OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE

(ORPAS)

MISSION TO BOSNIA AND HERZEGOVINA

7–16 October 2018

OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE

Conducted under IAEA Technical-Co-operation Project on “Strengthening Protection of Radiation Workers and Occupational Exposure Monitoring (RER/9/140)”

DEPARTMENT OF TECHNICAL CO-OPERATION
Division for Europe

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY
Division of Radiation, Transport and Waste Safety
MISSION DATE: 7-16 October 2018
LOCATION: Sarajevo, Banja Luka, Mostar / Bosnia and Herzegovina

Conducted by:

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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 organizations in the hosting country.

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

At the request of the Government of Bosnia and Herzegovina through the State Regulatory Agency for Radiation and Nuclear Safety (SRARNS) addressed to the International Atomic Energy Agency (IAEA) to conduct an Occupational Radiation Protection Appraisal Services (ORPAS) mission dated as 20 March 2018, the Agency organised the ORPAS in Bosnia and Herzegovina during 7-16 October 2018 with a team of ten international experts that includes a Team Leader and an Agency Coordinator. The State Regulatory Agency for Radiation and Nuclear Safety 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 Bosnia and Herzegovina. Prior to this mission, a pre-mission was conducted from 4 to 6 July 2018 in Sarajevo to determine the participating organizations, 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 organizations participated in the ORPAS mission were the following:

REGULATOR
- State Regulatory Agency for Radiation and Nuclear Safety (SRARNS)

TECHNICAL SUPPORT ORGANIZATIONS
- Public Health Institute of Federation Bosnia and Herzegovina, Radiation Protection Center
- Public Health Institute of Republic of Srpska, Radiation Protection Center
- EKOTEH D.O.O.
- Institute of Metrology of Bosnia and Herzegovina, Standard Dosimetry Laboratory
- Faculty of Veterinary Medicine, University of Sarajevo

END-USER FACILITIES
- University Clinical Centre of Sarajevo
- University Clinical Centre of Republic of Srpska
- International Medical Centre of Affidea
- University Clinical Hospital Mostar
- Jelšingrad Livar Steel Foundry
- Bosnamontaža Prijedor
- Jajce Alloy Wheels D.O.O.
- Elektroprivreda BiH Kakanj Coal Mine
- Elektroprivreda BiH Thermal Power Plant, Tuzla

The review compared the Bosnia and Herzegovina’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 national counterparts. The SRARNS provided the review team with advance material relevant to the mission including the self-assessment carried out by the participating organizations.

This report provides the main recommendations and good practices identified during the mission. Detailed findings for individual organizations are provided in the Appendices.
In general, occupational exposure control regime is covered in the regulatory framework of Bosnia and Herzegovina. The framework is based on the Law and the subsequent regulations, which is well structured and generally in line with the IAEA Safety Standards. No major gaps in relation to these Standards were observed. The regulatory framework consists of a broad set of regulations, complemented with a set of regulatory guides. Some overlaps have been observed, but no major contradictions were identified.

The ORPAS Team was impressed with the remarkable progress made by the host country in a relatively short period of time since the drafting of legislations and implementation into practice. It is unusual, yet encouraging, that the host country requested an ORPAS mission only 9 years after the regulatory body becoming operational. This demonstrates their willingness to further improve and expand the safety culture across a range of sectors and within the country. The ORPAS Team noticed open communication and adequate cooperation between the different radiation protection actors – regulator, TSOs and end users.

Specific to the regulatory authority, SRARNS should give priority to the development of a strategy for adequate staffing to fulfil its mission, furthermore, to the full implementation and further improvement of the regulations with consideration to a graded approach. In addition, the regulator should address the occupational exposure control in existing exposure situations, such as mining and mineral processing industries, in order that the actors in these fields become aware of the exposure due to natural radionuclides, including radon in the working environment and take actions, if necessary. Existing environmental monitoring programs could be used as a starting point for monitoring occupational exposure to natural radionuclides.

