service providers and operators (i.e. users of ionizing radiation). A provisional list of organizations was drawn up and was subject to some modification prior to the mission.
3.4 ORPAS PREPARATORY MEETING CONCLUSIONS

The preparatory meeting conclusions are summarized below:

- Continued organisational commitment from SLAERC is appreciated and necessary for success;
- Strong cooperation between all national counterparts is necessary for successful mission, with coordination of SLAEB;
- Each candidate to prepare brief presentation for entrance meeting of full mission;
- SLAERC provides available version of the draft Regulations/Rules;
- Candidate’s documentation to be provided (particularly Radiation Protection Program);
- Changes between completion of questionnaires and full mission is expected;
- IAEA coordinator to invite experts from the region where possible;
- Possible logistics for travel to Base Hospital, Thelippalai, to be communicated with the IAEA coordinator as early as possible;
- Lanka Mineral Sand ltd. to be invited to attend entrance meeting and interview on the following day.

Below timeline was agreed for preparation and conduct of the full mission:

<table>
<thead>
<tr>
<th>Completion Date</th>
<th>Action</th>
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<tbody>
<tr>
<td>18 July 2019</td>
<td>o Agree proposed candidates and timeline</td>
</tr>
<tr>
<td></td>
<td>o Official invitation letters to participating organizations with timeline and ORPAS Qs</td>
</tr>
<tr>
<td>26 July 2019</td>
<td>Candidate organizations provide brief overview to SLAEB</td>
</tr>
<tr>
<td>31 July 2019</td>
<td>SLAEB provides organization overviews to IAEA</td>
</tr>
<tr>
<td>09 August 2019</td>
<td>Issue of pre-ORPAS report by the IAEA</td>
</tr>
<tr>
<td>August - September 2019</td>
<td>o IAEA organizes External ORPAS Reviewers</td>
</tr>
<tr>
<td></td>
<td>o Finalization of full mission agenda</td>
</tr>
<tr>
<td>11 October 2019</td>
<td>Organizations provide completed questionnaires to SLAEB</td>
</tr>
<tr>
<td>18 October 2019</td>
<td>o SLAEB provides reviewed questionnaires to IAEA</td>
</tr>
<tr>
<td></td>
<td>o IAEA distributes appropriate questionnaires to Reviewers</td>
</tr>
<tr>
<td>24 November - 02</td>
<td>ORPAS mission</td>
</tr>
<tr>
<td>December 2019</td>
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3.5 TEAM

It was decided that the scope and duration of the appraisal required a team of eight experts including the IAEA Coordinator, comprising of:

- an experienced specialist in occupational radiation protection to act as team leader;
- at least two experienced specialists on ORP in technical services;
- at least two experienced specialists on regulation of ORP and ORP in industrial processes involving Naturally Occurring Radioactive Material (NORM);
- at least one experienced specialist on ORP in medical applications;
- at least one experienced specialist on ORP in industrial applications.

Accordingly, the IAEA has selected the ORPAS Team for conducting the mission in Sri Lanka.
3.6 MISSION PLANNING

After receiving the relevant information and self-assessment by the National Counterpart, detailed planning for the mission by the Team Leader and the Coordinator was performed accordingly. This included:

- study of available and relevant background information and material;
- creation of a guidance document for Reviewers and for the National counterparts (including review of preliminary programme for the full mission);
- compilation of an information package that was sent to Reviewers (the IAEA’s cloud was used the primary platform for information exchange).

3.7 MISSION PROGRAMME

The preliminary programme required slight amendments and the programme given in Annex-IV was followed.

3.8 CONDUCT OF VISITS

It was agreed at the initial team meeting that visits should 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 reviewers had the opportunity to evaluate the pre-mission questionnaires provided by each participating organization. This was valuable in pre-mission aspects of each visit and concentrating on important issues. However, time was a limiting factor for practically all the visits. Visits included a tour of each facility to obtain a comprehensive understanding of the information being gathered.

It was noted that the briefing meeting organized on the first day of the mission had provided valuable introduction of the purpose and conduct of the appraisal to the participating organisations and relevant staff.

During each site visit, the opportunity was taken to collect 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;
- Radiation Protection Programme (its establishment and maintenance);
- Assessment of occupational exposure from external sources of radiation;
- Assessment of occupational exposure due to intakes of radionuclides;
- Workplace monitoring;
- Advisory services;
- Procedures for dosimetry laboratories such as calibration protocols;
- Annual or other reviews of occupational exposures;
- Results of proficiency tests or interlaboratory comparisons;
- Quality assurance and quality management documentation;
- Examples of optimization or “ALARA” studies, and local rules as a part of Radiation Protection Program review;
- Investigation reports on overexposures;
- Review of safety culture at facilities and activities.
3.9 REPORTING SCHEDULE

The following reporting schedule was agreed at the exit meeting:

<table>
<thead>
<tr>
<th>Action</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Editing by Team Leader</td>
<td>24 January 2020</td>
</tr>
<tr>
<td>Editing by IAEA Coordinator</td>
<td>7 February 2020</td>
</tr>
<tr>
<td>Review by Team</td>
<td>14 February 2020</td>
</tr>
<tr>
<td>Transmission to National Coordinator</td>
<td>20 February 2020</td>
</tr>
<tr>
<td>Review by National Coordinator</td>
<td>27 February 2020</td>
</tr>
<tr>
<td>Final Report Issued</td>
<td>2 March 2020</td>
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</table>
4. MISSION IN GENERAL AND MAIN FINDINGS

4.1 INITIAL TEAM MEETING AND TRAINING

The initial team was organized on 24 November 2019 to refresh understanding on ORPAS mission implementation and discuss on initial impressions and finding based on completed questionnaires.

4.2 ENTRANCE MEETING

The meeting was held on 25 November 2019 and attended by all the organizations that are involved in the mission, including:

- Sri Lanka Atomic Energy Regulatory Council (SLAERC);
- Sri Lanka Atomic Energy Board (SLAEB), Personal Monitoring Services Laboratory;
- Sri Lanka Atomic Energy Board, Secondary Standards Dosimetry Laboratory;
- Sri Lanka Atomic Energy Board, Radiation Protection and Technical Services Division;
- Lanka Hospitals (Pvt) Ltd.;
- Ceylinco Healthcare Services Ltd.;
- National Hospital of Sri Lanka;
- National Centre for Non-Destructive Testing and the National Certification Body for Non-Destructive Testing;
- Sri Lanka Gamma Centre;
- Ceylon Petroleum Corporation;
- Sri Lanka Atomic Energy Board, Central Disused Radioactive Source Storage Facility;
- Lanka Mineral Sands Ltd. and Pulmudai Mineral Sand Factory;
- Nuclear Science Department, University of Colombo;
- IAEA ORPAS team.

SLAERC, SLAEB representatives, the IAEA Coordinator and ORPAS Team Leader officially welcomed all participants followed by a self-introduction of the participants. Each member of the team provided a detailed self-introduction that gave overall adequacy and reputation of the ORPAS reviewers to the national counterparts. The team covered all the technical areas regulatory, technical service providers, industrial, and medical sectors.

The meeting consisted of following formal presentations:

- “ORPAS” within the framework of IAEA review missions and mission process by the IAEA Coordinator;
- Presentations by official national counterparts of ORPAS.

The first presentation by the IAEA Coordinator covered information on the Agency’s services for Member States in general, the ORPAS review process, details and findings of the preparatory meeting, introduction of the ORPAS Team and information on mission arrangements. In addition, the work plan of the entire week and details of the teams delegated for different site visits and other aspects of the mission were introduced. The presentations of official participants provided detailed information on organisational aspects for occupational
radiation protection and implementation of Radiation Protection Programmes in each organisation. These were followed by questions and an open discussion. The briefing meeting greatly facilitated the mission process and the programme was finalized.

4.3 APPRAISAL AT NATIONAL COUNTERPARTS

The ORPAS Team conducted the appraisal at the sites of above-mentioned organisations, the Lanka Mineral Sands Ltd. and Pulmudai Mineral Sand Factory for which the interview was conducted at the premises of SLAERC. Details of the observations and recommendations of the appraisal conducted at these facilities are provided in Appendices 1 to 13. Major recommendations (R), suggestions (S) and good practices (GP) identified during the mission are given in this chapter.

4.4 ORPAS MAIN FINDINGS

In general, the occupational exposure control regime is covered in the regulatory framework of Sri Lanka. The framework is embodied in law and subsequent regulations, orders and rules. The Sri Lanka Atomic Energy Act, No. 40 of 2014 clearly identifies the independent regulatory body and the technical service provider and details their objectives, duties and powers. Furthermore, the Act includes all the necessary provisions for licensing, and radiation protection of workers which is far more detail than is usually incorporated in such Acts.

The ORPAS team notes that the Sri Lanka Atomic Energy Regulatory Council (SLAERC) intends to replace the current regulations, which are based on the previous version of GSR Part 3 (BSS 115, 1996), with modern regulations based on the current requirements on occupational exposure control of GSR Part 3 for planned exposure situations. The draft Regulations should be published as soon as possible and cover all exposure situations (planned exposure situation, existing exposure situations and emergency situations) with provisions for a radiation protection programme (RPP) including radiation protection of itinerant workers. However, the ORPAS team is impressed with the request of the Government of Sri Lanka for ORPAS such a short time after the establishment of the SLAERC.

The ORPAS team also notes that the Act empowers the SLAERC and SLAEB to perform some of the same functions, which may lead to duplication and inefficiency in coordination, cooperation and consultation.

The ORPAS Team notes that SLAERC has limited resources and recommends that it limits its activities to regulatory functions and allocate its resources in accordance with a graded approach. It should also be noted proper implementation of regulations and guidance can only be achieved by qualified and competent staff.

In general, regulations should be supported by guidance materials and employers, registrants and licensees would benefit from guidance from SLAERC to properly implement the regulations, e.g. guidance on the establishment and maintenance of the RPP by the license holders, harmonization of health surveillance program of workers, and establishment of dose constraints.

It is observed that SLAERC concentrates on the regulation of artificial sources and authorization of individuals. However, the overall arrangement for the control of occupational exposure requires oversight of occupational doses from all exposure situations, which can only
be provided through a national dose registry. SLAERC should consider the necessary arrangements for the establishment and maintenance of a national dose registry.

Stakeholder involvement is paramount for any regulatory activity and SLAERC should establish mechanisms for the necessary consultation, cooperation and coordination with relevant entities.

The ORPAS team notes that Sri Lanka has limited resources available for training for radiation protection and suggests that SLAERC and the SLAEB should consider cooperating to ensure that limited resources are used effectively and efficiently to ensure employers have sufficient access to radiation protection training services.

The Sri Lanka Atomic Energy Act, No. 40 of 2014, specifically empowers the SLEAB to provide radiation protection services, dosimetry services and calibrations. Therefore, SLAERC should authorize SLAEB as a technical service provider for calibration, workplace monitoring and individual monitoring to ensure that SLAEB has complied with the requirements stated in the Act and the Regulations.

The SLAEB is accredited according to IEC/ISO 17025:2005 to provide dosimetry and calibration services and is well equipped to provide such services. SLAEB is also capable of providing workplace monitoring and radiation protection training services.

The ORPAS team recommends that the SLAEB pursues recognition as the national laboratory for ionising radiation metrology and that it retains personal dose records for the period recommended in GSR Part-3.

The SLAERC should recommend the calibration period for all workplace monitoring instruments.

In order to improve its services, SLAEB is encouraged to change its monitor distribution paperwork to ensure that the RPO accepts responsibility for correctly distributing the monitors to the workers. In addition, the SLAEB should consider changing its charging policy to remove the financial disincentive for government hospitals to monitor workers. Treating all users equally would also enable more efficient use of the limited stock of TLD monitors available. The SLAEB should consider reporting the $Hp (0.07)$ dose recorded on each monitor. The SLAEB should consider implementing extremity monitoring and internal dose monitoring for workers.

As a general principle, the license holders and SLAERC should ensure that a safety assessment is conducted as the basis for the establishment of the RPP in the respective facilities. The RPP should include the necessary arrangements for the control, monitoring and recording the occupational exposure.

The license holders should make arrangements to define the boundaries of any controlled and supervised areas, taking into account the magnitude of the exposures expected in normal operation, the likelihood and magnitude of exposures in anticipated operational occurrences and in accident conditions, and the type and extent of the procedures required for protection and safety.
It is observed that all hospitals are licensed to use radiation sources by SLAERC. The license holders should provide internal dosimetry, double dosimetry and extremity monitoring to the relevant workers depending on the exposure pathways.

The license holders should provide appropriate training in protection and safety, including emergency response arrangement with a primary focus on emergency worker protection, as well as periodic retraining as required to ensure the necessary level of competence.

Furthermore, to improve their practice, nuclear medicine departments should consider using portable protective shields that would protect staff from patients following application of radiopharmaceuticals to patients.

In Sri Lanka NDT training and certification is based on international standards, which include training on radiation protection. To improve worker protection, NDT license holders should:

- Review the design of the shielded enclosure;
- Include rehearsal of emergency plans and refresher training in their training programme;
- Provide direct reading dosimeters (active / alarm personal dosimeters) to all radiographers and assistants;
- Implement an inspection and maintenance programme.

The ORPAS team acknowledges a significant achievement has been made by the establishment of independent regulatory authority in Sri Lanka, empowered single technical service provider for dosimetry services and calibrations, but recognizes there remains considerable work ahead to develop the national occupational radiation protection programme.
INDIVIDUAL FACILITY SPECIFIC \textit{(NATIONAL COUNTERPARTS)}

FINDINGS AND OBSERVATIONS
APPENDIX – I: SRI LANKA ATOMIC ENERGY REGULATORY COUNCIL (SLAERC)

Facilities and services: Regulatory Authority
Location: No 977/18, Kandy Road, Bulugaha Junction, Kelaniya Sri Lanka
Mission Dates: 26 and 27, November 2019
ORPAS Reviewers: Ms. H. Caplin (France), Ms. T. Iyu Lin (Malaysia), Mr. I. Hasanuddin (Indonesia), Mr. H.B. Okyar (IAEA)
Persons met: Mr. T.H. S Shanta (Director, Authorization)
Mr. S.S.K Kolambage (Deputy Director, Medical Authorization)
Mr. K.N.R Fernando (Deputy Director, Inspection - Medical Facilities)
Mr. K.K.P.I.K Kadadunna (Deputy Director, Inspection - Industrial facilities)
SLAEB representative: Mr. N. Ranasinghe (Scientific Officer)

INTRODUCTION

Sri Lanka Atomic Energy Regulatory Council (SLAERC) was established on January 1 of 2015 under the Sri Lanka Atomic Energy Act No. 40 of 2014. Currently, SLAERC functions under the Ministry of Power, Energy and Business Development.

The Act spell out the responsibilities of the SLAERC:
- To regulate practices by implementing licensing, inspections, enforcement and import/export control programmes;
- To enforce Regulations, Rules and conditions specified in licences;
- To provide information on regulatory matters to the general public, the media and any other relevant stakeholders;
- To formulate national policies and strategies on protection against ionizing radiation, safety and security of sources, nuclear material and on radioactive waste management;
- To formulate and review rules, codes, standards;
- To maintain the national source registry;
- To serve as the point of contact for nuclear or radiological emergencies in terms of relevant international instruments;
- To ensure compliance with international standards and obligation in the fields of nuclear energy which are required to be complied with by Sri Lanka.

In Sri Lanka, the hierarchy of the legislative system are the following:

1. Act (currently the Atomic Energy Act No.40 (2014) is in place and implemented);

2. Regulations and Orders (currently Regulation on Ionizing Radiation Protection of the Atomic Energy Safety Regulations No.1 of 1999 (published 2000) is in place and implemented). There are two draft Regulations still under review:
   - Regulation on Ionizing Radiation Protection and Safety of Radiation Sources (hereinafter referred to as the draft of new Safety Regulations);
   - Regulation on Source Security;
An Order was published in the Gazette to designate the High Court for prosecution;
- Regulation on Radiation Security.

3. Rules (currently two Rules published; licensing of practices and period of licence and notification of practices). A Rule is in the drafting process by the SLAERC: criteria for qualification of radiation workers.

4. Procedures/ Codes (currently few internal procedures are published, such as; user manual for personnel monitoring services and procedure for issuing authorizations (SLAERC/PROCEDURES/01/2019 - board paper n° BP 2019-08-04, approved on 14.06.2019)

GENERAL INFORMATION

SLAERC is headed by a Director General and has 35 employees and organisational structure is given in FIG 1, including 16 Scientific Staff, 19 Non-Scientific Staff and a Legal Officer (currently vacant). The organisation is structured with two divisions, including Division of Licensing, Import and Export Control and Division of Inspection, Emergency Management and Enforcement.

The authorization in the Act No.40 can be in terms of License, Approval (for import/ export activities, facility plans) or a No Objection letter.

Qualified Staff/Inspectors:

Among the 35 employees, 16 are scientific staff, 13 of whom had been authorised as inspectors with the other 3 are still under training.
APPRAISAL FINDINGS

LEGAL REGULATORY FRAMEWORK

The regulatory framework of Sri Lanka is comprised of Acts, Regulations, Orders and Rules, which are all mandatory, together with regulatory guidance and procedures. SLAERC has some guidance documents to assist applicants and employers, registrants and licensees or license holders to fulfil the mandatory requirements.

The legislative and regulatory framework has detailed provisions for occupational exposure control, monitoring and recording. The dose limits are included in the Appendix III of the Regulations 1999.

The Act No. 40 of 2014 states that SLAERC shall by rules made in that behalf, establish requirements for the protection of workers, the public and the environment, that are required to be complied with by all persons who are conducting activities related to mining or processing operations which generate radioactive material. Currently, no rule is draft or published.

The current Regulation on Ionizing Radiation Protection of the Atomic Energy Safety Regulations No.1 of 1999 is based on the IAEA BSS 115 (1996). However, the ORPAS Team observed that the draft Regulation on Ionizing Radiation Protection of the Atomic Energy Safety Regulations is mostly in line with GSR Part 3 requirements for occupational exposure control.

All sources of ionizing radiation used in medical or industrial applications and research purposes are regulated and controlled by SLAERC. Licenses issued by SLAERC are valid for one to three years: one year for high radiation risk facilities and three years for low radiation risk facilities.

The draft Safety Regulations apply only to planned exposure situations without any mention of emergency and existing exposure situations.

ESTABLISHMENT OF REGULATION AND STAKEHOLDER INVOLVEMENT

The ORPAS team has observed that the process to publish the Regulations involves several stages, including:
- Documents agreed by Council;
- Documents agreed by Minister In-charge;
- Documents approved by the Legal Draftsman Department;
- Documents translation to local languages and approval by the Legal Draftsman Department;
- Documents are gazetted;
- Documents to obtain Cabinet approval;
- Document approved by the Parliament.

The ORPAS team also observed that in case of Rules, the rules are prepared by the Council and gazetted after obtaining approval of the Legal Draftsman Department. The approval of the Parliament is taken after gazetting.
Stakeholders are involved in the drafting of the Regulations and Rules: relevant stakeholder organizations such as radiographer, radiologist and oncologist associations/ unions and relevant Ministries are invited to provide input during the drafting process.

NOTIFICATION, AUTHORIZATION AND APPROVAL

The licensing requirements for all sources of ionizing radiation are described in Act No. 40 of 2014 (art 18) and Regulations No. 1 of 1999 (art 12). The license application forms are available on the SLAERC website. The assessment and the authorization process are usually completed within 15 days from receipt of the application subject to provision of the information necessary for complete assessment and payments. For new facilities, licence is issued only after a regulatory inspection by the Council.

The authorization process involves:
- Notification by applicant to the SLAERC;
- Assessment whether authorization is required;
- Facility plan approvals/Import and export approvals;
- Application for a licence and approval.

Application guides are available to assist the applicants in completing the application form. Technical guidelines for use by regulators, applicants and licensees are also available.

Requirements for licence application (form):
- Details of the applicant;
- Details of the Head of Institute;
- Information of users to be authorised;
- Details of personnel to be authorised to work in control areas;
- List all of x-rays/ radioactive sources to be authorised for the institute;
- Radiation protection programme;
- Radiation monitoring equipment.

The ORPAS Team has observed that not all the requirements are completed on all applications.

Users of ionizing radiation for medical or industrial applications and research purposes are subjected to licensing. Sources and activities are controlled by licensing, inspections and enforcement actions; import and export control; and design and approval of irradiation facilities. SLAERC has issued approximately 700 licenses for facilities and practices to approximately 450 licensed organisations (90 industrial organisations and 360 medical institutions, mainly for general radiography).

The ORPAS team has observed that the graded approach is not addressed in the current regulations (Regulations No. 1 of 1999) but a graded approach is applied to licensing periods, including exemptions, in the Atomic Energy License Rules No. 1 of 2015.

RESPONSIBILITIES OF LICENSEES AND WORKERS, OPTIMIZATION AND DOSE LIMITATION

The primary responsibility for the safety of sources of ionizing radiation is assigned to the license holder according to Regulations No 1 of 1999 (art 26 assigns to licensees the responsibilities for the protection of workers from occupational exposure by providing them
with suitable and adequate individual monitoring and protective equipment to ensure that occupational exposure is optimized, and the relevant dose limits are not exceeded).

The responsibilities of Radiation Protection Officers and workers are detailed in article 27 and 28 of the Regulations No 1 of 1999.

RADIATION PROTECTION PROGRAMME

Review and approval of radiation protection programs are part of the licensing procedure, but the content is not stipulated in the Act No. 40 of 2014 or in Regulations No. 1 of 1999. There is no guidance regarding the content of the radiation protection programmes.

The ORPAS team has also observed that licenses are approved even though the content of radiation protection programmes does not match the characteristics of the facility or activity.

WORKPLACE MONITORING

Workplace monitoring is mentioned in article 35 of the Regulations No 1 of 1999. The ORPAS team has observed that workplace monitoring is carried out by some industrial radiography and irradiation facilities, but other license holders do not have arrangements for workplace monitoring.