One of the cornerstones to proper occupational radiation protection arrangement in a country is the stakeholder involvement during the drafting of regulations to have mutual understanding on the main characteristics of occupational exposure control, monitor and recording.

SRARNS should consider harmonizing the services provided by the TSOs, along with promoting capacity building for internal exposure assessment and calibration. It is essential that all TSOs optimize their processes to minimize the probability of human errors and provide relevant training to their personnel.

Authorization holders should apply a graded approach in decision making for individual monitoring, based on safety assessment. Moreover, a robust method of internal communication on the features of radiation protection programme with exposed workers should be established. Authorization holders should formalize any agreements with the relevant educational institutions to cover occupational radiation protection arrangements for trainees, such as residents.

Good practices, identified during the mission, are listed below:

- Policy on the Safety of Ionising Radiation Sources in Bosnia and Herzegovina as a commitment from the Council of Ministers,
- Broad range of authorizations of TSOs and requirement of appropriate accreditation,
- Mandatory training on radiation protection for authorization holder’s management reinforces overall safety culture of the organization.

Finally, it should be noted that not all the requirements of these Standards are relevant for every practice or source, or for all actions.
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1. INTRODUCTION

BACKGROUND

1.1. The International Atomic Energy Agency (IAEA) is authorized by its Statute to establish or adopt international standards of safety for protection of health and minimization of danger to life and property, and to provide for their application. 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 international Basic Safety Standards in Member States. To check whether the application of the standards is appropriate, the IAEA carries out appraisal reviews. This document is intended to assist in the appraisal of one area of application of the international safety standards, namely Occupational Radiation Protection.

1.2. To assist Member States in meeting the requirements for Occupational Radiation Protection, the IAEA has published series of Safety Guides which are jointly sponsored by the IAEA and the International Labour Office (ILO). These are the specific publications against which the appraisal described in this document is conducted. The IAEA has also published additional technical information on particular techniques, practices and activities.

CONCEPT OF APPRAISAL

1.3. 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.

SCOPE

1.4. This document is a report of an appraisal team’s mission to Bosnia and Herzegovina, primarily to check the regulatory and practical implementation of Occupational Radiation Protection arrangements. It includes some background as to the appraisal methods that were used, and conclusions and recommendations are made for Bosnia and Herzegovina.

STRUCTURE

1.5 The document consists of four chapters of main text, supported by fifteen Appendices that mostly provide the detailed findings of the mission and five Annexes.
2. OCCUPATIONAL RADIATION PROTECTION APPRAISAL

KEY OBJECTIVES

2.1. The purpose of the appraisal is to check the regulatory and practical implementation of Occupational Radiation Protection arrangements in the requesting Member State.

In other words, the review tries to answer the question “are the arrangements adequate and will they work?” given the national context in which they are applied.

An appraisal also aims at identifying specific strengths and best practices that can be shared with other Member States of the IAEA.

Finally, an appraisal provides a basis for determining where improvements may be required and for recommending actions to make such improvements.

2.2. In support of the purpose, the key objectives of the appraisal are to:

- provide the Bosnia and Herzegovina Government with an objective assessment of the provisions for occupational radiation protection;
- identify areas where performance should be improved to meet international standards;
- make recommendations on actions to be taken to achieve such improvements; and
- identify the strengths in the Bosnia and Herzegovina which are unique and worthy of bringing to the attention of others.

METHODOLOGY AND EVALUATION CRITERIA

2.3. 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):

- Governmental, Legal and Regulatory Framework for Safety (IAEA General Safety Requirements Part 1 No. GSR Part 1, Rev.1, 2016),
- Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (IAEA General Safety Requirements Part 3 No. GSR Part 3, 2014),

EVALUATION OF FINDINGS – STRENGTHS WORTHY OF SPECIAL MERIT

2.4. 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.
EVALUATION OF FINDINGS – WEAKNESSES AND CONSEQUENT RECOMMENDATIONS

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

2.6. 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.

The following priority categories have been used:

- **Essential,** means the recommendation addresses a serious weakness in the Occupational Radiation Protection Programme.

- **Important,** means until the situation is corrected; occupational radiation protection effectiveness in a certain area is compromised.

- **Advised,** means that the recommendation identifies a relatively minor weakness.

2.7. This system of prioritization goes along with the following guidelines for the suggested timing of the implementation of the recommendations:

<table>
<thead>
<tr>
<th>Priority</th>
<th>Timing of Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential</td>
<td>Should be immediate, certainly without undue delay.</td>
</tr>
<tr>
<td>Important</td>
<td>Should be reasonably achieved as soon as possible.</td>
</tr>
<tr>
<td>Advised</td>
<td>Implementation enhances effectiveness but may be delayed.</td>
</tr>
</tbody>
</table>
3. APPRAISAL PROCEDURE

THE REQUEST OF BOSNIA AND HERZEGOVINA GOVERNMENT AND RESPONSE

3.1. The Government of Bosnia and Herzegovina through State Regulatory Agency for Radiation and Nuclear Safety 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. The ORPAS was asked to be implemented with a pre-ORPAS in July 2018 and a full mission in October 2018, and conducted under IAEA Technical-Co-operation Project on “Strengthening Protection of Radiation Workers and Occupational Exposure Monitoring (RER/9/140)”

PREPARATORY VISIT AND OUTCOMES

3.2. A preparatory visit to Bosnia and Herzegovina was conducted from 4 to 6 July 2018 by Mrs Eleftheria Carinou (EEAE, Greece) as the ORPAS Team Leader and Mr H. Burcin Okyar, IAEA Division of Radiation, Transport and Waste Safety as the coordinator for the mission (for agenda, see Annex-II).

3.3. Discussions and visits were made to:
   - State Regulatory Agency for Radiation and Nuclear Safety,
   - Public Health Institute of Federation Bosnia and Herzegovina - Radiation Protection Center,
   - Clinical Centre of Sarajevo University, and
   - Faculty of Veterinary Medicine, University of Sarajevo.

The scope of the meetings 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 organization or service provider,
   - identify the program timescales,
   - view the facilities to obtain a preliminary understanding of their operations, and
   - agree and sign the Terms of References of the mission (Annex-III).

3.4. The mission objectives and the scope of the appraisal were agreed, given in section 2.1 and in section 3.3 respectively. The duration of the main (full) mission was set at 7 working days, and prior to the full mission, arrangements were made to provide each participating organization in Bosnia and Herzegovina 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 September 2018 so that briefing material could be prepared for the ORPAS team members.

AGREED SCOPE

3.5. During the preparatory visit it was agreed that the mission should involve appraisals of the regulatory authority, as well service providers and end-users (i.e. users of ionizing radiation). A provisional list of organizations was drawn up and was subject to some modification prior to the mission.
PRE-ORPAS CONCLUSIONS

3.6. The pre-ORPAS mission conclusions are summarized below;

- Continued organisational commitment from regulator is appreciated and necessary for success,
- Strong cooperation between all official participants is necessary for successful mission,
- Each candidate prepares brief presentation for the entrance meeting of full mission,
- SRARNS provides available English version of the current Regulations and summary of any revisions (on-going or planned),
- Candidate’s documentation is provided in English (particularly Radiation Protection Program),
- Changes between completion of questionnaires and full mission is expected, and
- IAEA coordinator invites experts from the region, where possible.