INDIVIDUAL DOSE MONITORING

Article 26 of Regulations No. 1 of 1999 provides requirements for license holders to be responsible for making arrangements for the assessment of the occupational exposure of workers, on the basis of individual monitoring where appropriate. However, the sole technical service provider in Sri Lanka is not authorised to provide a dosimetry service. The technical service provider provides monthly individual dose monitoring for workers in industrial X-rays and irradiators and bi-monthly for all other workers involved in radiation activities.

The ORPAS team has observed that cabinet X-ray/parcel scanners, body scanners, analytical devices, fixed gauges, and dental X-ray are exempted from individual dose monitoring on the basis that doses to the operators are negligible during their normal working procedures, based on inspection findings. However, such facilities are required to conduct workplace monitoring based on Regulations No. 1 of 1999, Art 35.

The dose limit for workers is 20 mSv/y, as stipulated in Regulations No. 1 of 1999 (Annex III).

There are 149 institutes registered with the SLAEB for individual dose monitoring. Some of the government hospitals where diagnostic X-rays are used (General radiography practices) do not perform individual dose monitoring due to budget constraints. The SLAERC has not taken any regulatory action against these hospitals because these hospitals provide essential services to the patients.

SLAERC has communicated with the Ministry of Health and the Ministry is aware of the requirements but no resolution has been achieved.

The ORPAS team has also observed that there is no technical service provider for internal, extremity and eye lens dosimetry.
HEALTH SURVEILLANCE REQUIREMENTS

Regulations No. 1 of 1999 (art.42) requires health surveillance, the records of which are to be kept by the license holders.

The ORPAS team observed that most health surveillance programs require annual chest X-rays. This is not specifically required under the regulations No 1 of 1999. Human imaging using radiation that is performed for occupational, legal or health insurance purposes, and is undertaken without reference to clinical indication, shall normally be deemed to be not justified.

The regulation states that the health surveillance program should base on general principles of occupational health and designed to assess the initial and continuing fitness of workers for their intended task. The Council has recommended the tests that should be included in the annual health surveillance.

INFORMATION AND TRAINING

In the current regulations (Regulations No. 1 of 1999), there is no specific requirement (content, training institutions) for the training for workers but it is understood that the training is required under the radiation protection programme. Both SLAERC and SLAEB conduct radiation protection training awareness courses. However, SLAEB training is not recognised by the SLAERC (no assessment on the content or syllabus has been conducted).

The Council is empowered to provide training for the staff of the council and any other relevant body of persons for the purposes of achieving its objectives. It is not limited to the subject area of radiation protection.

SLAERC automatically recognise as sufficient qualification for RPO:
   i. a degree from Colombo University (Nuclear Science, Medical Physics)
   ii. a degree from University of Peradeniya (Medical Physic & Nuclear Science)

RECORD KEEPING

Article 27(i) of Regulations No. 1 of 1999 stipulates the records to be kept and maintained by the RPO include: records of all work carried out by each occupationally exposed workers, health records for all workers, occupational exposures, results of monitoring, surveying and inspection of areas, apparatus and operations and calibration of monitoring instruments.

NATIONAL DOSE REGISTRY

The only technical service provider for individual dose monitoring is the SLAEB. Sri Lanka has not developed a National Dose Registry. However, SLAEB is investigating the software for a National Dose Registry. The dose records kept by SLAEB can be provided to the SLAERC upon request.
CONDITIONS OF SERVICE

The ORPAS team observed that the current regulations (Regulations No 1 of 1999) preclude offering extra benefits in lieu of radiation protection.

IMPLEMENTATION OF OPTIMIZATION OF PROTECTION

Article 31 of Regulations No 1 of 1999 emphasizes the implementation of optimization of radiation protection and safety. In addition, SLAERC also made necessary arrangement for the promotion of safety culture. Training programs also emphasise the safety culture. However, the ORPAS team has not observed the practical implementation of good safety culture.

OCCUPATIONAL EXPOSURE IN EMERGENCY EXPOSURE SITUATIONS

A few over exposure cases have been reported to the SLAERC, but, after investigation, it was confirmed that these cases were not genuine over exposures. SLAERC notified the license holder of the investigation results.

Over exposure is incorrectly interpreted as the dose received by the workers exceeding 20 mSv/y, pro rata.

The ORPAS team observed that the regulatory framework for emergency situations with respect to occupational exposure is addressed, however, no guidance for the proper protection of emergency workers and for the notification of events was observed.

EXEMPTION/CLEARANCE LEVELS, REFERENCE LEVELS AND DOSE CONSTRAINTS

Exemption and clearance levels are stipulated in the Appendix of Regulations No 1 of 1999.

Regulations No. 1 of 1999 and the draft Safety Regulation do not refer to reference levels, especially for emergency and existing exposure situations.

There is a specific schedule on dose constraints in the draft Safety Regulations. However, the dose constraints should be established by the license holder and not SLAERC.

MANAGEMENT SYSTEM

No documented management system has been observed by the ORPAS team.
| BASIS: | GSR Part 1 Requirement 16 Paragraph 4.5 states that: “The regulatory body has the responsibility for structuring its organization and managing its available resources so as to fulfil its statutory obligations effectively. The regulatory body shall allocate resources commensurate with the radiation risks associated with facilities and activities, in accordance with a graded approach.”
GSR Part 1 Requirement 18 states that: “The regulatory body shall employ a sufficient number of qualified and competent staff, commensurate with the nature and the number of facilities and activities to be regulated, to perform its functions and to discharge its responsibilities.” |
| OBSERVATION: | SLAERC has very limited resources and currently undertakes many different types of activities. |
| R1: | Recommendation: SLAERC should limit its activities to regulatory functions. |
| R2: | Recommendation: SLAERC should allocate resources commensurate with the radiation risks, in accordance with a graded approach. |
| BASIS: | GSR Part 3 Requirement 3 states that: “The regulatory body shall establish or adopt regulations and guides for protection and safety and shall establish a system to ensure their implementation.” |
| OBSERVATION: | The Draft Regulations based on GSR Part 3 have not been published yet. |
| R3: | Recommendation: SLAERC should publish the Draft Regulations as soon as possible. |
| BASIS: | GSR Part 3 Requirement 3 Paragraph 2.29 states that: “The regulatory body shall establish requirements for the application of the principles of radiation protection specified in paras 2.8–2.12 for all exposure situations and shall establish or adopt regulations and guides for protection and safety.”
GSR Part 3 Requirement 52 states that: “The regulatory body shall establish and enforce requirements for the protection of workers in existing exposure situations”
GSR Part 3 Requirement 45 states that: “The government shall establish a programme for managing, controlling and recording the doses received in an emergency by emergency workers.”
GSR Part 3 Requirement 3 Paragraph 2.30 states that: “The regulatory body shall establish a regulatory system for protection and safety that includes: […]
(e) The regulatory functions relevant to emergency exposure situations and existing exposure situations” |
| OBSERVATION: | The draft Regulations do not cover existing and emergency exposure situations. |
| R4: | Recommendation: SLAERC should publish regulations covering all exposure situations. |
| BASIS: | **GSR Part 3 Requirement 3 Paragraph 2.31 states that:** “The regulatory body shall adopt a graded approach to the implementation of the system of protection and safety, such that the application of regulatory requirements is commensurate with the radiation risks associated with the exposure situation.” |
| OBSERVATION: | The draft of Safety Regulations does not refer to the graded approach, for example different types of authorization for the different types of practices and the different stages in the lifetime of a facility or the duration of an activity according to the risk. |
| R5: | **Recommendation:** The SLAERC should implement a graded approach in their regulatory framework. |
| BASIS: | **GSR Part 3 Requirement 24 states that:** “Employers, registrants and licensees shall establish and maintain organizational, procedural and technical arrangements for the designation of controlled areas and supervised areas, for local rules and for monitoring of the workplace, in a radiation protection programme for occupational exposure.” |
| OBSERVATION: | Regulation No.1 of 1999 covers the establishment of the RPP. Draft of Safety Regulations do not refer to the implementation of a radiation protection programme or protection of itinerant workers. |
| R6: | **Recommendation:** The regulatory body should ensure that the provision for a radiation protection programme and itinerant workers are covered in the new regulations. |
| S1: | **Suggestion:** SLAERC should consider developing and publishing guidance materials for the establishment and maintenance of the RPP by the license holders. |
| BASIS: | **GSR Part 3 Requirement 3 Paragraph 2.36 states that:** “The regulatory body shall establish mechanisms for communication and discussion that involve professional and constructive interactions with relevant parties for all protection and safety related issues.”  
**GSR Part 1 Requirement 21 states that:** “The regulatory body shall establish formal and informal mechanisms of communication with authorized parties on all safety related issues, conducting a professional and constructive liaison.” |
| OBSERVATION: | The SLAERC has very limited arrangements for consultation and cooperation on its regulatory activities. |
| R7: | **Recommendation:** The SLAERC should establish mechanism for the necessary consultation, cooperation and coordination with relevant entities. |
| BASIS: | **GSR Part 3 Requirement 25 Paragraph 3.108 states that:** “Programmes for workers’ health surveillance shall be based on the general principles of occupational health and designed to assess the initial fitness and continuing fitness of workers for their intended tasks.” |
| OBSERVATION: | The Paragraph 42.c of Regulations No. 1 of 1999 states that Authority shall specify the type of medical examination depending on intended tasks and shall name the registered medical practitioners who shall conduct such examinations. The authority has not provided guidance for license holders about content of the medical examinations. |
Some of the license holders, as a part of their health surveillance program perform chest X rays. Only in exceptional circumstances, the regulatory body may decide that the justification of such human imaging for specific practices is to be considered.

**R8:** **Recommendation:** The health surveillance program should be developed in accordance with occupational medicine and designed to assess initial and continued fitness of workers for their tasks.

**BASIS:**

GSG-7 Paragraph 3.32 states that: “The establishment of constraints may be the result of interaction between the regulatory body, the affected operators and, where appropriate, workers’ representatives. As a general rule, it would be more appropriate for the regulatory body to encourage the development of constraints for occupational exposure within particular industries and organizational groupings, subject to regulatory oversight, than to stipulate specific values of constraints.”

GSR Part 3 - Requirement 11 Paragraph 3.22 (c) states that: “The government or Regulatory body shall establish or approve constraint on dose and on risk, as appropriate, or shall establish or approve a process for establishing such constraints, to be use in the optimization of protection and safety.

**OBSERVATION:** There is a specific schedule on dose constraints in the draft Safety Regulations.

**S2:** **Suggestion:** The SLAERC is encouraged to provide guidance for the establishment of dose constraints by the license holders and their use as tool for optimization and the basis for design and shielding calculations.

**BASIS:**

GSR Part 3 Requirement 3 Paragraph 2.32 states that: “The regulatory body shall ensure the application of the requirements for education, training, qualification and competence in protection and safety of all persons engaged in activities relevant to protection and safety.”

**OBSERVATION:** Sri Lanka has limited resources available for training for radiation protection.

**S3:** **Suggestion:** The SLAERC and the SLAEB should consider cooperating to ensure that limited resources are used effectively and efficiently to ensure employers have sufficient access to radiation protection training services.

**BASIS:**

GSR Part 3 Requirement 20 Paragraph 3.73 (c) states that: “The regulatory body shall be responsible, as appropriate, for: (a) ...(b) ... (c) Authorization or approval of service providers for individual monitoring and calibration services”

**OBSERVATION** SLAERC does not authorize SLAEB as technical service provider

**R9:** **Recommendation:** SLAERC should authorize SLAEB as a technical service provider for calibration, workplace monitoring and individual monitoring to ensure that SLAEB has complied with requirement stated in the Act and the Regulation.

**BASIS:**

GSG-7 Paragraph 7.265 states that: “Consideration should be given to the establishment of a national dose registry as a central point for the collection and maintenance of dose records.”
| OBSERVATION: | Personal dose is recorded and maintained by license holders as required by the regulation. However, there is no centralized recording system for the collection and maintenance of dose records. |
| S4:          | **Suggestion:** SLAERC should consider the necessary arrangements for the establishment and maintenance of a national dose registry. |
| BASIS:       | **GSG-7 Paragraph 3.162 states that:** “As a result of the criteria given in paras 3.159 and 3.161, and with account taken of current published measurements of occupational exposure, the following industrial activities are, or may be, subject to the requirements for planned exposure situation (a) - (l)” |
| OBSERVATION: | The ORPAS Team believes that other industries in Sri Lanka should be covered by the legislation. |
| S5:          | **Suggestion:** SLAERC should consider investigating whether other industries should be subject to regulation. |
INTRODUCTION

The visit to the Personal Monitoring Services Laboratory (PMSL) was to assess their ability to provide individual monitoring services for end users in Sri Lanka. The visit also assessed the implementation of occupational radiation protection in the laboratory.

GENERAL INFORMATION

The PMSL has been operating for several decades, initially using film dosimeters before switching to TLD in 1990. The PMSL uses a Harshaw 6600+ reader with a Harshaw 4500 reader as backup. The service uses two-element TLD-100 cards to measure personal dose equivalent. Individual monitoring is performed for approximately 1700 occupationally exposed workers and the PMSL has 7 permanent staff.

CONDUCT OF APPRAISAL

The visit started with an entrance meeting to introduce participating PMSL staff to the purpose and conduct of the appraisal. During the visit, the team had the opportunity to review the following, which assisted in the evaluation:

- Quality management system;
- The results of interlaboratory comparisons;
- Calibration and system performance assessments;
- Dose reports;
- Workplace monitoring reports;
- Specimen of dosimeters.

The visit concluded with an exit meeting to inform PMSL staff of the findings and recommendations of the evaluation.

APPRaisal FINDINGS

LEGAL REQUIREMENTS

The Sri Lanka Atomic Energy Act, No. 40 of 2014 specifically empowers the Sri Lanka Atomic Energy Board to provide dosimetry services (paragraph 5e). The laboratory is accredited by
the Sri Lanka Accreditation Board (SLAB) according to ISO/IEC 17025 to perform measurements of personal dose equivalent at the depth of 10 mm, Hp (10). However, the laboratory is not specifically authorised to provide the service by the regulatory body.

DOSIMETRIC QUANTITIES

The dosimetric quantity used for monitoring occupational exposure is Hp (10) for photon (gamma and x-ray) radiation.

Skin doses (Hp (0.07)), eye lens doses (Hp (3)) and doses of neutron exposure (Hp (10)) are not measured by the laboratory because very few customers request these services.

The laboratory intends to purchase extremity monitoring in the near future as some clients are requesting this service.

The dosimetry system is capable of measuring doses up to 10 Sv for emergency exposure situations.

The laboratory has no facilities or capability to assess internal exposures.

MONITORING FREQUENCY

In general, a set of TLD cards are issued on bi-monthly basis to each client organisation. Workers highly exposed in industrial X-ray and industrial irradiators use a one-month wearing period.

CALIBRATION

Calibration is performed by in-house staff every 6 months and/or after repair by irradiating the Gold Cards at the SSDL of SLAEB.

TYPE TESTING

The laboratory relies upon the results of the manufacturer’s type testing but has performed several tests to check the manufacturer’s results.

PERIODIC AND PERFORMANCE TESTING

There is a program for the routine performance testing and quality assurance of the TLD system. The TLD cards are processed using the Harshaw 4500 and Harshaw 6600+ Readers. QC checks are performed on the reader prior to each use to ensure that is working within the acceptable limits. The limits currently used are based on the recommendation in the Manual.

Reproducibility checks are conducted at regular intervals while the reader is in use. Linearity checks are performed every three months, up to 5 mSv dose. However, response to levels beyond 5 mSv has not yet been measured by the laboratory. Environmental conditions such as temperature and pressure are monitored in the laboratory.
Performance testing has been conducted to verify the type testing results and is programmed every three years. The laboratory has participated in the Intercomparison Program conducted by IAEA and ARPANSA in 2018. The results of the intercomparison were acceptable. However, the program for this in the coming years in not yet clear.

DOSE RECORD KEEPING AND REPORTING

After the TLD cards are processed, dose reports are generated for each monitoring period. The report indicates the estimated effective dose in terms of mSv to the whole body received by the user. Although not stated in the report, the dose is in terms of Hp (10). Hp (0.07) is not reported. The report also contains the name and address of the institute, monitoring period, process and receipt dates, names of the user and the dose received and remarks. Reports are typically available within 2-4 weeks after receipt of the used cards.

The minimum recording level for the 1-month period is 0.08 mSv and 0.15 mSv for the 2-month period. Investigation levels of 3.25 mSv (bimonthly) and 1.63 mSv (monthly) are set to initiate a notification to the RPO of the facility to verify / investigation whether the exposure is genuine or not. This notification is copied to the regulator.

Records of the distribution list, dose reports, request forms and other communications with the customers are filed and maintained in designated folders and stored in cabinets in the laboratory. Older records are archived in another location. The retention period of the records is 30 yrs as per procedure. Backup of the electronic files of the distribution lists, evaluation data and reports are also kept.

The PMSL noted that there were significant data quality issues in its records due to poor practices by some RPOs.

It was noted that there is not a national dose register. However, the laboratory is in the process of obtaining appropriate software to enable such a register to be provided.

STAFFING AND TRAINING

The PMSL has 5 technical and 2 administrative permanent staff. The technical staff is composed of the Technical manager, deputy quality manager, deputy technical manager and 3 technical assistants. The staff are very knowledgeable of their duties and responsibilities.

The required worker, qualifications, duties and responsibilities are described in quality manual. There is a comprehensive training schedule and competence assessment of the staff which includes written examinations. Training on the fundamentals of radiation protection and equipment operations and dosimetry are mostly conducted in-house.

WORK PROCESSES IN THE LABORATORY

Procedures and work instructions are in place for the overall processes of the PMSL. The process includes receiving of requests, distribution of the TLD cards to the users, processing of cards and evaluations of results, and generation of dose reports. Records generated for each of the process are also available and well maintained.
To apply for the service, the customers need submit the accomplished request form, RPO bio data form and the personal data form of the users. In addition to the general information of the customer, the terms and conditions of the service are also listed on the form.

Two TLD cards are dedicated for each worker. Typically, one card is assigned to the worker for each monitoring period. For interventional radiological procedures however, 2 cards are issued. A background cards is also provided with each issue.

TLD cards are distributed to the customers through post or courier service. The cards together with the distribution list / assignment are sent without the badge holders. The badge holders are with the customers and this has been the practice as a means to reduce the mailing cost and to protect the badge holders from breakage during mailing. Once the cards are received, the RPO places them in the holders and gives them to the workers, as per distribution list.

After each monitoring period, the RPO removes the card from the holder and sends it back to the PMSL for processing and dose evaluation. In the dose evaluation, background subtraction is performed. There is no procedure yet in the event of high background doses although, based on history, this has not occurred.

The dose reports are then generated, reviewed by the deputy technical management and certified by the technical manager. An excel macro developed in-house is being used for this purpose, however, the process is prone to human error.

The assessment team noted that, although the RPO was responsible for ensuring the designated TLD card was assigned to the appropriate worker, there was no record that the RPO had correctly distributed the cards.

It was noted that the issuing of TLD dosimeters for Government Hospitals are the responsibility of the Medical Supplies Division of Ministry of Health, while TLD dosimeters are supplied free of charge by the laboratory to other users. However, other users are required to pay a service fee, while Government hospitals are provided the measurement service free of charge. Government hospitals have a significant upfront fee which is approximately 3 times higher compared to other users as per November 2019. All users are required to purchase a TLD holder for each worker and at least one holder opener.

It was observed that, as government institutions were required to purchase TLD cards for their workers, several cards were not able to be used by the laboratory because they were owned by particular institutions rather than the laboratory.

It was noted that the laboratory processes dosemeters when they are returned, even if this is several months after the wearing period.

It was noted that the work processes are currently very manual, with limited automation and limited use of electronic record keeping.

UNCERTAINTY ASSESSMENT

There is a comprehensive assessment of the uncertainties. Key dosimetric parameters have been considered such as linearity, energy response, fading, accuracy and angular response.
among others. The expanded uncertainty for Hp (10) if one TLD is worn by the worker is +22% at k=2, 95% confidence level. If the two TLDs are worn, the expanded uncertainty is +12%. These are reflected in the Dose Report.

The assessment was developed by a former staff member. Recently, one of the PMSL staff has undergone IAEA training on uncertainty calculations. The uncertainty budget will be updated to incorporate the knowledge gained from this training.

CUSTOMER FEEDBACK

Assessment of customer feedback is part of the PMSL management system. There are procedures in place to measure customer satisfaction and address complaints.

RELIABILITY OF SERVICE

The PMSL monitors about 1700 workers from 149 institutes. Two TLD readers, Harshaw 4500 and Harshaw 6600+, are being utilized. Both readers are well maintained and routinely calibrated. Due to the availability of a backup reader, continued service is assured in the event of an equipment failure. However, the current supply of the TLD cards are not sufficient to meet the demand of the customers. There are pending requests for about 100 cards. Arrangements are being made with the IAEA for the procurement of additional cards.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

| BASIS: | EXAMPLE 1: GSR Part 3 Requirement 25 Paragraph 3.104 states that: Records of occupational exposure for each worker shall be maintained during and after the worker’s working life, at least until the former worker attains or would have attained the age of 75 years, and for not less than 30 years after cessation of the work in which the worker was subject to occupational exposure. |
| OBSERVATION: | It was observed that the management system requires records to be kept for only 30 years. |
| R1: | Recommendation: The PMSL should revise its record-keeping policy to ensure records are stored for the required length of time. |

| BASIS: | EXAMPLE 2: GSR Part 3 Requirement 20 Paragraph 3.73 (c) states that: The regulatory body shall be responsible, as appropriate, for authorization or approval of service providers for individual monitoring and calibration services; |
| OBSERVATION: | It was observed that, while the Sri Lanka Atomic Energy Act empowers the SLAEB to provide dosimetry services, this does not ensure that the service meets the requirements of GSR Part 3. |
| R2: | Recommendation: The SLAERC should authorise or approve the PMSL service. |

| BASIS: | EXAMPLE 3: GSG-7 Paragraph 8.29 states that: “The process for the control of monitoring and measuring devices should be conducted so as to establish an effective means of ensuring, with a high degree of confidence, that the data that are generated by these devices, and which are to be used as the basis for reported results, conclusions and interpretations, are accurate within prescribed requirements”.

|
OBSERVATION: As TLD cards are only numbered, there is a risk that the card could be mistakenly distributed to the wrong wearer.