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

<table>
<thead>
<tr>
<th>Action</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agree proposed candidates</td>
<td>13 July 2018</td>
</tr>
<tr>
<td>Agree proposed timeline-Regulator’s request participation from candidates</td>
<td>20 July 2018</td>
</tr>
<tr>
<td>SRARNS distributes questionnaires to organizations</td>
<td>27 July 2018</td>
</tr>
<tr>
<td>Candidate organizations provide brief overview to SRARNS</td>
<td>27 July 2018</td>
</tr>
<tr>
<td>IAEA identifies ORPAS Team Members</td>
<td>July – August 2018</td>
</tr>
<tr>
<td>Organizations provide completed questionnaires to SRARNS</td>
<td>27 August 2018</td>
</tr>
<tr>
<td>SRARNS provides reviewed questionnaires to IAEA</td>
<td>3 September 2018</td>
</tr>
<tr>
<td>IAEA distributes appropriate questionnaires to Team Members</td>
<td>7-16 October 2018</td>
</tr>
<tr>
<td>ORPAS Mission</td>
<td></td>
</tr>
</tbody>
</table>

TEAM

3.7. It was decided that the scope and duration of the appraisal required a team of nine experts and an IAEA coordinator, comprising of:

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

3.8. Accordingly, the IAEA has selected the ORPAS Team for conducting the mission in Bosnia and Herzegovina.
MISSION PLANNING

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

— detailed discussions with the IAEA coordinator,
— study of a large amount of relevant background information and material,
— creation of a guidance document for team members and for the national counterpart (including review of preliminary programme for the full mission), and
— compilation of an information package that was sent to team members (the IAEA cloud was used as the main platform for information exchange).

MISSION PROGRAMME

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

CONDUCT OF VISITS

3.11. 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 team members had the opportunity to evaluate the pre-mission questionnaires provided by each participating organization.

This was valuable in pre-planning aspects of each visit and concentrating on important issues. However, time was a limiting factor for practically all the visits.

3.12. 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 of the mission had provided valuable introduction of the purpose and conduct of the appraisal to the participating organizations and relevant staff.

3.13. 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, and
— Review of safety culture at facilities and activities.

REPORTING SCHEDULE

3.14. 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>23 October 2018</td>
</tr>
<tr>
<td>Editing by IAEA Coordinator</td>
<td>30 October 2018</td>
</tr>
<tr>
<td>Review by Team Leader</td>
<td>31 October 2018</td>
</tr>
<tr>
<td>Transmission to National Counterpart</td>
<td>1 November 2018</td>
</tr>
<tr>
<td>Review by National Counterpart</td>
<td>16 November 2018</td>
</tr>
<tr>
<td>Final Report Issued</td>
<td>19 November 2018</td>
</tr>
</tbody>
</table>
4. MISSION IN GENERAL AND MAIN FINDINGS

INITIAL TEAM MEETING AND TRAINING

4.1. The initial team meeting was organized on 7 October 2018 to refresh understanding on ORPAS mission implementation and discuss on initial impressions and finding based on completed questionnaires.

ENTRANCE MEETING

4.2. The meeting was held on Monday 8 October 2018 and attended by all the organizations that are involved in the mission, including:

- State Regulatory Agency for Radiation and Nuclear Safety (SRARNS),
- Public Health Institute of Federation Bosnia and Herzegovina, Radiation Protection Center,
- Public Health Institute of Republic of Srpska, Radiation Protection Center,
- EKOTEH D.O.O.,
- Institute of Metrology of Bosnia and Herzegovina, Standard Dosimetry Laboratory,
- Faculty of Veterinary Medicine, University of Sarajevo,
- University Clinical Centre of Sarajevo,
- University Clinical Centre of the Republic of Srpska,
- International Medical Centre of Affidea,
- University Clinical Hospital Mostar,
- Jelšingrad Livar Steel Foundry,
- Bosnamontaža Prijedor,
- Jajce Alloy Wheels D.O.O.,
- Elektroprivreda BiH Kakanj Coal Mine,
- Elektroprivreda BiH Thermal Power Plant, Tuzla, and
- IAEA ORPAS team.

4.3. SRARNS 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 Team members to the counterpart. The team covered all the technical areas regulatory, technical support organizations, industrial, and medical sectors. The meeting consisted of the following formal presentations:

- “ORPAS” within the framework of IAEA review missions and mission process by the IAEA Coordinator,
- Presentations by official participants of ORPAS (totally 15).

The first presentation by the IAEA coordinator covered information on the Agency’s services for Member States in general, the ORPAS process, details and findings of the pre-ORPAS mission, details of the ORPAS Team and information on mission process. 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 organization. These were followed by questions and an open discussion. The briefing meeting greatly facilitated the mission process and programme was finalized.

APPRAISAL AT THE REGULATORY AUTHORITY, END-USER FACILITIES AND TECHNICAL SERVICE PROVIDERS

4.4. The ORPAS Team conducted the appraisal at the sites of above mentioned organizations and facilities as mentioned in 4.2. Details of the findings and recommendations of the appraisal conducted at these facilities are provided in Appendices 1 to 15. Major generic recommendations and good practices identified during the mission are given in this chapter.

ORPAS MAIN FINDINGS

4.5. In general, the ORPAS Team was impressed with the remarkable progress made by the host country in a relatively short period of time since the drafting of legislations and implementation into practice. It is unusual, yet encouraging, that the host country requested an ORPAS mission only 9 years after the regulatory body becoming operational. This demonstrates their willingness to further improve and expand the safety culture across a range of sectors and within the country. The team noticed open communication and adequate cooperation between the different radiation protection actors – regulator, TSOs, and end users.

4.6. Bosnia and Herzegovina has an independent regulatory body (SRARNS) that was established in 2007 at state level for radiation and nuclear safety. SRARNS became fully operational in 2011. The administrative structure of the host country required a unique approach to this mission, whereby ORPAS Team visited comparable institutions, such as TSOs and end users, in separate entities.

4.7. The ORPAS Team has observed that most occupational radiation protection arrangements in the host country are in line with the international safety standards.

4.8. The regulatory framework, based on the Law and the subsequent regulations, is well structured and covers most aspects of occupational exposure control regime. No major gaps in relation to the IAEA Safety Standards were observed. The regulatory framework consists of a broad set of regulations, complemented with a set of regulatory guides. Some overlaps have been observed, but no major contradictions. SRARNS is reviewing regulations for updating and possible merging. It could be a consideration to move some of the most detailed aspects to regulatory guidance documents.

Recommendations

4.9. It is essential that all TSOs optimize their processes to minimize the probability of human errors and provide relevant training to their personnel.
Important

4.10. It is important that SRARNS gives priority to the development of a strategy for adequate staffing to fulfil its mission.

4.11. Priority should be given to the full implementation and further improvement of the regulations considering a graded approach.

4.12. It is important that all TSOs develop, establish and implement an appropriate quality management system.

4.13. Authorization holders should formalize any agreements with the relevant educational institutions to cover occupational radiation protection arrangements for trainees, such as residents.

Advised

4.14. SRARNS should consider improving the mechanism for stakeholder involvement during the drafting of regulations and decision making.

4.15. SRARNS should consider harmonizing the services provided by the TSOs, along with promoting capacity building in particular for internal exposure assessment and calibration.

4.16. SRARNS needs to develop a dissemination strategy to ensure that mining and mineral processing industries become aware of the exposure due to presence of natural radionuclides in the working environment.

4.17. TSOs should develop their methodology for extremity and eye lens dosimetry, as well as monitoring programmes to include the assessment of occupational exposure due to natural radionuclides including radon, and radon progeny.

4.18. Authorization holders should apply a graded approach in decision making for individual monitoring, based on safety assessment.

4.19. Authorization holders should establish a robust method of internal communication on the features of radiation protection programme with exposed workers.

4.20. Existing environmental monitoring programs could be used as a starting point for monitoring occupational exposure to natural radionuclides.

Good Practices

4.21. Good practices identified during the mission are listed below:
   — Policy on the Safety of Ionising Radiation Sources in Bosnia and Herzegovina as a commitment from the Council of Ministers,
— Broad range of authorizations of TSOs and requirement of appropriate accreditation,
— Mandatory training on radiation protection for authorization holder’s management reinforces overall safety culture of the organization.