S1: **Suggestion:** The PMSL should consider changing the monitor distribution paperwork to ensure that the RPO accepts responsibility for correctly distributing the monitors to the workers.

**BASIS:** GSG-7 Paragraph 8.16 states that: “For organizations providing technical services in protection and safety, interested parties are typically customers, staff, regulatory bodies, suppliers, the public and owners. Of these, customers should be accorded the most importance.”

OBSERVATION: The current charging policy for Government Hospitals provides a very high initial cost to arranging monitoring of a worker. The cards owned by government hospitals are not available for general use by the PMSL.

S2: **Suggestion:** The PMSL should consider changing its charging policy to remove the financial disincentive for government hospitals to monitor workers. Treating all users equally would also enable more efficient use of the limited stock of TLD monitors available.

**BASIS:** GSG-7 Paragraph 8.29 states that: “The process for the control of monitoring and measuring devices should be conducted so as to establish an effective means of ensuring, with a high degree of confidence, that the data that are generated by these devices, and which are to be used as the basis for reported results, conclusions and interpretations, are accurate within prescribed requirements.”

OBSERVATION: Processing TLD cards that have not been returned for an extended period introduces an increased risk that the monitor dose is not representative of the worker dose.

S3: **Suggestion:** The PMSL should consider imposing a time limit beyond which they will not process a monitor so as to ensure the dose is representative of the worker’s occupational dose.

**BASIS:** GSG-7 Paragraph 7.255 (c) states that: “The results of dose assessments for external exposure and the method of assessment, including, as appropriate: ii) The personal dose equivalent for exposure to weakly penetrating radiation, Hp (0.07)”.

OBSERVATION: The system used by the PMSL is capable of reporting both Hp (10) and Hp (0.07).

S4: **Suggestion:** The PMSL should consider reporting the Hp (0.07) dose recorded on each monitor.

**BASIS:** GSG-7 Paragraph 7.8 (a) states that: “Monitoring of hands and fingers should be considered for workplaces where extremities are particularly close to the radiation emitter or radiation beam, such as in situations where radioactive sources are handled in research, nuclear medicine and dismantling operations”.

OBSERVATION: Workers handling high specific activity sources, such as nuclear medicine technicians, can receive very high doses to the hands and fingers.

S5: **Suggestion:** The PMSL should consider implementing extremity monitoring for workers using high specific activity sources.

**BASIS:** GSG-7 Paragraph 3.109 (e) states that: “The following activities are examples of those for which routine individual monitoring for internal exposure should be considered: The production and handling of large...”
quantities of radiopharmaceuticals, such as $^{18}$F for diagnostics by positron emission tomography or $^{131}$I for therapy”.

GSG-7 Paragraph 7.133 (a) states that: “The assessment of doses received by workers from exposure due to intakes of radionuclides may be based on the results of individual monitoring involving one or more of the following types of measurement: Sequential measurements of radionuclides in the whole body or in specific organs, such as the thyroid or the lung”.

OBSERVATION: Nuclear medicine staff administering radioiodine have a risk of internal exposure.

S6: Suggestion: The PMSL should consider implementing thyroid monitoring for nuclear medicine staff involved in administering radioiodine.
APPENDIX – III: SRI LANKA ATOMIC ENERGY BOARD, SECONDARY STANDARDS DOSIMETRY LABORATORY

Facilities and services: Technical Service Provider (SSDL)
Location: Colombo
Dates: 27 November 2019
ORPAS Reviewers: Mr. S. Long (Australia), Ms. K. D. Romallosa (Philippines)
Persons met: Mr. Prasad Mahakamura (Technical Manager)
Mr. Lalantha Jayasinghe (Deputy Technical Manager)
Ms. Nirasha Rathnaweera (Deputy Quality Manager)
Mr. Dinesh Piyadasa (Technical Assistant)

INTRODUCTION

The visit to the Secondary Standards Dosimetry Laboratory (SSDL) was to assess their ability to provide calibration services for end users in Sri Lanka. The visit also assessed the implementation of occupational radiation protection in the laboratory.

GENERAL INFORMATION

The SSDL was established in 1991 and its current facilities include 3 exposure rooms, although only one is in use. The SSDL calibrates approximately 80 instruments each year, although it has calibrated 113 so far in 2019. These instruments include survey meters, electronic personal dosimeters and contamination monitors. The SSDL also provides exposures to approximately 300 TLD cards for calibration and quality control in the Personal Radiation Monitoring service. The SSDL also provides a maintenance service for instruments.

CONDUCT OF APPRAISAL

The visit started with an entrance meeting to introduce participating SSDL staff to the purpose and conduct of the appraisal.
During the visit, the team had the opportunity to review the following, which assisted in the evaluation:
- Quality management system;
- The results of laboratory’s performance in the IAEA Postal Quality Audit program;
- Calibration and system performance assessments;
- Calibration reports;
- The irradiation facility.

The visit concluded with an exit meeting to inform SSDL staff of the findings and recommendations of the evaluation.

APPRAISAL FINDINGS

LEGAL REQUIREMENTS

The Sri Lanka Atomic Energy Act, No. 40 of 2014 specifically empowers the Sri Lanka Atomic Energy Board to provide calibration services and services for radiation measuring equipment (paragraph 5e).
The laboratory is accredited by the Sri Lanka Accreditation Board (SLAB) according to ISO/IEC 17025:2005 to perform dosimetry calibration, but not contamination monitor calibration. The SSDL will be re-assessed according to ISO/IEC 17025:2017 in the coming year.

The laboratory is not recognised as the national metrology laboratory for measurement of radiation dose. The laboratory is not specifically authorised to provide the service by the regulatory body.

CALIBRATION

The SSDL calibrates dose rate meters, personal dosimeters and contamination monitors.

The reference equipment maintain by the SSDL are 600 cc cylindrical ionization chamber (NE 2575) and 10-L PTW spherical chamber. A 600cc cylindrical ionization chamber working standard is also available. The reference chambers are traceable to the BIPM through the IAEA-SSDL and are sent for calibration every 5 years. The standard gamma sources used are Co-60 and Cs-137, housed in an OB85 Buchler irradiator. The maximum output of Cs-137 is currently 25 mSv/h, while for Co-60 it is about 0.2 mSv/h. There is also Hopewell X-ray Irradiator, model X80-160-E, for calibrations in the narrow spectrum energies (48-118 keV), with a maximum dose rate of about 125 mSv/h.

Wide area planar sources (size: 10 cm x 15 cm and 6 cm diameter) are used for the calibration of contamination monitors. The isotopes available are Cs-137, Co-60, Sr-90, Tc-99, and C-14. The calibration date of these sources is 2001 and they are traceable to PTB.

The SSDL has 3 irradiation rooms, but currently only one room is in use. There are plans to acquire a new irradiator to upgrade the beam output.

DOSIMETRIC QUANTITIES

Dose rate instruments are calibrated in terms of ambient dose equivalent, H*(10), for Cs-137 and Co-60 energies and occasionally, upon request of the customer, to X-ray narrow spectrum energies. Personal dosimeters are calibrated in terms of Hp (10) for the Cs-137 energy using a PMMA slab phantom. Contamination meters are calibrated in terms of surface emission rate using the planar standard sources.

PERIODIC AND PERFORMANCE TESTING

There is a program for the periodic maintenance of the instrumentation used in the laboratory. Beam standardization measurements are performed annually. Stability check of the reference equipment are done regularly.

INTERCOMPARISON

The SSDL participates in the regular postal audit for conducted by the IAEA about every 3 years. The results are well within the acceptable limits.
RECORD KEEPING AND REPORTING

After calibration, a calibration certificate is generated. The certificate shows the calibration method used for gamma and X-ray narrow spectrum energies, the calibration factor of the instrument for each dose range, and the atmospheric condition during calibration. Certificates are typically issued within two days after receipt of instruments. There is no prescribed frequency of calibration of radiation monitoring instruments in the regulations, hence the due date for the next calibration is not indicated in the certificate.

All records of calibrations and other measurements are filed as a hard copy in the designated customer folders. A file copy of the certificates is also kept. The system for maintenance of records are well in place. The retention period for the certificates is 30 years.

STAFFING AND TRAINING

The SSDL has 4 technical staff composed of the Technical manager, deputy quality manager, deputy technical manager and 1 technical assistant. The staff are very knowledgeable of their duties and responsibilities and have extensive experience.

The required worker qualifications, duties and responsibilities are described in quality manual. There is a comprehensive training schedule and competence assessment of the staff which includes written examinations. Training on the fundamentals of radiation protection and equipment operations and dosimetry are mostly conducted in-house.

WORK PROCESSES IN THE LABORATORY

Procedures and work instructions are in place for the overall processes of the SSDL. The process includes receiving of requests, receiving of the instruments for calibration, pre-calibration checks, calibration, and generation of calibration certificates. Records generated for each of the process are also available and well maintained.

Walk-in customers are accompanied by the staff when they bring their instruments to the receiving area, which is inside the control room of the SSDL. The control room is a supervised area.

During calibration, the instruments are positioned using a telescopic and laser alignment system. Operation of the source is done remotely in the Control Room. Meter indications are viewed using a CCTV camera. Irradiation to various dose levels are done by varying the distance of the instrument from the source.

The acceptance criteria for the calibration is ±20%. After the calibration and if instrument response is within the limits, a calibrated certificate is generated. A calibration sticker, which indicates the calibration factor, is then placed in the instrument.

UNCERTAINTY ASSESSMENT

There is a comprehensive assessment of the uncertainties both for the calibration and standardization measurements. Among the quantities considered are instrument mean reading,
resolution, directional dependence, distance, and decay correction. Uncertainties are reported at k=2, 95% confidence levels.

**CUSTOMER FEEDBACK**

Assessment of customer feedback is part of the SSDLs management system. There are procedures in place to measure customer satisfaction and address complaints.

**RADIATION PROTECTION PROGRAM IN SSDL**

The SSDL is licenced by the regulator. A radiation protection program is in place, which includes individual monitoring for its staff, workplace monitoring and classification of areas.

### RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

| **BASIS:** | **GSR Part 3 Requirement 20 Paragraph 3.73 (c) states that:** The regulatory body shall be responsible, as appropriate, for authorization or approval of service providers for individual monitoring and calibration services”. |
| **OBSERVATION:** | It was observed that, while the Sri Lanka Atomic Energy Act empowers the SLAEB to provide calibration services, this does not ensure that the service meets the requirements of GSR Part 3. |
| **R3:** | **Recommendation:** The SLAERC should authorise or approve the SSDL service. |

| **BASIS:** | **GSG-7 paragraph 7.272 states that:** “A retention period of five years is generally recommended for the records of workplace monitoring and the records of the calibration of the workplace monitoring instruments”. |
| **OBSERVATION:** | It was noted that SSDL procedures require retention of records for 30 years. |
| **S7:** | **Suggestion:** It is suggested that the SSDL consider reviewing the retention period for its records to reduce storage costs. |

| **BASIS:** | **GSG-7 paragraph 7.98 states that:** “Once a workplace monitoring instrument is in use, periodic testing should be carried out to indicate any deterioration in its performance. Periodic testing should be carried out at least once a year and should involve a subset of the tests used in pre-use testing”. |
| **OBSERVATION:** | It was noted that there is no prescribed frequency of calibration of monitoring instruments in the regulations. |
| **S8:** | **Suggestion:** It is suggested that the SLAERC consider requiring periodic testing of workplace monitoring instruments. |

| **BASIS:** | **GSG-7 paragraph 7.104 states that:** “For all measurement methods, instruments should be regularly calibrated, and this calibration should be traceable to recognized national standards”. |
| **OBSERVATION:** | It was noted that the SSDL is not recognised as the national body for measurement of radiation dose or other radiation properties. |
| **S9:** | **Suggestion:** It is suggested that the SSDL pursue recognition as the national standard for dose. |
APPENDIX – IV: SRI LANKA ATOMIC ENERGY BOARD, RADIATION PROTECTION AND TECHNICAL SERVICES DIVISION

Facilities and services: Technical Service Provider (Workplace monitoring and Radiation Protection Training)
Location: Colombo
Dates: 26 and 27 November 2019
ORPAS Reviewers: Mr. S. Long (Australia), Ms. K. D. Romallosa (Philippines)
Persons met: Mr. Prasad Mahakamura (Technical Manager)
Mr. Nirasha Rathnaweera (Deputy Quality Manager)

INTRODUCTION

During the visits to the Personal Monitoring Services Laboratory and the Secondary Standards Laboratory of the Sri Lankan Atomic Energy Board, the team noted that the Radiation Protection Services Division also provided workplace monitoring and radiation protection training services.

GENERAL INFORMATION

The division has 9 permanent technical staff. These staff are well-qualified to provide the monitoring and training services.
The SLAEB also owns two facilities and equipment necessary to provide these services.

APPRAISAL FINDINGS

LEGAL REQUIREMENTS

The Sri Lanka Atomic Energy Act, No. 40 of 2014 specifically empowers the Sri Lanka Atomic Energy Board to provide radiation protection services to meet regulatory requirements (paragraph 3d) and to train persons in matters relating to radioactive materials and other related matters (paragraph 5i).

However, the division is not specifically authorised to provide these services by the regulatory body.

The division is not accredited to provide these services but has expressed its willingness to obtain accreditation if customer demand justifies the effort.
**RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES**

| BASIS: | GSR Part 3 Requirement 24 Paragraph 3.96 states that: Employers, registrants and licensees shall establish and maintain organizational, procedural and technical arrangements for the designation of controlled areas and supervised areas, for local rules and for monitoring of the workplace, in a radiation protection programme for occupational exposure. Registrants and licensees, in cooperation with employers where appropriate, shall establish, maintain and keep under review a programme for workplace monitoring under the supervision of a radiation protection officer or qualified expert. |
| OBSERVATION: | It was observed that Sri Lanka has limited resources available for workplace monitoring. |
| S10: | **Suggestion:** The SLAERC and the SLAEB should cooperate to ensure that limited resources are used effectively and efficiently to ensure employers have sufficient access to workplace monitoring services. |
| BASIS: | GSR Part 3 Requirement 26 states that: Employers, registrants and licensees shall provide workers with adequate information, instruction and training for protection and safety. |
| OBSERVATION: | It was observed that Sri Lanka has limited resources available for training in radiation protection. |
| S11: | **Suggestion:** The SLAERC and the SLAEB should cooperate to ensure that limited resources are used effectively and efficiently to ensure employers have sufficient access to radiation protection training services. |
APPENDIX V: LANKA HOSPITALS

Facilities and services: Operator (Medical Applications)
Location: Colombo
Dates: 26 November 2019
ORPAS Reviewers: Ms. O. Ciraj-Bjelac (Serbia)
Persons met: Dr. Wimal Karandagoda (Director, Medical Services)
Mr. Nimal Rathnayake (Group Chief Marketing Officer)
Dr. Parsanna Jayasekera (Chief Consultant Radiologist)
Dr. Chandraguptha Udugama (Chief Nuclear Medicine Consultant, RPO, Nuclear Medicine)
Mr. W.M.T.M. Bandara (RPO, Radiology)
Leading radiographers in gastroenterology department, nuclear medicine department, operational theatres, interventional cardiology
SLAEB representatives: Ms. Ama Sarani (Technical Assistant) and Mr. Lahiru Dias (Technician)

INTRODUCTION

The scope of the visit to Lanka Hospitals (Diagnostic Radiology and Nuclear Medicine Department) was to review the occupational radiation protection program in place for workers.

The visit started with an entrance meeting covering introductions, the purpose of the visit and an overview of how the appraisal would be conducted. Apart from the ORPAS team member and SLAEB representatives, hospital management representatives attended the meeting.

During the visit, the team had the opportunity to review available documentation, interview staff and tour the centre to observe the use of equipment and current practices in occupational radiation protection. The documents provided included: the license, the radiation protection manual, standard operating procedures (SOP) for various practices, individual dose records and workplace monitoring records (only in nuclear medicine department).

At the end of the visit, an exit briefing was held where the preliminary findings, conclusions and recommendations were presented to the hospital.

GENERAL INFORMATION

Lanka Hospitals is a large, private, internationally recognised hospital, with 350 beds. It provides multi-specialty tertiary care to patients. Radiation sources are used in two main departments: diagnostic radiology (including diagnostic and interventional X-ray modalities) and nuclear medicine. The latter provides diagnostic imaging using radiopharmaceuticals and radionuclide therapy for outpatients. There are also other departments using X-rays, e.g. gastroenterology, surgery and dentistry.

Currently, this hospital offers nuclear medicine service includes gamma camera and radionuclide therapy and outpatients (for Hyperthyroidism) with applied activity of I-131 up to 1100 MBq (30 mCi). The following radionuclides are used: Tc-99m (in Mo/Tc generators of 10 GBq purchased every second week) and I-131 capsules. The diagnostic radiology
Department is equipped with digital radiography, fluoroscopy, C-arm, full field digital mammography, bone densitometry unit, a number of mobile X-ray units, dental orthopantomographic and intraoral X-ray units and interventional radiology units (another is under installation).

There are 79 monitored workers employed in the Diagnostic Radiology Department and the Nuclear Medicine Unit, including, 3 consultant radiologist and 9 radiographers, one nuclear medicine consultant and a nuclear medicine technologist. The remaining workers are in other departments (surgery, gastroenterology, dentistry, interventional cardiology unit).

This hospital is eager to engage in international recognition and accreditation and the radiation protection program is a component of the overall hospital quality management systems, with great commitment of the hospital management and staff.

**APPRAISAL FINDINGS**

**LEGAL REQUIREMENTS**

Lanka Hospitals is a private hospital and has authorisation for use of ionising radiation by SLAERC. The hospital is subject to an inspection regime by SLAERC that includes a range of measurements (e.g. properties of x-ray tubes and generators and a dosimetry survey) to verify compliance with SLAERC requirements.

The hospital holds 4 different licences that are renewed regularly with a frequency that depends on the type of the practice: diagnostic radiology (low energy and high energy X rays) and nuclear medicine (diagnostic and therapy).

**RADIATION PROTECTION PROGRAM**

Lanka Hospitals has a well-structured Radiation Protection Program (RPP), developed by the RPOs in the department for diagnostic radiology and the department for nuclear medicine. The programs are different for these two types of practices. RPP for diagnostic radiology and nuclear medicine is described in two separate documents (each called a Radiation Protection Manual). However, both manuals are an integral part of the hospital Quality Management System. In addition, both departments use a number of radiation protection related Safety Operational Procedures (SOPs), as a part of the QMS.

The hospital has appointed RPOs for diagnostic radiology and nuclear medicine. Each are responsible for implementation of the RPP, in cooperation with hospital management and workers. Duties and responsibilities have been assigned by the hospital management. The RPO duties, as well as duties of workers are defined in the documents accompanying the RPP (SOPs).

There are 2 RPOs in the hospital with specific functions. The RPOs show excellent knowledge and skills in conducting the radiation protection duties in the hospital. They are dedicated, innovative and proactive in developing radiation management methods.

The RPOs have prepared standard operating procedures for various practices at the centre, some of which are specific to radiation protection. For example, SOPs for the access to the areas where radiation sources are used, emergency response, work with different radiation
sources, transporting and moving the mobile X-ray units, individual monitoring, radioactive waste management, cleaning of working areas, management of spillage, use of personal protective equipment and notifying of pregnancy. The SOPs are structured in accordance with hospital QMS. For example, the SOP for emergency response contain the following sections: scope, responsibilities, definitions, procedures, classification of events, contingency plan and references. There is also a distribution list for the SOPs that confirms that workers have been made aware of the SOPs.

Arrangements for pregnant workers are in place for workers so that those who are pregnant and breastfeeding (only in nuclear medicine) are not allowed to work regardless their estimated radiation doses. This arrangement is in accordance with requirement of the Ministry of Health.

In nuclear medicine department, which performs cardiac studies, the emergency care to the patients is provided by the nuclear medicine staff, specifically trained for that.

The radioactive waste in nuclear medicine department is adequately managed according to the procedure described in the RPP. It is clearly labelled, separated and kept in storage to decay (for 10 half-lives of radionuclides). The disused Mo/Tc generators are also kept in the hospital premises to decay. There is no arrangement for them to be returned to the supplier.

STAFF SELECTION, INFORMATION, AND TRAINING

The minimum training and qualification requirements for radiation workers are described in the RPP. Information about staff qualification and training is part of the licence application, however, there is no information about content and frequency of such training, or about approved training providers. Apparently SLAERC provides certain awareness training upon request of end-users. Occasionally, training sessions are provided by RPOs, but there is no information about the regularity of such training.

RADIATION PROTECTION MEASURES

Personal protective equipment (PPE) such as lead aprons, collars and lead glasses are available in the areas where they are required. There are properly maintained and checked.

Warning signs are posted on entrances to areas where X-rays are used. PPE, including protective aprons, goggles and thyroid collars are provided in the rooms where fluoroscopy guided procedures are performed.

Where unsealed radioactive sources are used, a survey meter and contamination monitoring devices are provided. The devices are calibrated once per year in the SSDL of SLAEB. SOPs for contamination and decontamination have been developed. Contamination monitoring is regularly performed and ORPAS team confirmed that spill kits were adequately equipped and maintained. The working areas are clean, well maintained and adequately equipped with protective tools such as lead bricks, containers, transport containers, forceps, etc.

Controlled and supervised areas are not clearly marked, although non-standard radiation signs are displayed at the entrance to each room where radiation sources are used. It was not clear what the criteria for classification of areas are and how it is applied to areas where mobile X-ray units are used. Currently, the classification for areas is based on the use of a particular room (“by design”). Designated supervised areas are distinguished using clear signage at the
entrance point to supervised area. The whole nuclear medicine department is classified as a controlled area.

**WORKPLACE MONITORING PROGRAM**

No records of a workplace monitoring programme in diagnostic radiology was observed.

Contamination and dose rate monitoring is regularly performed by staff in the nuclear medicine department and records are kept.