4.22. For facility specific detailed recommendations and good practices, reference should be made to the Appendices prepared for the regulator, the technical support organizations and the end-users.
APPENDIX – I: STATE REGULATORY AGENCY FOR RADIATION AND NUCLEAR SAFETY

Facilities and services: State Regulatory Agency for Radiation and Nuclear Safety
Location: Sarajevo
Mission dates: 9-11 October 2018
ORPAS Team: Peter Hofvander, An Fremout
SRARNS Representatives: S. Pandzic, expert advisor for legal affairs
I. Coralic, expert advisor for authorisation
M. Isovic, expert advisor for authorisation

INTRODUCTION

The State Regulatory Agency for Radiation and Nuclear Safety (SRARNS) is the Regulatory Body for radiation and nuclear safety in Bosnia and Herzegovina. It was established by the Law of 30 October 2007 on Radiation and Nuclear Safety in Bosnia and Herzegovina and became operational in 2009. The Law provides details on the status, functions and authority.

SRARNS is mainly funded from the budget of institutions of Bosnia and Herzegovina, upon the annual budget proposed by the Director of SRARNS based on the needs to implement the regulatory programme.

SRARNS reports to the Council of Ministers of Bosnia and Herzegovina and submits a yearly report on the status of radiation and nuclear safety to the Parliamentary Assembly of Bosnia and Herzegovina.

The Headquarters office is in Sarajevo, while regional offices have been established in Banja Luka (Republic of Srpska) and Mostar (Federation of Bosnia and Herzegovina).

GENERAL INFORMATION

The SRARNS has six organizational units:
- Administrative Sector (for general, legal, human resources and financial services),
- Authorization Sector (for registration and licensing activities, and approvals),
- Inspectorate (for inspection and enforcement), headed by Assistant Director (Head of Inspectorate),
- Two regional offices in Mostar and Banja Luka, and
- Director Office.

SRARNS is a relatively young organization and is currently in the process of developing an Integrated Management System.

Qualified Staff/Inspectors:

The organizational chart of SRARNS (figure 1) is planned for a total of 34 positions. However, due to financial freezing at the level of the State, at present only 16 positions are filled. In total, there are 16 employees, 12 of those have a university degree, including 3 lawyers and 9 employees with a degree in the fields of natural or technical sciences. There are 3 inspectors, who are based in regional offices (Sarajevo, Banja Luka and Mostar) and 3 experts for authorisation of whom 2 are based in Sarajevo and 1 in Banja Luka. The remaining positions
comprise about 10 natural science profiles, among which 1 inspector. Further recruitment is especially needed in the regional offices of Banja Luka and Mostar.

The current number of staff may be sufficient to cover the most urgent tasks. However, a plan is needed to build up the necessary resources in order to cover all regulatory responsibilities and to obtain a good implementation of regulations to TSOs and end-users.

**Figure 1: SRARNS Organisational chart**

**Equipment:**
The list of the available equipment at SRARNS includes, but is not limited to:

- Canberra InSpector 1000 spectrometer with NaI probe (6 pcs) and neutron probe (4 pcs)
- Atomtex AT6102 spectrometer with neutron counter (2 pcs)
- Thermo FH 40 survey meter with probes for alfa, beta, gamma radiation (4 pcs) and telescopic gamma probe and mobile laboratory for wipe tests (2 pcs)
- Canberra Radiagem 2000 survey meter with alfa, beta, gamma probes (5 pcs) and one gamma telescopic probe
- Ionising chamber Thermo Mini Ion (4 pcs)
— Ionising chamber Ludlum 9DP (3 pcs)
— Portable contamination monitor CoMo 170 (3 pcs)
— Ludlum swipe counter (scaler ratemeter)
— Radiation monitor Atomtex AT6130
— Radiation monitor Polimaster PM 1401
— Personal alarm dosimeter ThermoRadEye PRD (6 pcs)
— Personal alarm dosimeter Thermo EPD Mk2.3 (4 pcs)
— Personal alarm dosimeter Canberra Dosiman (3 pcs)
— ThermoPackEye backpack with accessory kit
— PTW Nomex multimeter (3 pcs)
— DIADOS CT ion chamber with adaptor (3 pcs)
— DIADOS E diagnostic dosimeter (3 pcs)
— DIAMENTOR set CM DAP meter (3 pcs)