**INDIVIDUAL MONITORING PROGRAM**

Individual monitoring is performed using TLD badges sold by SLAEB. TLD holders and cards are the property of the hospital, but measurement and reporting of dose is provided by SLAEB. The monitoring period is two months. However, extremity dosimetry, eye lens dosimetry and double dosimetry are not available. Electronic personal dosimeters are also not available.

All data related to occupationally exposed workers is collected and maintained by RPOs. Individual dose records are reviewed and investigated if necessary, by the RPOs. Investigation levels are established, based on the recommendation from SLAEB and adequate records about investigation are kept. However, this procedure is not described in the SOPs. Information on individual doses for a particular worker are available upon request.

Dose constraints are not established. Currently, an internal dose monitoring program is not available.

**INTERVENTION IN EMERGENCY**

The RPPs, which includes the plan for emergency situations, considers the possibility of exceeding dose limits and significant overexposure to X-rays in the case of an emergency. However, guidance values for emergency workers are not indicated in the RPP. The contingency plan is based on different scenarios, including X-rays and the use of unsealed sources in nuclear medicine.

If a substantial overexposure is suspected, an investigation is undertaken to assess the dose received by the worker concerned and range of medical tests are arranged.

**HEALTH SURVEILLANCE**

Medical examinations of occupationally exposed workers are performed before radiation work commences and periodic reviews occur annually. The program of health surveillance is designed by the RPO; however, it does not include the occupation medicine specialist and statement if the worker is fit to work. The records are kept in the hospital’s HR department.

**QUALITY ASSURANCE**

A quality assurance program is described in the RPP, including periodic checks of PPE, radioactive sources and radioactive waste inventory. The hospital has established QMS.
### RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

| BASIS | GSR Part 3 Requirement 24 states that: “Arrangements under the radiation protection programme. Employers, registrants and licensees shall establish and maintain organizational, procedural and technical arrangements for the designation of controlled areas and supervised areas, for local rules and for monitoring of the workplace, in a radiation protection programme for occupational exposure.” |
| OBSERVATION | Radiation areas are not classified as controlled or supervised. |
| **R1:** | **Recommendation:** The license holder should make arrangement to define the boundaries of any controlled area, taking into account the magnitude of the exposures expected in normal operation, the likelihood and magnitude of exposures in anticipated operational occurrences and in accident conditions, and the type and extent of the procedures required for protection and safety. |
| BASIS | GSR Part 3 Requirement 24 states that: “Arrangements under the radiation protection programme. Employers, registrants and licensees shall establish and maintain organizational, procedural and technical arrangements for the designation of controlled areas and supervised areas, for local rules and for monitoring of the workplace, in a radiation protection programme for occupational exposure.” |
| OBSERVATION | Contamination and dose rate monitoring is regularly performed by staff in the nuclear medicine department and records are kept. The workplace monitoring is not established in other departments. Workplace monitoring is not used to assess and control the occupational exposure, or to permit decisions on the occupancy of areas. |
| **R2:** | **Recommendation:** The license holder should establish, maintain and keep under review a programme for workplace monitoring to assess and control the occupational exposure, or to permit decisions on the occupancy of areas. |
| BASIS | GSR Part 3 Requirement 13 states that: “The regulatory body shall establish and enforce requirements for safety assessment, and the person or organization responsible for a facility or activity that gives rise to radiation risks shall conduct an appropriate safety assessment of this facility or activity.” |
| OBSERVATION | Safety assessment is not performed. |
| **R3:** | **Recommendation:** The license holder and the regulatory body should ensure that the safety assessment is documented and reviewed under the relevant management system, including the suitable program for individual monitoring. |
| BASIS | GSR Part 3 Requirement 25 states that: “Employers, registrants and licensees shall be responsible for making arrangements for assessment and recording of occupational exposures and for workers’ health surveillance.” |
| OBSERVATION | Internal dosimetry for nuclear medicine staff and eye lens dosimetry and double dosimetry is not available for staff performing fluoroscopy guided procedures. |
**R4:** **Recommendation:** The license holder should provide internal dosimetry, double dosimetry and extremity monitoring to the relevant workers.

**BASIS**
GSR Part 3 Requirement 26 states that: “Employers, registrants and licensees shall provide workers with adequate information, instruction and training for protection and safety.”

**OBSERVATION**
A radiation protection training programme is not established.

**R5:** **Recommendation:** The license holder should provide appropriate training in protection and safety, as well as periodic retraining as required to ensure the necessary level of competence.

**BASIS**
GSG-7 paragraph 6.2 states that: “For the purposes of occupational radiation protection, there is no reason to make any general distinction between workers on the basis of gender. However, additional protection measures are required to be considered for a female worker during and after pregnancy in order to protect the embryo or fetus or the breastfed infant.”

**OBSERVATION**
The pregnant workers are excluded from work with radiation sources immediately after declaring pregnancy.

**S1:**
**Suggestion:** The licensee should consider modifying the local arrangements for pregnant and breastfeeding workers to ensure that the embryo or foetus or the breastfed infant is afforded the same broad level of protection as is required for members of the public.

**BASIS**
GSR Part 3 Requirement 5 states that: “The principal parties shall ensure that protection and safety are effectively integrated into the overall management system of the organizations for which they are responsible.”

**OBSERVATION**
The hospital has well established QMS. However, multiple Radiation Management Systems control the use of radiation sources in multiple departments of the hospital.

**S2:**
**Suggestion:** The management should consider establishing a Radiation Safety Committee to align the RP practices in the entire hospital.

**BASIS**
GSR Part 3 Requirement 16 states that: “Investigations and feedback of information on operating experience Registrants and licensees shall conduct formal investigations of abnormal conditions arising in the operation of facilities or the conduct of activities and shall disseminate information that is significant for protection and safety.”

**OBSERVATION**
Investigation levels are used but are not documented in the RPP.

**S3:**
**Suggestion:** Investigation level should be documented within the RPP with the guidance of SLAEB.

**BASIS**
GSR Part 3 Requirement 25 states that: “Employers, registrants and licensees shall be responsible for making arrangements for assessment and recording of occupational exposures and for workers’ health surveillance.”

**OBSERVATION**
Hard copies of individual dose records are kept but information about annual dose for a particular worker is not available.
S4: **Suggestion:** The RPOs should evaluate the annual effective dose based on the radiation dose reports provided by the SLAEB, noting that doses less than 0.15 mSv per monitoring period do not have to be recorded.

**BASIS**

GSR Part 3 Requirement 25 states that: “Employers, registrants and licensees shall be responsible for making arrangements for assessment and recording of occupational exposures and for workers’ health surveillance.”

**OBSERVATION**

A systematic program of health surveillance is not established.

S5: **Suggestion:** Lanka Hospitals should consider designing a health surveillance programme, based on the consultation with occupational medicine physicians.

**BASIS**

SSG-46 Paragraph 3.89 states that: “Personal protective equipment and in-room protective devices shall be available and used when structural shielding and administrative controls alone cannot afford the required level of occupational radiation protection.”

**OBSERVATION**

Different types of protective tools are used in nuclear medicine department; however, the portable protective shields are not available in the imaging room.

S6: **Suggestion:** The nuclear medicine department should consider use of portable protective shields that would protect staff from patients following application of radiopharmaceuticals.

**BASIS**

GSR Part 3 Requirement 17 Para. 3.51 and SSG 46 Para. 3.11 states that: “Registrants and licensees shall take into account the broad requirements when choosing a location to use a radiation generator, and these are relevant to the design of a radiology facility.”

**OBSERVATION**

The shielding calculation and requirements are not specific to the particular medical radiological facility.

S7: **Suggestion:** The license holder should consider developing shielding design procedures based on the realistic assessment of the actual practice.

**BASIS**

GSR Part 3 Requirement 23 Para. 3.85 states that: “If workers are engaged in work that involves or that could involve a source that is not under the control of their employer, the registrant or licensee responsible for the source and the employer shall cooperate to the extent necessary for compliance by both parties with the requirements of these Standards.” Further basis is provided in GSG-7 Section 6.

**OBSERVATION**

There is no arrangement in the RPP that address the occupational radiation protection of itinerant workers.

S8: **Suggestion:** Lanka Hospitals should consider providing arrangements for the protection and safety of itinerant workers.

**GP1:** **Good Practice:** The movement of every of mobile X-ray unit is recorded in a logbook.

**GP2:** **Good Practice:** Protective aprons are checked every year using fluoroscopy and findings, including images, are recorded.
INTRODUCTION

The scope of the visit to Ceylinco Healthcare Services Ltd. was to review the occupational radiation protection program in place for workers.

The visit started with an entrance meeting covering: introductions, the purpose of the visit and an overview of how the appraisal would be conducted. Apart from the ORPAS team member and SLAEB representatives, the meeting was attended by the hospital manager and two medical physicists, one of whom one is appointed RPO. During the visit, the team had the opportunity to review available documentation, interview staff and tour the centre to observe the use of equipment and current practices in occupational radiation protection. The documents provided included: the license, inspection reports, the radiation protection manual, standard operating procedures for various practices, individual dose records and emergency response procedures.

At the end of the visit, an exit briefing was held with hospital management, where the preliminary findings, conclusions and recommendations were presented to the hospital staff.

GENERAL INFORMATION

Ceylinco Healthcare Services Ltd. is a private hospital, specialising in radiotherapy treatments using X ray sources and sealed and unsealed sources of ionising radiation. This hospital offers radionuclide therapy for thyroid cancer for inpatients in a special design ward with four patients’ rooms, with total activity of I-131 (capsule) up to 2220 GBq annually.

The radiotherapy department uses one linear accelerator (maximum photon energy: 6 and 10 MeV), a High-Dose-Rate brachytherapy system using Ir-192 and a Tomotherapy unit. In addition, a CT simulator and mobile C-arm fluoroscopy are used for verification of treatment.

There are 18 workers employed in the hospital including, 1 consultant oncologist, 2 medical physicists, 4 radiology technologists, 1 medical officer and 10 nurses.

APPRAISAL FINDINGS

LEGAL REQUIREMENTS

Ceylinco Healthcare Services Ltd. is a private hospital and has authorisation for use of ionising radiation issued by the SLAERC. The hospital is subject to an inspection regime by SLAERC inspectors, including a radiation dose survey, to verify compliance with SLAERC
requirements. The hospital holds 3 different licences that are renewed regularly with a frequency that depends on the type of the practice.

RADIATION PROTECTION PROGRAM

Ceylinco Healthcare Services Ltd. has a well-structured Radiation Protection Program (RPP), developed by the RPO. The cornerstone of the RPP is Radiation Protection Manual (RPM). The content of the RPM is: radiation safety program, radiation effects, physical quantities, radiation protection committee (RPC) and its duties, duties of the responsible staff (radiation protection officer, radiation medical practitioner, medical physicist, radiation therapist), quality assurance, safety in external beam radiotherapy, equipment in external beam radiotherapy and brachytherapy, area monitoring equipment, acceptance testing of radiotherapy equipment, constancy tests, preventative maintenance, testing frequency and record keeping, external beam radiation treatment planning, approval and delivery, brachytherapy, accidents in radiotherapy, protection of pregnant radiation worker, radiopharmaceutical treatments, safety in I-131 treatments, personal monitoring and dosimetry, emergency procedure for I-131 therapy, emergency procedure if the source fails to return to the safe in brachytherapy, dose limits for planned exposure situations.

The hospital has appointed a medical physicist as the RPO. The RPO is responsible for implementation of the RPP in cooperation with hospital management and workers. The duties of the RPO, as well as duties of workers are defined in the RPM, as described above.

The RPO has prepared standard operating procedures (SOPs) for various practices at the centre, specific to radiation protection. These are part of the RPM which is distributed to all staff members. For example, SOPs, emergency response, work with different radiation sources, individual monitoring, radioactive waste management, or notification of pregnancy.

In the nuclear medicine department, the emergency care of patients is provided by specially trained hospital staff.

STAFF SELECTION, INFORMATION, AND TRAINING

The qualification requirements for radiation workers are described in the RPP. Information about staff qualification and training is part of the licence application, however, there is no information about content and frequency of such training, or about approved training providers. Occasionally, training sessions are provided by RPO, but the regularity of such training is not defined in the manual.

RADIATION PROTECTION MEASURES

According to the RPP, the hospital has established a Radiation Protection Committee, that meets occasionally. The duties of this committee are described in the RPP.

Personal protective equipment (PPE) such as lead aprons are available in the areas where they are required.

In areas where radiation sources are used, warning signs are posted on entrances. In addition, in brachytherapy and where unsealed radioactive sources are used, survey meters and contamination monitoring devices are provided. The devices are calibrated once per year in
the SSDL of SLAEB and the ORPAS team observed the calibration certificate. SOPs for contamination and decontamination have been developed.

Controlled and supervised areas are not clearly marked, although nonstandard radiation warning signs are displayed on each door where radiation sources are used. Due to the absence of regular workplace monitoring, dose rate levels and written procedures, the criteria for classification of areas is not clear. At present, the classification for areas is based on the use of the particular room (“by design”).

WORKPLACE MONITORING PROGRAM

There is no evidence of a workplace monitoring programme in diagnostic radiology. Dose rate monitoring is occasionally performed in brachytherapy and in the nuclear medicine department, but records are not kept.

INDIVIDUAL MONITORING PROGRAM

Personnel dose monitoring is performed using TLD badges sold to the hospital by SLAEB. TLD holders and cards remain the property of the hospital, but measurement and reporting of dose is performed by SLAEB. The wearing period is two months. Electronic personal dosimeters are not available to the workers in brachytherapy and I-131 therapy. All data related to exposed workers is collected and maintained by RPOs. Individual dose records are reviewed and investigated if necessary, by the RPOs. Investigation levels are established, based on the recommendation from SLAEB and adequate records about investigation are kept. However, this procedure is not described in the SOPs. Information on individual doses for a particular worker are available upon request. Dose constraints are not established. Currently, an internal dose monitoring program is not available.

INTERVENTION IN EMERGENCY

The RPP includes the list of possible emergency situations and contingency plans. The contingency plan is based on the different scenarios in radiotherapy and nuclear medicine. However, the emergency response plan (which is part of the RPP) does not include or establish guidance values for emergency workers. There is no evidence that procedures are rehearsed regularly, however, some drills are organised occasionally.

HEALTH SURVEILLANCE

Medical examinations of occupationally exposed workers are performed before radiation work commences and periodic reviews occur annually. The program of health surveillance is designed by the RPO; however, it does not include the occupation medicine specialist and statement if the worker is fit to work. The records are kept in the hospital’s human resources department.

QUALITY ASSURANCE

A Quality assurance (QA) program is described in the RPP. The QA program is performed by medical physics staff.
### RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

| **BASIS:** | **GSR Part 3 Requirement 24 states that:** “Employers, registrants and licensees shall establish and maintain organizational, procedural and technical arrangements for the designation of controlled areas and supervised areas, for local rules and for monitoring of the workplace, in a radiation protection programme for occupational exposure.” |
| **OBSERVATION:** | Radiation areas are not classified as controlled or supervised. |
| **R6:** | **Recommendation:** The license holder should make arrangement to define the boundaries of any controlled area, taking into account of the magnitude of the exposures expected in normal operation, the likelihood and magnitude of exposures in anticipated operational occurrences and in accident conditions, and the type and extent of the procedures required for protection and safety. |
| **BASIS:** | **GSR Part 3 Requirement 24 states that:** “Employers, registrants and licensees shall establish and maintain organizational, procedural and technical arrangements for the designation of controlled areas and supervised areas, for local rules and for monitoring of the workplace, in a radiation protection programme for occupational exposure.” |
| **OBSERVATION:** | The workplace monitoring is not established. |
| **R7:** | **Recommendation:** The license holder should establish, maintain and keep under review a programme for workplace monitoring. |
| **BASIS:** | **GSR Part 3 Requirement 13 states that:** “The regulatory body shall establish and enforce requirements for safety assessment, and the person or organization responsible for a facility or activity that gives rise to radiation risks shall conduct an appropriate safety assessment of this facility or activity.” |
| **OBSERVATION:** | Safety assessment is not performed. |
| **R8:** | **Recommendation:** The license holder and the regulatory body should ensure that the safety assessment is documented and reviewed under the relevant management system, including the suitable program for individual monitoring. |
| **BASIS:** | **GSR Part 3 Requirement 25 states that:** “Employers, registrants and licensees shall be responsible for making arrangements for assessment and recording of occupational exposures and for workers’ health surveillance.” |
| **OBSERVATION:** | Internal dosimetry for nuclear medicine staff is not available. |
| **R9:** | **Recommendation:** The license holder should provide internal dose monitoring to the relevant workers. |
| **BASIS:** | **GSR Part 3 Requirement 26 states that:** “Employers, registrants and licensees shall provide workers with adequate information, instruction and training for protection and safety.” |
| **OBSERVATION:** | Radiation protection training programme is not established. |
| **R10:** | **Recommendation:** The license holder should provide appropriate training in protection and safety, as well as periodic retraining as required to ensure the necessary level of competence. |
| **BASIS:** | **GSG-7 6.6 states that:** “the restrictions should be such as to ensure that under normal operational conditions the requirements of GSR Part 3 with regard to dose limitation for members of the public are met” |
for the embryo or foetus during pregnancy and for the breastfed infant thereafter”.

<table>
<thead>
<tr>
<th>OBSERVATION:</th>
<th>According to the RPP, the radiation dose to the embryo/foetus of a declared pregnant woman should be limited to 5 mSv.</th>
</tr>
</thead>
<tbody>
<tr>
<td>S9:</td>
<td><strong>Suggestion:</strong> The licensee should consider modifying the local arrangements for pregnant and breastfeeding workers to ensure that the embryo or foetus or the breastfed infant is afforded the same broad level of protection as is required for members of the public.</td>
</tr>
<tr>
<td>BASIS</td>
<td><strong>GSR Part 3 Requirement 16 states that:</strong> “Investigations and feedback of information on operating experience Registrants and licensees shall conduct formal investigations of abnormal conditions arising in the operation of facilities or the conduct of activities and shall disseminate information that is significant for protection and safety.”</td>
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<td>OBSERVATION:</td>
<td>Investigation levels are used but are not documented in the RPP.</td>
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<td><strong>Suggestion:</strong> Investigation levels should be documented within the RPP with the guidance of SLAEB.</td>
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<td><strong>GSR Part 3 Requirement 25 states that:</strong> Employers, registrants and licensees shall be responsible for making arrangements for assessment and recording of occupational exposures and for workers’ health surveillance.</td>
</tr>
<tr>
<td>OBSERVATION</td>
<td>The individual dose records are kept in hard copy and information about total dose for a particular worker is not available.</td>
</tr>
<tr>
<td>S11:</td>
<td><strong>Suggestion:</strong> The RPOs should evaluate the annual effective dose based on the radiation dose reports provided by the SLAEB.</td>
</tr>
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<td><strong>GSR Part 3 Requirement 25 states that:</strong> Employers, registrants and licensees shall be responsible for making arrangements for assessment and recording of occupational exposures and for workers’ health surveillance.</td>
</tr>
<tr>
<td>OBSERVATION</td>
<td>The systematic program of health surveillance is not established.</td>
</tr>
<tr>
<td>S12:</td>
<td><strong>Suggestion:</strong> The license holder may consider designing the health surveillance programme based on the consultation with occupational medicine physicians.</td>
</tr>
<tr>
<td>BASIS:</td>
<td><strong>GSG-7 Paragraph 6.66 states that:</strong> The radiation protection programme should, among other things, assign responsibilities for protection and safety for itinerant workers to the management of the facility and to the contractor in accordance with the terms of the contractual agreement.</td>
</tr>
<tr>
<td>OBSERVATION</td>
<td>There is no arrangement in the RPP that address the occupational radiation protection of itinerant workers.</td>
</tr>
<tr>
<td>S13:</td>
<td><strong>Suggestion:</strong> The license holder may consider providing arrangements for itinerant workers, in terms of their protection and safety.</td>
</tr>
<tr>
<td>BASIS:</td>
<td><strong>SSG 46 Pars. 4.130 and 5.169 states:</strong> Use of electronic dosimeters is required for certain practices.</td>
</tr>
<tr>
<td>OBSERVATION</td>
<td>The electronic personal dosimeters are not available for the relevant workers in brachytherapy and I-131 therapy.</td>
</tr>
<tr>
<td></td>
<td><strong>Suggestion:</strong> The license holder may consider providing electronic personal dosimeters to the workers in brachytherapy and nuclear medicine.</td>
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<tr>
<td><strong>S14:</strong></td>
<td><strong>BASIS:</strong> GSG-7, Para. 9.24 (contamination control) and SSG 46 Para. 4.276 stare that: “Radioactive waste should be managed and controlled accordingly.”</td>
</tr>
<tr>
<td><strong>OBSERVATION:</strong></td>
<td>The contaminated transport containers and other contaminated items are not kept in a manner to avoid spread of contamination.</td>
</tr>
<tr>
<td></td>
<td><strong>Suggestion:</strong> The license holder may consider locating bins for the temporary storage of linen and waste contaminated with radioactive materials, including containers for delivery of radiation sources in the dedicated waste storage area.</td>
</tr>
<tr>
<td><strong>S15:</strong></td>
<td><strong>BASIS:</strong> SSG 46 Pars. 4.93 states that: “Specific local rules and procedures for radiopharmaceutical therapy”.</td>
</tr>
<tr>
<td><strong>OBSERVATION:</strong></td>
<td>It is not clear if nurses, cleaners and other support staff in the ward used for radionuclide treatment are adequately trained and subject to health surveillance.</td>
</tr>
<tr>
<td></td>
<td><strong>Suggestion:</strong> The license holder may consider providing training for nuclear medicine staff. The training should cover radiation protection and specific local rules, in particular for situations where there is a risk of significant contamination.</td>
</tr>
<tr>
<td><strong>S16:</strong></td>
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</table>
INTRODUCTION

The scope of the visit to the National Hospital of Sri Lanka, Diagnostic Radiology and Nuclear Medicine Department and Interventional Cardiology Department, was to review the occupational radiation protection program in place for workers.

The appraisal was conducted separately for the Interventional Cardiology and Diagnostic Radiology and the Nuclear Medicine Department and Interventional Cardiology Department, following the same agenda. Therefore, the visit started with an entrance meeting covering introductions, the purpose of the visit and an overview of how the appraisal would be conducted. Apart from the ORPAS team member and SLAEB representatives, the meeting was attended by department management representatives. During the visit, the team had the opportunity to review available documentation, interview staff and tour the centre to observe the use of equipment and current practices in occupational radiation protection. The documents provided included: the license, some of the local rules and individual dose records and inspection records.

At the end of the visit, an exit briefing was held where the preliminary findings, conclusions and recommendations were presented to the hospital staff.

GENERAL INFORMATION

The National Hospital, situated in Colombo, is the largest teaching hospital in Sri Lanka and the final referral centre in the country consisting of 3000 beds. It is the training centre for undergraduate and postgraduate trainees of the Faculty of Medicine. It provides multi-speciality tertiary care to patients. The radiation sources are used in two main departments: diagnostic radiology and nuclear medicine (including diagnostic and interventional X-ray modalities, SPECT and PET/CT) and interventional cardiology.

Currently, the hospital offers nuclear medicine service includes three gamma cameras and a PET/CT. No radionuclide therapy is provided at the moment. The following radionuclides are
used: Tc-99m (in Mo/Tc generators of 12.5 GBq purchased every second week), total 325 GBq per year and F-18 imported from India, twice per week, total 192.4 GBq per year.

The diagnostic radiology department is equipped with radiography (10 units), fluoroscopy (3 units), multiple mobile C-arms, full field digital mammography (1 unit), interventional radiology units (2 units) and CT (2 units).

The interventional cardiology department offers a range of cardiac interventional procedures performed in four interventional cardiology rooms.

There are 125 workers employed in the diagnostic radiology and nuclear medicine departments, including 75 radiographers, 25 radiologists and 10 consultants. The remaining workers are radiographers and nuclear medicine staff members.

In the interventional cardiology departments, there are totally 93 staff members (all designated as occupationally exposed workers): Interventional Cardiologists (13), Senior Registrars (15), Radiographers (9), Nurses (34), Cardiographers (10) and Heath Care Assistants (12).

APPRAISAL FINDINGS

LEGAL REQUIREMENTS

The National Hospital is a public, teaching hospital and has authorisation for use of ionising radiation issued by the SLAERC. The hospital is subject to an inspection regime that includes also a range of measurements (e.g. properties of x-ray tubes and generators and dosimetry survey) to verify compliance with regulatory requirements.

The hospital holds 3 different licences that are renewed regularly with a frequency that depends on the type of the practice: general radiology, nuclear medicine and interventional cardiology.

RADIATION PROTECTION PROGRAM

The National Hospital does have a structured Radiation Protection Program (RPP). Some elements of the RPP were observed by the ORPAS team. However, there is no systematic documentation to support the RPP.

The hospital has appointed RPOs for the diagnostic radiology and nuclear medicine department and for the interventional cardiology department. The duties and responsibilities of the RPO have not been documented. No documentation indicating the duties of workers or Standard Operational Procedures (SOPs) was observed. In the nuclear medicine department, the ORPAS team observed that the RPO duties are limited to the distribution of dosimeters but that no documentation was observed that assigned other radiation protection duties to any of the staff members.

Arrangements for pregnant and breast-feeding workers are not formally in place, however the common practice is that female workers are transferred to other duties, that exclude the use of ionising radiation sources, after declaring the pregnancy.

There is no formal documentation for the following elements of the RPP: classification of area, local rules, individual and workplace monitoring, information and training of workers, health surveillance, investigation levels, interventional in emergency and quality assurance.
There is no documentation that trainees, fellow and residences are covered by the RPP. There are no arrangements for itinerant workers.

STAFF SELECTION, INFORMATION, AND TRAINING

There is no documentation of the minimum training and qualification requirements for all radiation workers in the hospital. Information about staff qualification and training is part of the licence application, however, the ORPAS team has been informed that no documentation supporting staff training is submitted with the license application.

RADIATION PROTECTION MEASURES

Personal protective equipment (PPE) such as lead aprons, collars and lead glasses are available in the areas where they are required. The number seems to be adequate and ORPAS team has observed that these are used. The PPE is occasional tested, however, the ORPAS team has also observed that they are not adequately maintained and stored in all departments. There is no documentation of regular testing of the PPE. However, after completing the ORPAS questionnaires, the RPO in the interventional cardiology departments has initiated activities to test the lead aprons.

The fluoroscopy guided procedures are performed on dedicated interventional units and also using the over-couch fluoroscopy units. The PPE includes protective aprons, goggles and thyroid collars, which are provided in the room and these are utilized. All rooms are equipped with ceiling screens, used as a collective protective tool.

In some areas where X-rays are used, non-standard radiation warning signs are posted at the entrance, but not in all departments.

Where unsealed radioactive sources are used, a survey meter and a contamination monitoring device is available. However, there is no documentation that this has been calibrated and used regularly. A spill kit was not observed. Additional observations related to the radiation protection in nuclear medicine department include control unit of a gamma camera is located in the imaging room, portable shields are not available, very few syringe protection tools and forceps are available, working surfaces are not covered with absorbing materials.

Radioactive waste in the nuclear medicine department is managed using dedicated storage and bins, however, the ORPAS team observed that the bins and storage are not properly marked, that different types of waste is not separated and that there are no written procedures for radioactive waste management. The disused Mo/Tc generators are also kept on hospital premises, without a plan for their further management. There is no arrangement for them to be returned to the supplier.

Controlled and supervised areas are not clearly marked, although non-standard radiation warning signs are displayed on each door where radiation sources are used. Due to the absence of workplace monitoring, dose rate levels and written procedures, the criteria for the classification of areas is not clear.

WORKPLACE MONITORING PROGRAM

There is no documentation regarding a workplace monitoring programme.
The ORPAS team had an opportunity to see the quality control kit, that includes the radiation dose survey meter that has been delivered to the hospital through a national IAEA TC project. The equipment is kept, but not used, in the radiology department with two medical physicists who are not formally involved in any radiation protection activities in the hospital. In addition, one contamination monitor/survey meters is available in the nuclear medicine department. There is no documentation that this equipment has been used routinely.

INDIVIDUAL MONITORING PROGRAM

Individual monitoring is performed using TLD badges sold by SLAEB. TLD holders and cards are property of the hospital, while the measurement and reporting service is provided by SLAEB. The monitoring period is set to two months. However, extremity dosimetry, eye lens dosimetry and double dosimetry are not available. Electronic personal dosimeters are not available to the workers in fluoroscopy guided interventional procedures.

All data related to exposed workers is collected and maintained by RPOs in the form of bi-monthly SLAEB reports. Some instructions on how to use TLDs are provided to the workers from the RPO.

The ORPAS team observed that individual monitoring is not provided to all workers. For example, in interventional cardiology, monitoring is only available to 35 workers out of 93. In the diagnostic radiology and nuclear medicine department all staff members and all workers are provided individual monitors. However, X-ray units are used in other departments (surgery, gastroenterology…) and it is not known whether these employees are monitored.

The individual monitoring for workers working in multiple places has not been arranged.

Dose constraints are not established. Currently, an internal dose monitoring program is not available.

INTERVENTION IN EMERGENCY

There is no evidence of any plan for emergency situations or any related activities.

HEALTH SURVEILLANCE

There is no documentation regarding a health surveillance program, except occasional blood count tests.

QUALITY ASSURANCE

There is no documentation regarding a quality assurance programme.
### RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

<table>
<thead>
<tr>
<th>BASIS:</th>
<th>GSR Part 3 Requirement 25 states that: <em>Employers, registrants and licensees shall be responsible for making arrangements for assessment and recording of occupational exposures and for workers’ health surveillance.</em></th>
</tr>
</thead>
<tbody>
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<td>OBSERVATION:</td>
<td>The individual monitoring is not available to all occupationally exposed workers.</td>
</tr>
<tr>
<td><strong>R11:</strong></td>
<td><strong>Recommendation:</strong> The license holder should make arrangements for assessment of the occupational exposure of workers, on the basis of individual monitoring where appropriate.</td>
</tr>
<tr>
<td>BASIS:</td>
<td>GSR Part 3 Requirement 24 states that: “Arrangements under the radiation protection programme. Employers, registrants and licensees shall establish and maintain organizational, procedural and technical arrangements for the designation of controlled areas and supervised areas, for local rules and for monitoring of the workplace, in a radiation protection programme for occupational exposure.”</td>
</tr>
<tr>
<td>OBSERVATION:</td>
<td>Radiation areas are not classified as supervised or controlled areas.</td>
</tr>
<tr>
<td><strong>R12:</strong></td>
<td><strong>Recommendation:</strong> The license holder should make arrangement to define the boundaries of any controlled area, taking into account of the magnitude of the exposures expected in normal operation, the likelihood and magnitude of exposures in anticipated operational occurrences and in accident conditions, and the type and extent of the procedures required for protection and safety. The proper radiation warning signs should be used accordingly.</td>
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<tr>
<td>OBSERVATION:</td>
<td>Safety assessment is not performed.</td>
</tr>
<tr>
<td><strong>R14:</strong></td>
<td><strong>Recommendation:</strong> The license holder and the regulatory body should ensure that the safety assessment is documented and reviewed under the relevant management system, including the suitable program for individual monitoring.</td>
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</tr>
<tr>
<td>OBSERVATION:</td>
<td>The internal dosimetry for nuclear medicine staff and eye lens dosimetry and double dosimetry is not available for staff performing fluoroscopy-guided procedures.</td>
</tr>
<tr>
<td>R15:</td>
<td><strong>Recommendation:</strong> The license holder should provide double dosimetry and extremity monitoring to the relevant workers in fluoroscopy guided interventional procedures and nuclear medicine.</td>
</tr>
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<td>BASIS:</td>
<td>GSR Part 3 Requirement 26 states that: “Employers, registrants and licensees shall provide workers with adequate information, instruction and training for protection and safety.”</td>
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<td>OBSERVATION:</td>
<td>Radiation protection training programme is not established.</td>
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<tr>
<td>R16:</td>
<td><strong>Recommendation:</strong> The license holder should provide appropriate training in protection and safety, as well as periodic retraining as required to ensure the necessary level of competence.</td>
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<tr>
<td>OBSERVATION:</td>
<td>The hospital has not developed and documented a radiation protection programme</td>
</tr>
<tr>
<td>R17:</td>
<td><strong>Recommendation:</strong> The National Hospital should establish and maintain organizational, procedural and technical arrangements for the designation of controlled areas and supervised areas, for local rules and for monitoring of the workplace, in a radiation protection programme for occupational exposure.</td>
</tr>
<tr>
<td>BASIS:</td>
<td>GSG 7 6.2 – 6.20 states that: “additional protection measures are required to be considered for a female worker during and after pregnancy in order to protect the embryo or fetus or the breastfed infant.”</td>
</tr>
<tr>
<td>OBSERVATION:</td>
<td>The arrangement for pregnant and breastfeeding workers is not documented in the RPP</td>
</tr>
<tr>
<td>S17:</td>
<td><strong>Suggestion:</strong> The licensee should consider modifying the local arrangements for pregnant and breastfeeding workers to ensure that the embryo or foetus or the breastfed infant is afforded the same broad level of protection as is required for members of the public.</td>
</tr>
<tr>
<td>BASIS:</td>
<td>GSR Part 3 Requirement 5 states that: “The principal parties shall ensure that protection and safety are effectively integrated into the overall management system of the organizations for which they are responsible.”</td>
</tr>
<tr>
<td>OBSERVATION:</td>
<td>The radiation sources are used in multiple department of the hospital, with multiple appointed RPOs, without any documented RPP. The medical physicist is not involved in any radiation protection activities.</td>
</tr>
<tr>
<td>S18:</td>
<td><strong>Suggestion:</strong> The management should consider establishing a Radiation Safety Committee to align the radiation protection practices in the hospital.</td>
</tr>
<tr>
<td>BASIS:</td>
<td>GSR Part 3 Requirement 21 Para. 3.77 and GSG 7 Para. 3.29 states that: “Dose constraints are set separately for each source under control”</td>
</tr>
</tbody>
</table>
and they serve as boundary conditions in defining the range of options for the purposes of optimization of protection and safety. Dose constraints are not dose limits: exceeding a dose constraint does not represent non-compliance with regulatory requirements, but it could result in follow-up actions.”

**OBSERVATION:** Dose constrains are not used in the hospital.

**S19:** **Suggestion:** The dose constrains should be established, with the guidance of SLAERC.

**BASIS:** GSR Part 3 Requirement 25 states that: “Employers, registrants and licensees shall be responsible for making arrangements for assessment and recording of occupational exposures and for workers’ health surveillance.”

**OBSERVATION:** The individual dose records are kept in hard copy and information about annual dose for a particular worker is not available.

**S20:** **Suggestion:** The RPOs should evaluate the annual effective dose based on the radiation dose reports provided by the SLEAB.

**BASIS:** GSR Part 3 Requirement 25 states that: “Employers, registrants and licensees shall be responsible for making arrangements for assessment and recording of occupational exposures and for workers’ health surveillance.”

**OBSERVATION:** The systematic program of health surveillance is not established.

**S21:** **Suggestion:** The license holder may consider designing the health surveillance programme based on the consultation with occupational medicine physicians.

**BASIS:** GSR Part 3 Requirement 24 Para. 3.93 and 3.95 states that: “Personal protective equipment and in-room protective devices shall be available and used when structural shielding and administrative controls alone cannot afford the required level of occupational radiation protection.”

**OBSERVATION:** The portable protective tools are not available in the nuclear medicine department.

**S22:** **Suggestion:** The nuclear medicine department should consider use of portable protective shields that would protect staff from patients following application of radiopharmaceuticals.

**BASIS:** GSR Part 3 Para. 3.51 and SSG 46 Para. 3.11 states that: “Registrants and licensees shall take into account the broad requirements when choosing a location to use a radiation generator, and these are relevant to the design of a radiology facility.”

**OBSERVATION:** The shielding calculation and requirements are not specific to the particular medical radiological facility.

**S23:** **Suggestion:** The license holder should consider developing shielding design procedures based on the realistic assessment of the actual practice.

**BASIS:** GSG-7 Paragraph 6.66 states that: “The radiation protection programme should, among other things, assign responsibilities for protection and safety for itinerant workers to the management of the facility and to the contractor in accordance with the terms of the contractual agreement.”
<table>
<thead>
<tr>
<th>OBSERVATION:</th>
<th>There is no arrangement in the RPP that address the occupational radiation protection of itinerant workers. Trainees, fellows and residents are not covered by the RPP.</th>
</tr>
</thead>
<tbody>
<tr>
<td>S24:</td>
<td><strong>Suggestion</strong>: The license holder may consider providing arrangements for itinerant workers, in terms of their protection and safety. The arrangement for occupational radiation protection of trainees, fellows and residents should be in place.</td>
</tr>
<tr>
<td>BASIS:</td>
<td>SSG 46 Pars. 4.130 and 5.169 states: “Use of electronic dosimeters is required for certain practices.”</td>
</tr>
<tr>
<td>OBSERVATION:</td>
<td>Electronic personal dosimeters are not available to the staff performing fluoroscopy guided interventional procedures.</td>
</tr>
<tr>
<td>S25:</td>
<td><strong>Suggestion</strong>: The license holder should consider providing electronic personal dosimeters to the workers in interventional cardiology and interventional radiology.</td>
</tr>
<tr>
<td>BASIS:</td>
<td>GSG-7, Para. 9.24 (contamination control) and SSG 46 Para. 4.276 state that: “Radioactive waste should be managed and controlled accordingly.”</td>
</tr>
<tr>
<td>OBSERVATION:</td>
<td>The radioactive waste is not segregated and properly labelled.</td>
</tr>
<tr>
<td>S26:</td>
<td><strong>Suggestion</strong>: The license holder should consider labelling the bins for the temporary storage of radioactive waste of different type.</td>
</tr>
<tr>
<td>BASIS:</td>
<td>SSG-46 Para. 4.93 states that: “Specific local rules and procedures for radiopharmaceutical therapy is required to be developed.”</td>
</tr>
<tr>
<td>OBSERVATION:</td>
<td>It is not clear if nuclear medicine staff are properly trained about basic safety features related to the used of unsealed radiation sources in nuclear medicine</td>
</tr>
<tr>
<td>S27:</td>
<td><strong>Suggestion</strong>: The license holder should consider training of nuclear medicine staff. The training should cover radiation protection and specific local rules, in particular for situations where there is a risk of significant contamination.</td>
</tr>
<tr>
<td>BASIS:</td>
<td>GSG 7 Para 7.7 states that: “In situations where protective clothing such as lead aprons can be used, it is advisable to use one dosimeter under the protective clothing and one on an unshielded part of the body.”</td>
</tr>
<tr>
<td>OBSERVATION:</td>
<td>Double dosimetry and eye lens dosimetry for staff in fluoroscopy guided interventional procedures is not available.</td>
</tr>
<tr>
<td>S28:</td>
<td><strong>Suggestion</strong>: The license holder should consider providing double dosimetry for staff in fluoroscopy guided interventional procedures, as interventional radiology and interventional cardiology. This arrangement could be used for eye lens dose assessment.</td>
</tr>
</tbody>
</table>
INTRODUCTION

The purpose of the visit to NCNDT and CBNDT was to review their arrangements for occupational radiation protection and to provide a report incorporating findings, recommendations and suggestions for strengthening the Occupational Radiation Protection Programme of these organizations.

The result for the two organizations has been combined into a single report. The reason for this is that the CBNDT is actually using the employees and the equipment of the NCNDT for conducting the practical part of the examination on Radiographic Testing (RT). In fact, this practice is covered by the license and the radiation protection program of the NCNDT. As a result, every RT exam organized by CBNDT requires prior authorization from the RPO of NCNDT.

GENERAL INFORMATION

Prior to the appraisal, both NCNDT and CBNDT were requested to complete ORPAS questionnaires for end users and a questionnaire that was designed by the ISEMIR WG on Industrial Radiography. The ISEMIR questionnaire is based on IAEA Specific Safety Guide 11 Radiation Safety in Industrial Radiography, and consisted of questions related to four broad subjects:

- Qualification and training of industrial radiographers in radiation protection;
- Learning from incidents;
- Systems and procedures in place for safe operation;
- Emergency preparedness and response.

The RPO of NCNDT completed the questionnaires. Further clarification and documentation were provided during the visit. From this, the ORPAS team got a good impression of the Radiation Protection Program and how it was implemented.

NCNDT performs radiography both inside and external to their own premises. They possess two X-ray generators and one gamma exposure device. Since the activity of the latter has
decayed to an activity of less than $5 \times 10^{-8}$ Ci, the gamma exposure device is only used for training.

NCNDT has a team of 24 scientific, technical and support staff (17 operators and 7 support staff). 13 operators are qualified in Radiographic Testing (RT) level 1 or level 2 as per ISO 9712 standard and other 4 are trainee operators who operate machine under the close supervision and presence of a qualified operator. All of the workers are registered with the Personal Monitoring Service (SLAEB).

NCNDT offers both NDT training and NDT inspection services. In 2020 three training programmes are scheduled for RT: for level 1, 2 and 3, respectively. The syllabus of the training is based on IAEA-TECDOC-628 (Rev. 3) and includes training on radiation protection: 16, 12 and 5 hours for RT level 1, 2 and 3, respectively.

As an indication of the workload of RT inspection services the number of films exposed is used. In 2018 NCNDT exposed 487 films inside their own premises and 53 outside their premises. In 2019, they have exposed 165 films inside and about 200 outside. However, it was noted that NCNDT has been granted a relatively big project at a power station in which they have to perform RT on 1,800 joints. This will be executed in the last weeks of 2019. During this project they expect to expose maximum of 3,600 films for 1,800 joints and 2 films at one time.

**APPRAISAL FINDINGS**

**AUTHORIZATION DETAILS:**

A license was issued to the Director of the NCNDT with number GM/49/0/IR-01/L/01/2019, effective from 01/01/2019 with an expiry date of 31/12/2019. It mentions RPO and covers the use and possession of two X-ray sources and the storage of one Ir-192 source. Every year, by September, NCNDT has to apply for renewal. This leaves enough time for the SLAERC to conduct an inspection and issue a new license. The application form requires the available radiation monitoring equipment and emergency equipment to be listed.

On 22 November NCNDT received a specific authorization “for use of industrial radiography X-ray machines for radiography work at Norochchole power plant” (valid until 23 January 2020).

**EXPOSURE DEVICES AND ANCILLARY EQUIPMENT:**

The exposure device is a Sentinel 880 Delta with matching ancillary equipment (control cable and guide tube). Since the activity of the Ir-192 source decayed to less than 1 μCi, the gamma exposure device is only used for training purposes.

**RADIATION SOURCES**

The specification of the two X ray generators are as follows:

- Eresco 300MF4-R, max. 300 kV and max. 6 mA
- Teledyne ICM SITE-XS C2504, max 250 kV and 4 mA
A preventive maintenance program was not in place until November 2019. The ORPAS team notes that the first preventive maintenance inspection occurred on 22 November 2019.

TRAINING

Training is arranged via the RT certification scheme, as described above. Refresher training is not yet organized, but the RPO intends to implement this in 2020. There is also no specific practical training for emergency situations.

INDIVIDUAL MONITORING AND HEALTH SURVEILLANCE

The RT operators and support staff wear TLDs. A bimonthly (once in 2 month) readout frequency was agreed with the SLAERC. In 2016, 2017 and 2018 no annual doses above the minimum detection limit were recorded. However, in 2019 there were four technical assistants for whom an annual dose between 0.69 and 0.81 mSv were recorded, apparently all received in the same month. An investigation did not reveal the cause of this “unusual dose”, although the four assistants worked closely together. Monthly dose reports are shared with employees by publication on the notice board and ‘dose notification record’ is sent for each occupationally exposed worker.

NCNDT classifies a single readout of 3.25 mSv (per 2 months) as an ‘over-exposure’. Exposures above this level prompt an investigation into the cause. This level is a general level defined by the Personal Monitoring Service. NCNDT does not apply a workplace-specific investigation level or dose constraint.