APPRAISAL FINDINGS

LEGAL REGULATORY FRAMEWORK

List of regulations available in English translation:
— Regulation on requirements for the transfer and Use of Sources of Ionising Radiation (2010) – “Reg Use”
— Regulation on the Radiation Protection in Occupational Exposure and Public Exposure (2011) – “Reg Occ”
— Regulation on the National Register of Individuals Exposed to Ionizing Radiation (2015) – “Reg NDR”
— Regulation on Radiation Protection of Outside Workers (2015) – “Reg Outside Workers”
— Regulation on Radiation Protection Officer (2015) – “Reg RPO”
— Regulation on the Qualified Expert Status (2014) – “Reg RPE”
— Regulation on Radiological Emergency Events in Practices involving Radioactive Sources (2016) – “Reg Emergency”
— Regulation on inspection monitoring in the field of radiation and nuclear safety (2010) – “Reg Insp”
— Regulation on the ionizing radiation protection in medical Exposure (2011) – “Reg Med”
— Regulation on the control of high-activity sealed radioactive sources and orphan sources (2012) – “Reg HASS”
— Regulation on the Concentration Limit for Radionuclides in Food, Feed, Medicines, Items of general use, Building Materials, and other goods placed on the market (2014) – “Reg Conc Limits”
— Regulation on the Monitoring of Radioactivity in the environment (2014) – “Reg Env”
— Regulation on the Categorization of Radiation Threats (2011) – “Reg Threats”

List of additional regulations (available in original language only):
— Regulation of keeping records of legal persons performing activities with sources of ionizing radiation (2012) – “Reg Records”

Regulatory guidance documents (available in original language only):
— Guide for making the radiation protection programme in diagnostic facilities
— Guide for making the radiation protection programme in dental facilities
— Guide to Applicants for Access to Information
— Guide for radiation protection for pregnant women and nursing mothers
— Guide for the classification of controlled and supervised areas and the categorization of professionally exposed workers, trainees and students
— Guide to handling the detection of orphan sources
— Guide for radiation protection for Medical Exposure of Pregnant Women and Nurses
— Guide for Recognizing a Qualified Expert
— Guide for Radiation Safety Procedures for Technical Services
— Guide to the content of radiation protection training for persons responsible for radiation protection (RPO)
— Guide to use personal dosimeters
— Security of radioactive sources - implementation guide

There are also several laws on labour in the two entities and the district of the country, which are legally binding.

The ORPAS Team has observed that the regulatory framework, based on the Law and the different regulations, is well structured and covers most aspects of occupational exposure control. SRARNS aspires to be in line with IAEA Safety Standards. No major gaps in relation to the IAEA Safety Standards were observed. More information on specific issues are discussed further on.

The regulatory framework consists of a large set of regulations, complemented with a set of Guides. Some overlaps have been observed, but no contradictions. SRARNS is reviewing some of the regulations for updating and possible merging for some of them. It could be a consideration to move some of the most detailed aspects to regulatory guidance documents instead of regulations.
The general Policy on the Safety of Ionising Radiation Sources in Bosnia and Herzegovina is a high-level commitment that is to be used by all relevant authorities in Bosnia and Herzegovina. It was proposed by SRARNS and approved by the Council of Ministers. The ORPAS Team acknowledges this document as a good initiative and a basis to promote safety culture.