NCNDT does not employ persons under 18 years of age. They employ 3 female operators and 1 female assistant. They are informed during training about the importance to immediately report pregnancy to their supervisor. Pregnant workers will be assigned other work in which they are not exposed to ionising radiation.

All operators and assistants must undergo an annual health surveillance. The conclusion whether a person is fit or unfit is shared with the RPO who keeps a file. NCNDT asks for quotation from different hospitals thereby specifying the medical test that have to be performed. This includes an annual chest X-ray. There is no justification with respect to radiation protection for mandating the annual chest X-ray.

SHIELDED ENCLOSURE

Since the NCNDT moved from their previous location, they do not have a well-designed shielded enclosure available. They are currently using the dark room on the ground floor, next to the canteen for this purpose. This had been approved by the regulator under the provision that the canteen and the area in front of the entrance of both the canteen and the dark room are cordoned off as a controlled area. Actually, this is like the performance of site radiography, but then on NCNDT’s own location. The RPO has performed a radiation survey during the operation of the x-ray equipment at the highest potential and current, and the dose rate at the floor above the dark room was acceptable.
In September 2019 the construction of a new shielded enclosure started and is expected to be finalized in the first half of 2020. The design of this “Industrial Radiography room” had already been approved by the regulator in writing on 29 August 2017, but the budget only became available this year. In the approval the minimum thicknesses of concrete walls are prescribed, although without a shielding calculation. The ORPAS team was informed that room plan of the shielded enclosure is similar to the room plan of the shielded enclosure NCNDT had available on their previous location. The design does not include safety systems: no door interlock system or emergency stop buttons or pull cords are intended to be installed.

OPERATING PROCEDURES

During the visit no RT was performed. The dark room, in which one X-ray generator and the gamma exposure device with the decayed Ir-192 source was stored, was observed.

WORKPLACE MONITORING

Workplace monitoring is performed with calibrated survey meters. Valid calibration certificates were shown. Controlled areas are cordon off at 2.5 μSv/h.

RADIATION PROTECTION PROGRAM

Version NCNDT/RPP/2019/10 of the RPP was shared with the reviewer, as well as version NCNDT/EP/2019/10 of the emergency (preparedness and response) plan (EPR). The RPP mentions the position of an assistant RPO, however this position is not yet filled. Overall the RPP and the EPR look well aligned with the guidance given in SSG-11.

<table>
<thead>
<tr>
<th>RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASIS:</td>
</tr>
<tr>
<td>GSR Part 3 Requirement 21, Paragraph 3.76 (h) states that:</td>
</tr>
<tr>
<td>“Suitable and adequate human resources and appropriate training in protection and safety are provided, as well as periodic retraining as required to ensure the necessary level of competence”.</td>
</tr>
<tr>
<td>SSG-11 Paragraph 5.7 states that: “The training should provide practical exercises, including the rehearsal of emergency plans ...”</td>
</tr>
<tr>
<td>SSG-11 Paragraph 5.8 states that: “Radiography personnel should ensure that their knowledge and skills are kept up to date through a programme of refresher training.”</td>
</tr>
<tr>
<td>SSG-11 Paragraph 13.22 states that: “All persons who will participate in implementing the emergency plans should be adequately trained for the effective fulfilment of their roles.”</td>
</tr>
<tr>
<td>OBSERVATION: There is no proof that the emergency training nor refresher training conducted at NCNDT includes rehearsal of emergency plans</td>
</tr>
<tr>
<td>R1: Recommendation: The license holder should include rehearsal of emergency plans and refresher training in their training programme.</td>
</tr>
<tr>
<td>BASIS:</td>
</tr>
<tr>
<td>SSG-11 Paragraph 6.7 states that: “...Operating companies should therefore provide personal alarm monitors to all radiographers and assistants...”</td>
</tr>
<tr>
<td>OBSERVATION: Operators and assistant are not provided with personal alarm monitors.</td>
</tr>
<tr>
<td><strong>R2:</strong></td>
</tr>
</tbody>
</table>
| **BASIS:** | GSR-Part 3 Requirement 15 Paragraph 3.39 states that: “The registrant or licensee, in cooperation with other responsible parties, shall ensure that the siting, location, design, manufacture, construction, assembly, commissioning, operation, maintenance and decommissioning (or closure) of facilities or parts thereof are based on good engineering practice…”  
SSG-11 Paragraph 10.7 states that: “Enclosures should preferably have a shielded roof.”  
SSG-11 Paragraph 10.26 states that: “Shielded enclosures should be fitted with suitable interlocks on the access doors to ensure that no one can access an enclosure while an X-ray generator is generating radiation”  
SSG-11 Paragraph 10.33 states that: “Emergency stop buttons or pull cords with manual resets should be incorporated in the interlock system, to enable any person within the shielded enclosure to trigger an alarm immediately and to automatically prevent or terminate radiation exposure.” |
| **OBSERVATION:** | The design for the new shielded enclosure does not include safety systems |

| **R3:** | **Recommendation:** The license holder should review the design of the shielded enclosure. |
| **BASIS:** | SSG-11 Paragraph 6.20 states that: “The operating organization should make arrangements for the health surveillance of relevant employees in compliance with regulatory requirements.” |
| **OBSERVATION:** | NCNDT requires a chest X-ray to be included in the annual health surveillance, however there is no justification with respect to radiation protection for this. |

| **S1:** | **Suggestion:** NCNDT should consider removing the requirement for a chest X-ray from their requests for quotations for annual health surveillance. |
APPENDIX IX: CEYLON PETROLEUM CORPORATION

Facilities and services: Operator (NDT inspection)
Location: Colombo
Dates: 28 November 2019
ORPAS Reviewers: Mr. R. van Sonsbeek (the Netherlands)
Persons met: Mr. C.R.K. Gamage (Deputy Refinery Manager (Technical Services) Actg.)
Mr. Madawa Rajapaksha (Deputy Engineering Manager (Inspection) Actg. & Radiation Protection Officer)
Ms. G.C. Kuruppu (NDT Superintendent)
Mr. J. Malinda Buddhika (NDT Technician)
Mr. A.A. Mohomed Arham (NDT Technician)
SLAEB representative: Mr. Nirodha Ranasinghe (Scientific Officer), Ms. Madushika Dayawansa (Technical Assistant)

INTRODUCTION

The purpose of the visit to CPC was to review their arrangements for occupational radiation protection and to provide a report incorporating findings, conclusions and recommendations and suggestions for strengthening the Occupational Radiation Protection Programme of this organization.

GENERAL INFORMATION

Prior to the appraisal, CPC was requested to complete an ORPAS questionnaires for end users and a questionnaire that was designed by the ISEMIR WG for Industrial Radiography. The ISEMIR questionnaire is based on IAEA Specific Safety Guide 11 Radiation Safety in Industrial Radiography, and consisted of questions related to four broad subjects:

- Qualification and training of industrial radiographers in radiation protection;
- Learning from incidents;
- Systems and procedures in place for safe operation;
- Emergency preparedness and response.

The RPO of CPC completed the ORPAS questionnaires but did not complete the ISEMIR questionnaire. Further clarification and documentation were provided during the visit. From this the ORPAS team got a good impression of the Radiation Protection Program and how it was implemented. The inspection department of CPC performs gamma radiography both inside the refinery and on a radiation yard on the premises of CPC. They do not perform any NDT outside their own facility. The inspection department has a team of 18 workers, including 2 Senior NDT Technicians, 5 NDT Technicians and 5 assistants. According to the RPO the actual RT testing is performed by the latter two groups. The workload of RT inspections is estimated to be between 1,000 to 1,500 exposures annually, i.e. about 200 to 300 exposures per NDT technician. Work is scheduled after normal working hours, when there are no other workers on site.
APPRAISAL FINDINGS

AUTHORIZATION DETAILS

SLAERC issued a license to CPC for Industrial Radiography Using Ionizing Radiation with number GM/04/0/IR-01/L/01/2019. This license was effective from 01.01.2019 with an expiry date of 31.12.2019. It mentions Mr. B.D.L. Srikantha as RPO and covers the use and possession of three Ir-192 sources and the storage of one Cs-137 source. It refers to a further five Ir-192 sources that are decayed to activities below the exemption level. A modification to the license was issued on 15 August 2019 because of the loading of a new Ir-192 source in one of the exposure devices. Furthermore, Mr B.D.L. Sirkantha resigned recently, and Mr Madawa Rajapaksha is now appointed as RPO. This is also confirmed in the application for the renewal of the license in 2020. Mr. Rajapaksha was trained by SLAERC on the Safe and Secure Use of Radiation Sources in Industry and Research. Proof of certification was issued on 16 June 2017.

EXPOSURE DEVICES AND ANCILLARY EQUIPMENT

The single exposure device used by the NDT technicians is a Sentinel 880 Delta with matching ancillary equipment (control cable and guide tube). In addition, they have two Sentinel Model 880 Sigma exposure devices and a range of other older types of exposure devices and transport containers, which all are currently not used.

RADIATION SOURCES

The Ir-192 source had an activity of 2.25 TBq (60.8 Ci) on 4 June 2019. The other Ir-192 sources have decayed too much for practical use. CPC has written to the SLAEB requesting collection of the disused sources.

MAINTENANCE

No records of routine inspection and periodic maintenance on the exposure devices and ancillary equipment were observed.

TRAINING

The NDT technicians are certified as either RT level 1 or level 2. There is also additional in-house training on radiation protection. Records show dates of initial training and certification but do not indicate if there is any refresher training organized.

INDIVIDUAL MONITORING AND HEALTH SURVEILLANCE

The RT operators and assistants wear TLDs. In addition, they have to wear electronic personal dose meters (model RAD-50S) Three of these devices are available at CPC. It was noted that the last calibration was performed on 19 September 2018, i.e. more than one year ago. After every RTD job, the NDT technician has to record the total accumulated dose since the last reset of the EPD. From a comparison of the dates of RT jobs and the records, the reviewer observed that there is a lack of discipline to follow this procedure. The doses recorded with the EPD appear to be well below 1 μSv per RT job. All dose reports are below the minimum detection limit, which is remarkable for the performance of industrial radiography.
All workers must participate in an annual health surveillance. The record is kept with the medical doctor of the CPC refinery, who was not interviewed.

SHIELDED X-RAY YARD

If RT is not performed in the refinery, it is performed in an X-ray yard at the premises of CPC. CPC is currently building U-shaped shielding construction with dimensions of 20 x 10 meters. In addition, a 22-meter-long concrete wall will be constructed opposite the entrance to the “U”. All walls will be 5-meter-high and 60 cm thick. This yard is not a shielded enclosure as described by SGS-11, i.e. radiography on the X-ray yard would still have to be considered as site radiography. No shielding calculations could be shown.

OPERATING PROCEDURES

During the visit no RT was performed. The ORPAS team was able to assess the storage facility, which was very secure with three locks preventing removal of an exposure device or a transport container with a source from a storage pit. No elevated radiation levels were measured outside the storage facility.

WORKPLACE MONITORING

Workplace monitoring is performed with survey meters. It was noted that the last calibration was performed on 19 September 2018, i.e. more than one year ago.

RADIATION PROTECTION PROGRAM

It was noted that the original author of the Word document with the RPP is Anushke Weerakoon, the RPO of NCNDT. The RPP covers the elements of the RPP as described in SSG-11. It was noted that the RPP does not mention the obligation to wear an EPD while performing a RT job.

EMERGENCY PREPAREDNESS AND RESPONSE

An emergency plan was shown which includes a range of reasonably foreseeable situations. Emergency equipment (long tongs, bags with lead shot, lead apron, safety googles with lead glass) was observed in both the storage facility and in the room adjacent to the dark room. No record of the performance of practical exercises was observed.

<table>
<thead>
<tr>
<th>BASIS:</th>
<th>GSR Part 3 Requirement 21, Paragraph 3.76 (h) states that: “Suitable and adequate human resources and appropriate training in protection and safety are provided, as well as periodic retraining as required to ensure the necessary level of competence”.</th>
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</tr>
</tbody>
</table>
SSG-11 Paragraph 13.22 states that: “All persons who will participate in implementing the emergency plans should be adequately trained for the effective fulfilment of their roles.”

**OBSERVATION:** There is no proof that the emergency training nor refresher training conducted at CPC includes rehearsal of emergency plans.

**R4:** **Recommendation:** The license holder should include rehearsal of emergency plans and refresher training in their training programme.

**BASIS:**
- **GSR Part 3 Requirement 17 Paragraph 3.49 (b) states that:** “Ensuring that radiation generators and radioactive sources are tested to demonstrate compliance with the relevant specifications.”
- **SSG-11 Paragraph 9.30 states that:** “To ensure continued good operation, gamma radiography equipment (including all ancillary equipment) should be subject to both routine inspections and periodic maintenance.”

**OBSERVATION:** CPC could not demonstrate the performance of routine inspections and maintenance.

**R5:** **Recommendation:** The license holder should implement a programme for routine inspection and periodic maintenance.
APPENDIX X: SRI LANKA GAMMA CENTRE

Facilities and services: Operator Industrial Applications (Irradiator)
Location: Colombo
Dates: 27 November 2019
ORPAS Reviewers: Mr. R. van Sonsbeek (the Netherlands), H.B. Okyar (IAEA)
Persons met: Ms. Anoma Kumari Rathnayake (Director)
Mr. Viraj Sampath (Radiation Protection Officer)
Mr. K. Asiri Sampath Kodikara (Irradiator operator)
Ms. R.D. Roshani Ranasinghe (Scientific officer Microbiology)
Ms. A.A. Ganga Madurakanthi (Scientific officer Dosimetry)
SLAEB representative: Mr. Muditha Rathnayake (Scientific Officer), Ms. Ama Sarani (Technical Assistant)

INTRODUCTION
The purpose of the visit to SLGC was to review their arrangements for occupational radiation protection and to provide a report incorporating findings, conclusions and recommendations and suggestions for strengthening the Occupational Radiation Protection Programme of this organization.

GENERAL INFORMATION
SLGC is a Gamma Irradiation Centre owned by the SLAEB. It has been operating since January 2014. The irradiator is designed and constructed by Symec Engineers from India. SLGC employs 38 workers, 25 of which are permanent staff. The others are security officers and janitorial service workers. The centre operates 24/7. The core business is the sterilization of objects used in hospitals, such as surgical gloves, surgical aprons, biofertilizers, urine collection bottles, blood collection tubes. They also offer services for sterilization of spice, tea and dehydrated food products.

APPRAISAL FINDINGS

AUTHORIZATION DETAILS
SLAERC issued a license to SLGC for Sterilization and Food Preservation with number GM/02/O/SI-01/L/01/2019, effective from 1 January 2019 and expiring on 31 December 2019.

RADIATION SOURCES
The irradiator consists of frames with a capacity to hold 1,180 pencil Co-60 sources, or 111 PBq (3 MCi). The current activity of the irradiator is 7.4 PBq (200 kCi) as of 16 November 2019. When the source is not in operation it is lowered into a water pool.

ACCESS CONTROL
Access is strictly controlled, including the use of fingerprint scanners. The control room can only be opened by two authorized persons. The bunker with the irradiator can only be accessed from the control room. A fail-safe interlock system is installed to the access door.
IRRADIATOR DESIGN

The irradiator design was assessed against the requirements given in chapter 8 of SSG-8. The ORPAS team was given a tour through the control room and bunker. The design of the safety and security systems was very well explained and demonstrated, including a test of the emergency cord. The ORPAS team did not find any shortcomings.

TRAINING

Training is provided by the RPO and is repeated annually, as confirmed by some of the interviewed employees. A set of power point files has been developed covering various relevant aspects of radiation protection of the irradiation facility.

INDIVIDUAL MONITORING AND HEALTH SURVEILLANCE

All employees are provided with a TLD that is readout on a monthly basis. During normal operation no doses are recorded above the minimum detection limit. For access to the bunker operators have to wear electronic personal dosimeters. Doses received are recorded in a logbook in the control room, indicating the name of the person.

All workers have to undergo an annual health surveillance, which is offered by a hospital based on the requirements of the SLGC. These requirements include a chest X-ray, however there is no justification with respect to radiation protection for mandating the annual chest X-ray.

WORKPLACE MONITORING

Radiation surveys, consisting of measurements of radiation dose rate levels at clearly marked positions in rooms around and above the bunker, are performed frequently. Records of the performance of this workplace monitoring were observed.

TESTING AND MAINTENANCE

Weekly, monthly, bi-annual and annual checklist are completed in accordance with chapter 9 of SSG-8. The same applies to preventive maintenance. Completed testing and maintenance checklists were shown to the reviewer.

EMERGENCY PREPAREDNESS AND RESPONSE PLAN

An emergency plan, describing all kinds of reasonably foreseeable events, was observed. However, it appeared that only fire drills were done and there were no rehearsals of other emergency situations.

SOURCE LOADING OPERATIONS

SLGC expects to load new Cobalt-60 sources with a total activity of 9.25 PBq (250 kCi) in April 2020. This is actually the most critical planned exposure. The ORPAS team was shown the preparation plan of a similar operation that was performed in 2017. The actual loading is performed by a team of employees from the Indian source supplier (Symec), but all other operators of the facility will be involved. As an example of limiting individual doses, it was
explained that the removal of bolts from the transport container was managed between employees. Therefore, the maximum doses recorded was 0.36 mSv.

### RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

<table>
<thead>
<tr>
<th>BASIS:</th>
<th>GSR Part 3 Requirement 21, Paragraph 3.76 (h) states that: “Suitable and adequate human resources and appropriate training in protection and safety are provided, as well as periodic retraining as required to ensure the necessary level of competence”. SSG-8 11.16 states that: “The operating organization is required to inform staff of any emergency plan that might affect their area of work, and of their role if the plan has to be implemented, and it should arrange for staff training and emergency drills appropriate to each situation.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBSERVATION:</td>
<td>SLGC currently does not perform any emergency drills other than fire drills.</td>
</tr>
<tr>
<td>R1:</td>
<td><strong>Recommendation:</strong> The license holder should organize emergency drills that cover all foreseeable emergency situations.</td>
</tr>
<tr>
<td>BASIS:</td>
<td>GSR Part 3 Requirement 25 3.108 states that: “Programmes for workers’ health surveillance as required in para. 3.76(f):(a) Shall be based on the general principles of occupational health [19];(b) Shall be designed to assess the initial fitness and continuing fitness of workers for their intended tasks”.</td>
</tr>
<tr>
<td>OBSERVATION:</td>
<td>SLGC requires a chest X-ray to be part of the annual health surveillance</td>
</tr>
<tr>
<td>S1:</td>
<td><strong>Suggestion:</strong> The license holder should consider removing the requirement for a chest X-ray from their requests for quotations for annual health surveillance.</td>
</tr>
</tbody>
</table>
Facilities and services: Operator (Storage of Radioactive Sources)
Location: Colombo
Dates: 28 November 2019
ORPAS Reviewers: Mr. R. van Sonsbeek (the Netherlands), Mr. H.B. Okyar (IAEA)
Persons met: Mr. Prasad Mahakumara (Technical Manager/RPO)
Mr. Nirodha Ranasinghe (Scientific Officer)
Ms. Nirasha Rathnaweera (Scientific Officer)
Mr. Buddhika Kariyawasam (Technical Assistant)
Mr. U. Amarasena (Lab Assistant)

INTRODUCTION

The purpose of the visit to the CDRSS was to review their arrangements for occupational radiation protection and to provide an appraisal report incorporating findings, conclusions and recommendations and suggestions for strengthening the Occupational Radiation Protection Programme of this organization.

GENERAL INFORMATION

Building and maintaining facilities for management and disposal of radioactive wastes has been identified as a duty and function of SLAEB (Atomic Energy Act No. 40 of 2014 Section 4(g)). Therefore, SLAEB has a responsibility to maintain the CDRSS, and have already applied for a license.

The new building for the CDRSS facility has been constructed and storage facilities were finalized in 2017. The old storage was demolished after transferring all the sources to the new storage facility. The SLAEB began operation of the facility on 02/10/2018.

The CDRSS is operated by the Radiation Protection and Technical Services Division of the SLAEB. The employees of SLAEB effectively work part-time for the CDRSS and part-time for other radiation facilities of the Division. The Division consists of 1 technical manager & RPO, 4 scientific officers, 5 technical assistants and 2 technician/lab assistants.

When a client requests the storage of disused sources, the sources will be collected by the CDRSS after a risk assessment has been made and radiation surveys have been performed. This may lead to the performance of decontamination activities at the site of the client (as was the case at the University of Colombo).

APPRAISAL FINDINGS

AUTHORIZATION DETAILS

SLAEB applied for a license for the CDRSS from the regulator on 30 May 2019. The regulator requested additional information, which was provided on 17 September 2019. The CDRSS is waiting for an inspection by the regulator, after which a license is expected to be granted for three years. It was noted that the CDRSS is currently operating without a licence.
RADIATION SOURCES

CDRSS offers long-term storage for category 3-5 sources and temporary storage for category 1 and 2 sources. The waste-source registry shows a range of sources, including Ra-226 needles from hospitals, Cs-137 sources used for brachytherapy, Am-241/Be sources used in moisture probes and domestic smoke detectors.

ACCESS CONTROL

Access to the storage facility is strictly controlled, including the use of fingerprint scanners. There is also an alarm installed and a CCTV system. In case of an unwanted intrusion the police will automatically receive an alarm and respond.

STORAGE DESIGN

The storage facility contains three separate rooms: for Ra-226 sources, sources for final storage and sources for temporary storage, respectively. No elevated radiation levels were observed outside the facility and outside each of the rooms. The Radon survey reports were also filed in the radiation survey section of the facility master file.

TRAINING

According to the RPP of the Division, radiation protection training is provided twice per year. Records are kept by the RPO.

INDIVIDUAL MONITORING AND HEALTH SURVEILLANCE

All employees are provided with a TLD that is read out on a monthly basis. Although they do not have dedicated TLDs for their work for the CDRSS, employees of SLAEB wear separate TLDs for special activities they perform for the CDRSS. As an example, the dose records for the transfer of the sources from the old storage facility to the new storage facility, which took place in 2017, was shown. Maximum doses of 0.05 mSv were recorded during this one-day operation.

Employees of CDRSS undergo annual health surveillance in accordance with the RPP of the division. It was observed that a chest X-ray is part of this surveillance.

WORKPLACE MONITORING

Radiation surveys, comprising the measurement of radiation dose rate levels at locations outside the storage facility, are performed frequently.

CONCLUSION

The ORPAS finds that the CDRSS is well designed and run and therefore the ORPAS team does not offer any recommendation or suggestion.
APPENDIX XII: LANKA MINERAL SANDS LTD. AND PULMUDAI MINERAL SAND FACTORY

Facilities and services: Operator (natural source of radiation, mining and milling)
Location: Colombo
Dates: 27 November 2019
ORPAS Reviewers: Ms. H. Caplin (France), Ms. T. Iyu Lin (Malaysia), Mr. I. Hasanuddin (Indonesia), Mr. H.B. Okyar (IAEA)
Persons met: Mr. S.A.A. Koswatta (Chemist)
Mr. N.M.A. Wijesekara (Production Engineer)
SLAEB representatives: Mr. Nirodha Ranasinghe (Scientific Officer)

INTRODUCTION

The purpose of the interview with Lanka Mineral Sands Ltd. (LMSL) was to review their arrangements for occupational radiation protection and to provide a report with findings, conclusions, and recommendations for strengthening the occupational radiation protection within the company.

GENERAL INFORMATION

Lanka Mineral Sands Ltd. is a fully government owned company. The Head Office is in Colombo and the facility is at Pulmudai (Pulmudai Mineral Sand Factory).

In 2016, a comprehensive radiation survey was carried out by the SLAEB at the mineral sands processing zone at LMSL, Pulmudai, on the request of the company. Almost 15 years ago, the company was made aware of the radiological issue of monazite by a Japanese client. This Japanese company required radioactivity measurements of the monazite and provide LMSL with dose-rate measuring devices. Furthermore, some employees are aware of the radiological issue of some ores (like monazite) due their degree course and workshops. The work at the factory is performed in shifts. Currently, monazite is not valued as a product for sale and is stored in the facility. The facility exports ilmenite (50,000 tons every year) to China, Ukraine and India. There is another Sri Lankan company which use some by-products of LMSL.

CONDUCT OF APPRAISAL

No questionnaires were sent beforehand to the LMSL. LMSL has provided the report of SLAEB on the comprehensive survey in 2016. So, the appraisal comprised a meeting held in the premises of the SLAERC (no visit of the production facility).

During this meeting, the ORPAS Team explained the objective of the ORPAS mission, the role of the IAEA in this respect and purpose of the interview. The ORPAS Team asked the LMSL representatives about existing radiation sources, the potential occupational radiation protection programme, and the awareness of radiation protection measures regarding individual and workplace monitoring and protection of workers from exposure to natural sources of radiation.
In its survey report, SLAEB had recommended:

- Working time at crude monazite collection and storage areas should be limited due to the elevated external dose rate at these areas;
- Some workers should use Personal Monitoring devices to ensure that their exposure is kept low;
- All the workers in the Rutile and Zircon plants wear dust masks to control internal exposure by airborne radioactive dusts. It is a good practice if all workers use dust masks during the working hours for occupational hygiene reasons.

APPRAISAL FINDINGS

AUTHORIZATION DETAILS

The Sri Lanka Atomic Energy Act, No. 40 of 2014, paragraph 69 states that “The Council shall by rules made in that behalf, establish requirements for the protection of workers, the public and the environment, that are required to be complied with by all persons who are conducting activities related to mining or processing operations which generate radioactive material”. However, no such rule has been drafted or published. As there are no current regulations regarding radiation protection for such industrial operations, the company is operating without a license governing the radiation protection of workers.

New regulations on Ionizing Radiation Protection and Safety of Radiation Sources have been drafted and include activities involving NORM with activity concentrations higher than 1 Bq/g for U-238 decay chain and/or for Th-232 decay chain under the planned exposure situation related requirements.

The facility is inspected by a factory inspection engineer from the Labour Department twice a year. The inspector verifies occupational health and safety and inspects industrial hygiene/safety, fire safety and the working environment, reporting recommendations for improvement, which must be implemented.

MANAGEMENT STRUCTURE

LMSL has appointed a RPO. He has only undertaken a training programme on radiation safety conducted by SLAEB, which only provided a certificate of participation (not a qualification certificate).

There is no formalized list of duties for the RPO, but one of his duties is to explain the results of the TLD badges to the workers.

ASSESSMENT OF EXPOSURE SITUATIONS

Based on the comprehensive survey by SLAEB, the company has identified areas where gamma radiation levels may be elevated. The main areas are the crude monazite collecting point and the storage of crude monazite. According to LMSL, no one works full-time in these areas. Other exposure situations were not assessed.
RADIATION PROTECTION PROGRAMME

There is no radiation protection programme.

CONTROL AND ACCOUNTABILITY OF RADIOACTIVE SOURCES

Currently, LMSL has only identified monazite as NORM, but rutile, ilmenite and zircon are also NORM and may have activity concentrations higher than 1 Bq/g for U-238 decay chain and/or Th-232 decay chain.

RADIATION PROTECTION MEASURES

In the production areas, the major occupational risks are mechanical and electrical risks. So, the workers wear specific personal protective equipment (PPE): gloves, safety shoes.

According to LMSL, there are only a couple of places which need dust control (due to the radioactivity in monazite). As recommended in the SLAEB report, the workers have to wear dust masks.

There is no internal procedure relating to the wearing of PPE. In specific areas, there are information boards requiring the wearing of PPE.

The areas for transfer and storage of monazite are enclosed by concrete walls and there are restrictions for their access (the workers need a specific authorization). But there is no internal procedure to notify these restrictions and to obtain a specific authorization.

WORKPLACE MONITORING PROGRAMME

The 2016 survey by SLAEB was the only monitoring operation conducted in the facility. Currently there is no monitoring programme in place.

The facility has the measurement devices provided by the Japanese company 15 years ago. But these devices are not calibrated and are no longer functional.

INDIVIDUAL MONITORING PROGRAMME

On the basis of the SLAEB report, TLD badges are provided to 4 workers in the facility. No records were observed by the ORPAS team.

INFORMATION AND TRAINING

According to LMSL, the workers have been informed of the presence of radioactive materials in the facility.

The factory inspector provides training on occupational risks and their prevention to the workers of LMSL; however, this training does not include radiation protection.
EMERGENCY ARRANGEMENTS (EMERGENCY PLANS)

In case of incident, the workers have to follow the conventional procedure for all types of incidents. There is no specific emergency arrangement regarding radiation protection. In case of an incident, LMSL has to inform the Labour Department.

HEALTH SURVEILLANCE PROGRAMME

There is a conventional health surveillance programme (not based on radiation protection) for workers.

OTHER MATTERS OF INTEREST

There are no contractors for maintenance or cleaning operations.

The transport of NORM (raw materials from mining areas to processing facility) and export is an issue for LMSL. The SLAERC has required (for instance in 2016) the company to obtain a specific temporary license for the transport of crude monazite. The validity of this license was one month.

CONCLUSION

The ORPAS team recognise that LMSL has requested a radiological survey by SLAEB and implemented some radiation protection measures, even though it is not currently regulated or licensed by the SLAERC. The voluntarily radiation protection measures implemented by LMSL include:

- appointment of a RPO,
- access restrictions for the areas with the highest dose rates,
- the wearing of dust mask.

The ORPAS team note that the Sri Lanka Atomic Energy Act No.40 of 2014 (paragraph 69) explicitly requires SLAERC to make rules for all persons who are conducting activities that are related to mining of processing operations which generate radioactive material.

In addition, the company is strongly advised to approach the SLAEB for a complete radiological characterisation, based on the GSG-7.
APPENDIX XIII: DEPARTMENT OF NUCLEAR SCIENCE, UNIVERSITY OF COLOMBO

Facilities and services: Laboratory for Education and Research
Location: Colombo
Dates: 29 November 2019
ORPAS Reviewers: Mr. R. van Sonsbeek (the Netherlands), Mr. H.B. Okyar (IAEA)
Persons met: Mr. Dr. Jeyasingam Jeyasugiththan (Senior Lecturer in Medical Physics, Program coordinator for postgraduate degree program in Medical Physics)
Ms. Dr. Manuja Lamabadusuriya (Head of the Department)
Mr. Chatura Abeygunawardena (Senior Staff Technical Officer, RPO)
SLAEB representative: Mr. Muditha Rathnayake (Scientific Officer), Mr. Dinesh Piyadasa (Technical Assistant)

INTRODUCTION

The purpose of the visit to the University of Colombo was to review their arrangements for occupational radiation protection and to provide a report incorporating findings, conclusions and recommendations and suggestions for strengthening the Occupational Radiation Protection Programme of this organization.

GENERAL INFORMATION

The Department originates from the previous Atomic Energy Authority (AEA) of Sri Lanka. About twenty years ago, the laboratory was taken over by the University of Colombo.

The laboratory provides practical radiation protection training of maximum 8 hours per student to about 200 students annually. In addition, there are about 3-5 research students who spend 3 months in the laboratory. All students are older than 18 years.

The Department performs gamma spectroscopy on samples with a HPGe detector.

In the past, the AEA also performed gamma radiography. The laboratory still has a dark room even though gamma radiography has not been performed for more than 20 years.

APPRAISAL FINDINGS

AUTHORIZATION DETAILS

The regulatory body issued a license to the Department on 12 April 2018 which expires on 31 December 2019. The license mentions the RPO and 5 other staff authorised to use/operate the radioactive sources and 2 additional persons allowed to work in the controlled area of the facility. On 27 August 2019 the license was modified with an updated list of sources and allowing 2 extra persons to work in the controlled area.
RADIATION SOURCES

When the laboratory was taken over by the University of Colombo, the University was unaware that it had also taken possession of a number of radioactive sources. These sources were identified during an inspection carried out by the SLAEB in 2018. The source inventory has since then been updated to include these sources. Although these radioactive sources belonged to the previous AEA organization, the regulatory authority considers them to be responsibility of the Department of Nuclear Science. The Department would like to dispose of the sources; however, they do not have budget for having them placed in long-term storage at the CDRSS.

Section 10 of the license lists 25 sources. The activity of 9 sources are unknown. Most of these sources are the ones that were discovered in 2017. Most of the other sources are point sources that are used during the practical exercises. One of the two sources with the highest activity is a 185 GBq Pu/Be neutron source which is used for neutron activation. This is only done by technical officers. The other source with a high activity is a Cs-137 source with an activity of 185 GBq that was used in the past for gamma radiography.

RADIATION PROTECTION PROGRAM

There is no formalized RPP. Only recently, the Department became aware of its legal obligations. They also do not have an emergency response plan for the same reason. The only formal document is a notice to students about the rules in the laboratory.

CONTROLLED AREA

Access to the controlled area in the laboratory is restricted to authorised staff and research students. The controlled area is demarcated by a bench and signage. At the entrance there are washbasins and there is an emergency shower. The RPO demonstrated that the shower worked.

TRAINING

All authorized persons have obtained training from the regulator on the safe and secure use of radiation sources in industry and research. Proof of certification was shown to the reviewers. The certificates have a validity of 5 years.

INDIVIDUAL MONITORING

All authorized employees are provided with a TLD that is read out on a bi-monthly basis. These are stored in a cupboard just outside the controlled area. Each TLD is marked with the initials of the wearer. Dose records from the last couple of years did not show any significant doses.

Research students are also provided with a TLD for the period that they are working at the laboratory. The Department does not keep the records of these read-outs.

The Department does not have any active personal dosimeter to provide to staff.
WORKPLACE MONITORING

The Department has two radiation survey meters for X-ray and gamma radiation, one digital (Canberra Radiagem) and one analogue (Dosimeter Corporation, Cincinnati, Ohio, Model 3007A). Neither of these survey meters has been calibrated. The needle of the dial of the analogue survey meter is broken. The Department does not have a neutron dosimeter or contamination monitor. One of the TLD is used for area monitoring in the laboratory. Recent dose records do not show any dose above the minimum detection level.

STORAGE OF SOURCES

The smaller sources are stored in the laboratory in locked cupboards. The neutron source is stored in its own shielding. These storages all appear safe and secure.

However, this was not the case for the old gamma exposure device, which contained the 185 GBq Cs-137 source. This was stored in a separate room of a nearby building, which could be accessed via a wooden door with a simple lock. The ORPAS team has raised their concerns with the Director General of SLAERC and recommended urgent action to ensure secure storage of the source. The SLAERC promptly instructed the RPO of the University of Colombo to store the source in a more secure location. The RPO promptly moved the source to a secure room with concrete walls, lead shielding and a securely locked steel door.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

| BASIS: | GSR Part 3 Requirement 24 states that: “Employers, registrants and licensees shall establish and maintain organizational, procedural and technical arrangements for the designation of controlled areas and supervised areas, for local rules and for monitoring of the workplace, in a radiation protection programme for occupational exposure.” |
| OBSERVATION: | The Department has no RPP nor an ERP. |
| R1: | Recommendation: The licence holder should develop a radiation protection program. |

| BASIS: | GSR Part 3 Requirement 21 Paragraph 3.76 (g) states that: “Appropriate monitoring equipment and personal protective equipment is provided and arrangements are made for its proper use, calibration, testing and maintenance”. GSR Part 3 Requirement 24 state that: “Employers, registrants and licensees shall establish and maintain organizational, procedural and technical arrangements for the designation of controlled areas and supervised areas, for local rules and for monitoring of the workplace, in a radiation protection programme for occupational exposure.” |
| OBSERVATION: | The Department has no calibrated survey meters or contamination monitors suitable for the practices performed. |
| R2: | Recommendation: The licence holder should ensure that it has equipment for workplace monitoring. |
ANNEX–I: IAEA REFERENCE MATERIAL USED FOR THE MISSION


INTERNATIONAL ATOMIC ENERGY AGENCY, IRRS Guidelines, IAEA Services Series No.37, IAEA, Vienna (2018).


INTERNATIONAL ATOMIC ENERGY AGENCY, OSART Guidelines, IAEA Services Series No.12 (Rev.1), IAEA, Vienna (2016).


INTERNATIONAL ATOMIC ENERGY AGENCY, SARIS Guidelines, IAEA Services Series No. 27, IAEA, Vienna (2014).

INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, PAN AMERICAN HEALTH ORGANIZATION, WORLD HEALTH ORGANIZATION,


INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and NORM Residue Management in the Production of Rare Earths from Thorium Containing Minerals, Safety Reports Series No. 68, IAEA, Vienna (2011).


INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and NORM Residue Management in the Titanium Dioxide and Related Industries, Safety Reports Series No. 76, IAEA, Vienna (2012).

INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Management of NORM Residues in the Phosphate Industry, Safety Reports Series No. 78, IAEA, Vienna (2013).


INTERNATIONAL ATOMIC ENERGY AGENCY, Training guidelines in non-destructive testing techniques, IAEA-TECDOC-628/Rev.3, IAEA, Vienna (2014)
## ANNEX–II: PREPARATORY MEETING PROGRAMME

**16 – 18 July 2019**  
**Colombo, Sri Lanka**

Venue: Sri Lanka Atomic Energy Board (SLAEB)

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Speaker(s)</th>
</tr>
</thead>
</table>
| 09:00 – 09:15 | Welcome, Introductions  
Opening remarks by the ORPAS Team Leader  
Introduction by IAEA  
Self-introduction of all attendees  
Objectives of the pre-ORPAS meeting  
ORPAS Mission expectations from the Host | Director General/SLAEB  
Mr Mahakumara (SLAEB)  
Introducing the Team Leader and IAEA Coordinator |
| 09:15 – 10:00 | ORPAS Appraisal Service and the scope of the pre- & full missions | Mr Okyar (IAEA) |
| 10:00 – 10:45 | Technical support organisations and their operations, technical services for radiation protection and typical end-user facilities | Mr Mahakumara (SLAEB) |
| 10:45 – 11:00 | Coffee break | |
| 11:00 – 11:45 | Occupational radiation protection provisions for end-user facilities and Radiation Protection Programmes | RPOs of a Radiation facility Medical/ Industrial/ Research |
| 11:45 – 12:30 | Laboratory Visit (SSDL and PMS of SLAEB) | All Participants |
| 12:30 – 13:30 | Lunch break | |
| 13:30 – 14:30 | Occupational Exposure Control with the Agency perspective (GSR Part 3 and GSG-7) | Mr Okyar (IAEA) |
| 14:30 – 14:45 | break | |
| 14:45 – 17:00 | Round table discussion (Logistics & practical arrangements) for the ORPAS mission, e.g.:  
- Mission dates and scope  
- Confirmation of the facilities to be visited during the pre-mission  
- Roles and responsibilities of ORPAS team members, the national coordinator & the national counterparts  
- Self-assessment process  
- Hotel and local transport arrangements (Including site visits etc.);  
- Working areas and facilities for individuals and teams (on-site and off-site, including the hotel);  
- IT, data-projectors, secretarial support etc.;  
- Arrangements for communication between ORPAS team members (reviewers) and national counterparts;  
- Translators and technical escorts, if required;  
**Review of the day, summary and conclusions.** | Counterpart/ IAEA |
Wednesday, 17 July 2019
NCNDT Premises Kelaniya, SLGC Biyagama, Lanka Hospital

09:00 – 09:45  Current Occupational Radiation Protection status, an overview on regulatory framework in Sri Lanka  Mr. Shantha THENUWARA (D/SLAERC)

09:45 – 10:30  Logistics for the ORPAS mission (Cont’d)  Counterpart/ IAEA
- Process of interviews and document review
- Necessary arrangements for entry to facilities, including clearance and any required training
- Initial Team Meeting (time, venue participants)
- Entrance Meeting (time, venue participants)
- Site visits (date(s), duration, venue(s) participants)
- Discussion and agreement on advanced reference material (ORPAS questionnaires, RASIMS TSA 2)
- Exit Meeting (time, venue participants)
- Media relations
- Meetings with State officials
- Social events

10:30 – 11:00  Coffee break

11:00 – 12:15  Site visit* to a selected site for verification of the logistics, transportation, entry process, etc.  Counterpart/ IAEA NCNDT Centre & SLAERC

12:15 – 13:30  Lunch break

13:30 – 17:00  Site visit* to a selected site  Counterpart/ IAEA SLGLanka Hospital

Thursday, 18 July 2019

09:00 – 12:15  Site visit* to a selected site for verification of the logistics, transportation, entry process, etc.  Counterpart/IAEA Nuclear Medicine Unit - Peradeniya

12:15 – 13:30  Lunch break

13:30 – 16:30  Review of the Detailed Mission Programme  Counterpart/ IAEA

16:30 – 17:30  Summary of meeting and Follow-up items  End of preparatory meeting  Mr OKYAR (IAEA) Director General/SLAEB

*In each Facility or Service (e.g. individual monitoring service (IMS), medical centre, industrial facility, NDT company, NORM site)

The Facility or Service:
- Meet with the management and the officers responsible for radiation protection
- Presentation on the services provided and the structure of the organization
- Presentation on the occupational radiation protection program and responsibilities

The IAEA:
- Promote the use of self-assessment and the tools
- Inform on the scope and objectives of full appraisal
- Agree on list of people and places to be visited during full appraisal
- Inform on timing of review mission (as appropriate)
- Inform on framework for the schedule of meetings (as appropriate).

Site Visit:
- Joint visit to the facility or service.
ANNEX–III: TERMS OF REFERENCE

OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE – ORPAS
TO SRI LANKA

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 Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (IAEA GSR Part 3). The IAEA has also a statutory responsibility to provide for the application of these Basic Safety Standards (BSS) in Member States and the IAEA carries out appraisals to check whether the application of the standards is appropriate.

The IAEA Occupational Radiation Protection Appraisal Service (ORPAS) is an appraisal of occupational radiation protection arrangements following the development and implementation programme. It is an effective way to ensure that those arrangements are optimized and effective. The ORPAS process sets out to accomplish this purpose through enabling structured peer review of national regulatory arrangements for occupation exposure control, and application of occupational radiation protection by the operators and technical service providers against IAEA safety standards to propose recommendations and suggestions; and sharing of relevant good practices.

The ORPAS mission was requested by the Government of Sri Lanka through the Sri Lanka Atomic Energy Board on 14 March 2019.

2. ORPAS MISSION DATES (Pre-mission and Mission)

Preparation meeting: 16- 18 July 2019
Mission: 24 November – 02 December 2019

3. OBJECTIVES OF THE PRE-ORPAS

• To liaise with the host organization (Sri Lanka Atomic Energy Board) and agree a program of visits to Operators (such as hospitals, NDT companies, etc.) and Technical Services Providers (TSP) (such as individual monitoring laboratories, SSDL, workplace monitoring, advisory services, etc.) that will participate in the appraisal process;
• To hold meetings with the identified National Counterparts to present the appraisal process, and introduction of the ORPAS self-assessment questionnaires with a RASIMS TSA 2 demonstration;
• To visit the facilities of the identified facilities to form an understanding of these facilities; and
• To agree the program of the full ORPAS appraisal mission to be organized from 24 November to 2 December 2019.

4. ORPAS TEAM COMPOSITION

Team Leader: LONG, S.A. (Australia)
Team Coordinator: OKYAR, H.B. (IAEA)
Team Members: To be decided
5. **MAIN COUNTERPARTS**

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Country</td>
<td>Prasad Mahakumara</td>
<td>Director, Radiation Protection &amp; Technical Services Division</td>
</tr>
<tr>
<td>National Coordinator</td>
<td>Mahakumara</td>
<td>Sri Lanka Atomic Energy Board</td>
</tr>
</tbody>
</table>

6. **CONDUCT OF THE MISSION**

6.1. **Self-assessment**

The ORPAS questionnaires are essential:

- To provide an effective and efficient information gathering technique;
- To provide a complete information database upon which to base recommendations;
- To assist in achieving consistency across different missions;
- To provide a standard recording format for incorporation into the country profile.

As such, national counterparts of the ORPAS are invited to complete the ORPAS questionnaires for regulator body, the Operators and the TSPs with a deadline which will be agreed during the pre-ORPAS. Applicable Questionnaires are for Regulator body, Operators, External Dosimetry TSP, Internal Dosimetry TSP, Dose Record Keeping Service, Workplace Monitoring TSP and General Technical Services.

6.2. **Action plan**

Upon completion of the self-assessment through questionnaires including self-analysis of the questionnaire responses, an initial action plan should be developed by the host country to address deficiencies revealed during the self-assessment. The involved organizations, as appropriate, will determine the most appropriate way for preparing the action plan.

7. **LOGISTICS (for pre-mission and full missions)**

7.1. **Funding**

The funds have been already allocated.

7.2. **Roles and responsibilities of ORPAS team members (Reviewers), the responsible officer and the counterparts**

The major roles and responsibilities will be described in the IAEA presentation during the pre-ORPAS. Interviews will be scheduled by the host country National Coordinator.

7.3. **Hotel and local transport arrangements**

The hotel will be preliminary booked by the responsible officer for the ORPAS pre-mission and full mission. The IAEA Coordinator will contact the ORPAS Team members in due course to confirm the hotel booking. Preferably, the hotel should be within walking distance from the Office where the ORPAS Team will be based.
7.4. Working areas and facilities for individuals and teams (on-site and off-site, including the hotel)

The ORPAS Team will have 24/7 access to the premises of Sri Lanka Atomic Energy Board during the mission.

7.5. IT, data-projectors, secretarial support, etc.

Wi-Fi access, 3 separate meeting rooms, screen and overhead projector will be made available for the ORPAS team. Secretarial support will be provided during the normal office hours for printing, copying, etc. technical material. Standing lunch will be provided by Sri Lanka Atomic Energy Board to save time and gain convenience.

7.6. Arrangements for communication between ORPAS team members and national counterparts

Counterparts can be contacted during the office hours via mobile phone or electronic messages. The contact details of the counterparts, areas of expertise will be collected, summarized and made accessible for the ORPAS Team.

7.7. Translators and technical escorts, if required

All documents will be mostly available in English. The Self-Assessment questionnaires will be completed in English. All national counterparts are expected to speak English, so there is no need for official translation.

7.8. Process of interviews and document review

Interviews will be organized in such a way to provide for document review and direct observations in operation (main goal is to have direct and face to face interactions) during the visits to the different facilities and sites. ORPAS Team members must be accompanied by a host institute representative.

7.9. Necessary arrangements for entry to facilities, including clearance and any required training

All necessary arrangements for entry to facilities, including clearance and any required training will be organized by the host country National Coordinator in consultation with the sites to be visited. Official identification documents will be necessary for the site visits and authorizations to take pictures for official use during the visits are required.

7.10. Initial Team Meeting

The initial team meeting (normally a day before the mission starts) will be agreed and the gathering of the team will be in the hotel lobby, and then the team will come together to the premises of Sri Lanka Atomic Energy Board. From the host countryside, the host country National Coordinator will attend the Initial Team Meeting and will provide introductory guides on the locations of different facilities and sites to be visited.

A separate agenda will be developed by the IAEA Coordinator for the initial team meeting.
7.11. Entrance Meeting

Room large enough to accommodate the ORPAS Team and host country national counterparts should be identified by the host institute. 1 day is enough for the entrance meeting. It can start between 9:30 and 10:00. A separate agenda for the entrance meeting will be developed by the IAEA Coordinator.

7.12. Direct observation and site visits

Site visits will be arranged accordingly. The list of ORPAS Reviewers who will take part in the site visits will be given to the host country National Coordinator.

7.13. Exit Meeting (time, venue participants)

A room large enough to accommodate the ORPAS Team and host country national counterparts should be identified. Exit meeting is for about 1 hour and a high-ranking IAEA official takes part in it. The host country defines their wish about the closing representatives.

7.14. Media relations and press conference

Press release will be issued by the IAEA; host country is involved in the validation of the press release. Press conference is optional, the host country decides about the need of the press conference. This will be discussed, and the IAEA will be informed at least 2 months before the ORPAS mission starts.

7.15. Meetings with State officials

A meeting will be discussed and organized.

7.16. Social events

Few options will be elaborated considering good or bad weather.

A Farewell dinner will be planned.

8. SCHEDULE

The tentative detailed agenda for the mission will be prepared during the pre-ORPAS and the IAEA Coordinator and the host country National Coordinator will continue working on the finalization of the agenda.

9. ADVANCE REFERENCE MATERIAL

The IAEA Coordinator will prepare a package of background information on the host country that includes:

- The provisional scope of the proposed appraisal;
- Reports from relevant past IAEA missions or projects;
- The IAEA Country Radiation and Waste Safety Profile;
- The IAEA Nuclear Safety Profile of the host country (if appropriate);
- The host country profile (e.g. from sources such as published files), including population distributions, demography & geography, meteorology, industry, government, commerce;
• Public holidays;
• Religious customs;
• Business practices such as working hours and work week;
• Other relevant local customs.

10. REPORT CONFIDENTIALITY

In the interest of openness, countries are encouraged to make their ORPAS mission report public. Unless Sri Lanka clearly specifies within 90 days of the IAEA transmittal letter that the report should remain restricted; the report will be made available to the public by the IAEA.

For the IAEA:
(Signed)

Mr H.B. OKYAR
IAEA Coordinator
Occupational Radiation Protection Unit
Radiation Safety and Monitoring Section
Division of Radiation, Transport and Waste Safety

Address:
Vienna International Centre P.O. Box 100,
1400 Vienna, Austria
Phone number: +43 1 2600 21308
Email: h.b.okyar@iaea.org

Colombo, 18 July 2019

For the National Coordinator:
(Signed)

Mr Prasad Mahakumara
Director
Radiation Protection & Technical Services Division
Sri Lanka Atomic Energy Board

Address:
60/ 460, Baseline Road, Orugodawatta, Wellampitiya,
Sri Lanka

Colombo, 18 July 2019
<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Activity</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>24 November 2019 Sunday</strong></td>
<td>10:00 – 17:30</td>
<td><strong>Initial Team meeting</strong></td>
<td>ORPAS Team Members&lt;br&gt;<strong>Venue:</strong> Cinnamon Lakeside Hotel&lt;br&gt;<strong>Remarks:</strong> To refresh understanding and discuss on initial impressions and findings based on completed ORPAS Questionnaires</td>
</tr>
</tbody>
</table>
| **25 November 2019 Monday**  | 09:00 – 17:00 | **Entrance meeting**                          | Welcoming address<br>Mr. Deepal Gunaratne, Chairman, Sri Lanka Atomic Energy Board<br>Mr. Anil Ranjith (Director General, Sri Lanka Atomic Energy Regulatory Council)<br>**Remarks by the ORPAS Team Leader:** Mr. S. Long (Australia)<br>**Remarks by the IAEA Coordinator:** Mr. H.B. Okyar (IAEA)<br>**Introduction of the ORPAS Team:** Ms. O. Ciraj-Bjelac (Serbia), Ms. H. Caplin (France), Ms. K. D. Romallosa (Philippines), Ms. T. Iyu Lin (Malaysia), Mr. I. Hasanuddin (Indonesia), Mr. R. van Sonsbeek (the Netherlands)<br>**“ORPAS” within the Framework of IAEA Review Missions & Mission Process:** Mr. H.B. Okyar (IAEA)<br>**Group photo session** ORPAS official participants<br>**Coffee break**<br>**Presentations by official participants of the ORPAS**<br>Maximum 20 min. per organisation<br>Break when needed for lunch and coffee<br>Sri Lanka Atomic Energy Regulatory Council Mr. T.H.S. Shantha<br>Personal Monitoring Services Laboratory (PMSL) Mr. Muditha Rathnayake<br>Secondary Standards Dosimetry Laboratory (SSDL) Ms. Nirasha Rathnaweera<br>Lanka Hospitals (PLC)- Department of Radiology Mr. W.M.T.M. Bandara<br>Ceylinco Healthcare Services Ltd. Mr. P.S.S. Gunawardhana<br>National Hospital of Sri Lanka – Institute of Cardiology Mr. A.T.M. De Zoysa<br>National Centre for Non-Destructive Testing (NCNDT) Mr. Anusha Weerakoon<br>Sri Lanka Gamma Centre (SLGC) Mr. E.D.V. Sampath<br>Central Disused Radioactive Source Storage (CDRSS) Facility Mr. Nirodha Ranasinghe<br>Ceylon Petroleum Corporation (CPC) - cancelled Mr. Madhawa Rajapakse<br>Lanka Mineral Sands Ltd. Mr. S.A.S. Koswattha<br>Pulmudai Mineral Sand factory<br>Certification Body for Non-Destructive Testing Ms. A.B.C. Jayani<br>Department of Nuclear Science, University of Colombo Dr. J. Jeyasugiththan<br><br><br>**Concluding remarks and introduction of site visits programme**<br>Round table discussion to clarify the scope of the appraisal & agenda of site visits<br><br><b>Adjourn – 1st day</b><br>S. Long (ORPAS Team Leader)<br>H.B. Okyar (IAEA)<br>P. Mahakumara (National Counterpart)
<table>
<thead>
<tr>
<th>Day</th>
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<th>Location</th>
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<td><strong>26 November 2019</strong></td>
<td><strong>Tuesday</strong></td>
<td>09:00 – 17:00</td>
<td>1&amp;IC (am) Sri Lanka Atomic Energy Regulatory Council</td>
<td>Mr. Nirodha Ranasinghe</td>
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<td></td>
<td></td>
<td>18:00</td>
<td>2&amp;IC (pm) Sri Lanka Atomic Energy Board, Personal Monitoring Services Laboratory (PMSL)</td>
<td>Ms. Nirasha Rathnaweera Mr. Muditha Rathnayake</td>
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<td></td>
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<td>3 Lanka Hospitals (PLC)- Department of Radiology</td>
<td>Ms. Ama Sarani Mr. Lahiru Dias</td>
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<td></td>
<td>4 National Centre for Non-Destructive Testing (NCNDT)</td>
<td>Mr. Buddhika Kariyawasam</td>
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<td>Certification Body for Non-Destructive Testing</td>
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<td><strong>27 November 2019</strong></td>
<td><strong>Wednesday</strong></td>
<td>09:00 – 17:00</td>
<td>1(5)&amp;IC (am) Interview with Sri Lanka Mineral Sands Ltd. Pulmadai Mineral Sand factory</td>
<td>Mr. Nirodha Ranasinghe</td>
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<td></td>
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<td>2 Sri Lanka Atomic Energy Board, Secondary Standards Dosimetry Laboratory (SSDL)</td>
<td>Ms. Nirasha Rathnaweera Mr. Lalantha Jayasinghe</td>
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<td></td>
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<td>3 Ceylinco Healthcare Services Ltd.</td>
<td>Mr. Krishan Gamage Mr. Buddhika Kariyawasam</td>
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<td>4&amp;IC (pm) Sri Lanka Gamma Centre (SLGC)</td>
<td>Mr. Muditha Rathnayake Ms. Ama Sarani</td>
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<td></td>
<td>All ORPAS Team meeting</td>
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<tr>
<td><strong>28 November 2019</strong></td>
<td><strong>Thursday</strong></td>
<td>09:00 – 17:00</td>
<td>4&amp;IC (am) Ceylon Petroleum Corporation (CPC) Central Disused Radioactive Source Storage (CDRSS) Facility</td>
<td>Mr. Nirodha Ranasinghe Ms. Madushika Dayawansa</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>1 &amp; 2 Report preparation</td>
<td>-</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>3 &amp; IC (am) National Hospital of Sri Lanka – Institute of Cardiology</td>
<td>Mr. Muditha Rathnayake Mr. Krishan Gamage</td>
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<tr>
<td></td>
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<td></td>
<td>All ORPAS Team meeting</td>
<td>-</td>
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<tr>
<td><strong>29 November 2019</strong></td>
<td></td>
<td>09:00 –</td>
<td>4&amp;IC Department of Nuclear Science, University of Colombo</td>
<td>Mr. Muditha Rathnayake Mr. Dinesh Piyadasa</td>
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1: IC: IAEA Coordinator
<table>
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<tr>
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<th>Type</th>
<th>Details</th>
<th>Location</th>
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<td>I&amp; 2 Report preparation</td>
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<tr>
<td></td>
<td>18:00</td>
<td>3 Report preparation</td>
<td>Colombo</td>
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<td>All ORPAS team meeting</td>
<td>Colombo</td>
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<tr>
<td>30 November</td>
<td>10:00 –</td>
<td>All Preparation of Preliminary</td>
<td>Preparation of Preliminary Appraisal Report to develop Recommendations,</td>
<td>International ORPAS Team</td>
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<tr>
<td>2019</td>
<td>21:00</td>
<td>Appraisal Report to develop Recommendations, Suggestions and Good Practices</td>
<td>Good Practices</td>
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<td>Saturday</td>
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<tr>
<td>1 December</td>
<td>09:00 –</td>
<td>All o Presentation of Preliminary</td>
<td>S. Long (ORPAS Team Leader)</td>
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<tr>
<td>2019</td>
<td>10:00</td>
<td>Report to the National Counterpart</td>
<td>P. Mahakumara (National Counterpart)</td>
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<tr>
<td>Sunday</td>
<td>19:00 –</td>
<td>All Final ORPAS team meeting to resolve the issues (if any)</td>
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<tr>
<td>2 December</td>
<td>09:00 –</td>
<td>All Exit meeting</td>
<td>To be attended by all ORPAS official participants</td>
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<tr>
<td>2019</td>
<td>12:00</td>
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<tr>
<td>Monday</td>
<td>14:00 –</td>
<td>All Wrap-up meeting</td>
<td>S. Long (ORPAS Team Leader), P. Mahakumara (National Counterpart), H.B. Okyar (IAEA)</td>
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<td>17:00</td>
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# ANNEX–V: LIST OF MISSION COUNTERPARTS

**Entrance meeting**  
25 November 2019

<table>
<thead>
<tr>
<th>#</th>
<th>NAME</th>
<th>INSTITUTION/FACILITY</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Mr. Deepal Gunaratne</td>
<td>Sri Lanka Atomic Energy Board</td>
</tr>
<tr>
<td>2</td>
<td>Mr. Anil Ranjigh</td>
<td>Sri Lanka Atomic Energy Regulatory Council</td>
</tr>
<tr>
<td>3</td>
<td>Mr. T.H.S. Shantha</td>
<td>Sri Lanka Atomic Energy Regulatory Council</td>
</tr>
<tr>
<td>4</td>
<td>Mr. A. T. M. De Soysa</td>
<td>National Hospital (Cardiology)</td>
</tr>
<tr>
<td>5</td>
<td>Mr. W. M. T. M. Bandara</td>
<td>Lanka Hospital (Pvt) Ltd</td>
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<tr>
<td>6</td>
<td>Mr. Tharuka De Silva</td>
<td>Ceylinco Healthcare Hospital (Pvt) Ltd</td>
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<tr>
<td>7</td>
<td>Mr. M. P. S. S. Gunawardhana</td>
<td>Ceylinco Healthcare Hospital (Pvt) Ltd</td>
</tr>
<tr>
<td>8</td>
<td>Mr. T. M. R. Tennakoon</td>
<td>Sri Lanka Atomic Energy Board</td>
</tr>
<tr>
<td>9</td>
<td>Mrs. Anoma Rathnayake</td>
<td>Sri Lanka Atomic Energy Board (SLGC)</td>
</tr>
<tr>
<td>10</td>
<td>Mr. E. D. V. Sampath</td>
<td>Sri Lanka Gamma Centre (SLGC)</td>
</tr>
<tr>
<td>11</td>
<td>Mr. Anura Jayathilaka</td>
<td>National Center for Non-Destructive Testing (NCNDT)</td>
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<tr>
<td>12</td>
<td>Ms. A. B. C. Jayani</td>
<td>Certification Body for NDT</td>
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<tr>
<td>13</td>
<td>Mr. N. H. P. N. Gunawardhana</td>
<td>National Centre for Non-Destructive Testing</td>
</tr>
<tr>
<td>14</td>
<td>Mr. Madhawa Rajapakshe</td>
<td>Acting Deputy Engineering Manager Inspection</td>
</tr>
<tr>
<td>15</td>
<td>Mr. C. S. Abegunawardhana</td>
<td>Nuclear Science Department, University of Colombo</td>
</tr>
<tr>
<td>16</td>
<td>Dr. Jeyasingam</td>
<td>University of Colombo</td>
</tr>
<tr>
<td>17</td>
<td>Mr. S. A. S. Koswatha</td>
<td>Lanka Mineral Sands Ltd-Pulmoddai</td>
</tr>
<tr>
<td>18</td>
<td>Mr. H. M. N. R. Bandara</td>
<td>Sri Lanka Atomic Energy Board</td>
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<tr>
<td>19</td>
<td>Dr. E. A. N. V. Edirisinghe</td>
<td>Sri Lanka Atomic Energy Board</td>
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<td>20</td>
<td>Mr. Dileepa Assarapperuma</td>
<td>Sri Lanka Atomic Energy Board</td>
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<td>21</td>
<td>Ms. H. M. N. L. Handa</td>
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<td>22</td>
<td>Ms. J. D. C. Gunasekara</td>
<td>Sri Lanka Atomic Energy Board</td>
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<td>23</td>
<td>Mr. Buddika Kariyawasam</td>
<td>Sri Lanka Atomic Energy Board</td>
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<td>24</td>
<td>Mr. Prasad Mahakumara</td>
<td>Sri Lanka Atomic Energy Board</td>
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<tr>
<td>25</td>
<td>Ms. Arwa Sarani</td>
<td>Sri Lanka Atomic Energy Board</td>
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<td>26</td>
<td>Mr. Pradeep Lasantha</td>
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<td>27</td>
<td>Ms. N. R. Ratnaweera</td>
<td>Sri Lanka Atomic Energy Board</td>
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<td>28</td>
<td>Mr. Lalantha Jayasinghe</td>
<td>Sri Lanka Atomic Energy Board</td>
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<td>29</td>
<td>Ms. Monika Kaluarachchhi</td>
<td>Sri Lanka Atomic Energy Board</td>
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<td>30</td>
<td>Ms. W. A. T. L. Weerakkody</td>
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<td>31</td>
<td>Mrs. D. C. K. Dissanayake</td>
<td>Sri Lanka Atomic Energy Board</td>
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<td>32</td>
<td>Mr. Dileepa Assarapperma</td>
<td>Sri Lanka Atomic Energy Board</td>
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<tr>
<td>33</td>
<td>Mr. Nirodha Ranasinghe</td>
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<td>Mr. E. D. V. Sampath</td>
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<td>35</td>
<td>Mrs. H. G. Dharmarathna</td>
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<td>36</td>
<td>Mr. W. A. M. P. Fernando</td>
<td>Sri Lanka Atomic Energy Board</td>
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<td>Mr. S. D. V. Piyadasa</td>
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<td>Mr. R. M. N. S. Rathnayake</td>
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<td>40</td>
<td>Mr. K. G. K. M. Gamage</td>
<td>Sri Lanka Atomic Energy Board</td>
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<td>41</td>
<td>Ms. K. M. M. Dayawansha</td>
<td>Sri Lanka Atomic Energy Board</td>
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<td>#</td>
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<td>28</td>
<td>Mr. Pradeep Lasantha</td>
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<td>29</td>
<td>Ms. Nirasha Ratnaweera</td>
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<td>30</td>
<td>Mr. Lalantha Jayasinghe</td>
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<td>Ms. Monika Kaluarachchi</td>
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<td>Mr. Dileepa Assarapperma</td>
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<td>33</td>
<td>Mr. Nirodha Ranasinghe</td>
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<td>Mr. E.D.V. Sampath</td>
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<td>Mr. W.A.M.P. Fernando</td>
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<td>Mr. S.D.V. Piyadasa</td>
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<td>Mr. R.M.N.S. Rathnayake</td>
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<td>Mr. S.L.S. Dias</td>
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<td>Mr. K.G.K.M. Gamage</td>
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<td>Ms. K.M.M. Dayawansha</td>
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<td>Counterpart Institute</td>
<td>Responsible Coordination officer</td>
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<td>Sri Lanka Atomic Energy Regulatory Council</td>
<td>Mr. Shantha Thenuwara – Director (Authorization)</td>
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<td>Personal Monitoring Services Laboratory (PMSL) of Sri Lanka Atomic Energy Board</td>
<td>Mr. Muditha Rathnayake – Deputy Technical Manager of PMSL/ Scientific Officer</td>
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<td>Secondary Standards Dosimetry Laboratory (SSDL) of Sri Lanka Atomic Energy Board</td>
<td>Mr. Lalantha Jayasinghe – Deputy Technical Manager of SSDL/ Scientific Officer</td>
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<td>Lanka Hospitals (Pvt) Ltd.</td>
<td>Mr. W.M.T.M. Bandara – RPO/ Senior Radiographer</td>
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<td>Ceylinco Healthcare Services Ltd.</td>
<td>Mr. Samantha Gunawardhana – RPO/ Senior Medical Physicist</td>
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<td>National Hospital of Sri Lanka - Colombo</td>
<td>Mr. A.T.M. De Zoysa – RPO/ Radiographer</td>
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<td>National Centre for Non-Destructive Testing</td>
<td>Mr. Anushke Weerakoon- RPO/ Scientific Officer</td>
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<td>National Certification Body for Non-Destructive Testing</td>
<td>Ms. A.B.C. Jayani - / Scientific Officer</td>
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<td>Sri Lanka Gamma Centre</td>
<td>Mr. Viraj Sampath – RPO / Scientific Officer</td>
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<td>Ceylon Petroleum Corporation</td>
<td>Mr. C. R. K. Gamage – RPO / Acting Deputy Refinery Manager</td>
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<td>Central Disused Radioactive Source Storage Facility of Sri Lanka Atomic Energy Board</td>
<td>Mr. Prasad Mahakumara – RPO / Director Radiation Protection and Technical Services, SLAEB</td>
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<td>Lanka Mineral Sands Ltd. and Pulmudai Mineral Sand Factory</td>
<td>Mr. S.A.S. Koswattha – RPO / Chemist</td>
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<tr>
<td>Department of Nuclear Science, University of Colombo</td>
<td>Dr. (Ms.) Manuja Lamabadusuriya – Head, Department of Nuclear Sciences</td>
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