ESTABLISHMENT OF REGULATION AND STAKEHOLDER INVOLVEMENT

Regulations are prepared and issued by SRARNS, in accordance with the Law. This process does not require any consultation with other state bodies unlike the “transposition” of a European directive, whereby the text has to be sent to a state body, the Directorate for European Integration. A specific act prescribes the format of legal documents.

Recently the process has changed. During the preparation of a regulation, the draft text has to be published on the website for 21 days for consultation. A web-based platform for the announcement of draft regulations and collection of the comments has been introduced by the Council of Ministers. It is obligatory for all the authorities who draft regulations to use this system since other authorities can provide comments via the system. This process is in accordance with an act on stakeholder involvement for all authorities to send their draft regulation to the Council of Ministers for approval.

Although SRARNS is not obliged to follow this act, they choose to do so for the sake of transparency. In most cases, during the drafting of regulations, SRARNS actively communicate with the main stakeholders, such as TSOs and medical physics departments, but not with end users since it is not obligatory. External stakeholders can be involved during the drafting of regulations, as members of working groups.

For the proper implementation of regulations, an active communication with the authorization holders is needed. SRARNS has chosen to do this communication through authorized TSOs, during the inspection or authorisation process, and by means of information sessions or “round table” meetings for stakeholders. A recent example to this is the organization of information sessions at different locations about the new regulations on training.

NOTIFICATION, AUTHORIZATION AND APPROVAL

The process of notification and the process of issuing authorization for carrying out practices involving sources of ionizing radiation are described in Reg Not. An authorization can either be a license or a registration, according to a graded approach. The main requirements for authorization holders are detailed in Reg Use.

Certain elements of the hierarchy of preventive measures are not explicitly addressed, such as priority of design and technical measures for controlling occupational exposures to minimize the need to rely on administrative controls and personal protective equipment. Art 27 of Reg Not describes the approval process for possession of ionizing radiation sources. Therein reference is made to an application form that has to be filled by a TSO. However, this form does not explicitly ask for design criteria and design features. This makes difficult for the end-users to know what is expected by SRARNS. The ORPAS Team identified the need for clarification in guidance.
In total, about 450 facilities are authorized for approximately 1600 devices.

TSOs are authorized legal persons that provide services to third parties, such as individual monitoring, workplace monitoring, calibration, training, quality control and radiation safety control. An authorization from SRARNS is required for the TSOs, within the same regulatory framework.

Currently, 29 TSOs are authorized (some in more than one areas):

<table>
<thead>
<tr>
<th>Areas for authorization</th>
<th># of authorizations issued</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation safety control</td>
<td>4</td>
</tr>
<tr>
<td>Medical physics</td>
<td>4</td>
</tr>
<tr>
<td>Individual monitoring of exposed workers</td>
<td>3</td>
</tr>
<tr>
<td>Installation, servicing and dismantling of devices</td>
<td>14</td>
</tr>
<tr>
<td>Radiation monitoring of the environment</td>
<td>3</td>
</tr>
<tr>
<td>Medical surveillance of exposed workers</td>
<td>5</td>
</tr>
<tr>
<td>Training in ionizing radiation protection</td>
<td>5</td>
</tr>
<tr>
<td>Controlling the presence of radioactive material in scrap metal shipments</td>
<td>1</td>
</tr>
<tr>
<td>Protection and quality control in intraoral dental radiology</td>
<td>3</td>
</tr>
<tr>
<td>Calibration of measuring instruments and/or individual monitoring equipment</td>
<td>-</td>
</tr>
<tr>
<td>Operator of the central storage facility for radioactive waste</td>
<td>-</td>
</tr>
<tr>
<td>Collecting spent and disused sealed sources in original devices or containers</td>
<td>-</td>
</tr>
</tbody>
</table>

Another 5 or 6 TSOs are in the process of applying for authorization or renewing it. For the moment, no TSOs are licensed for instrument calibration.

RESPONSIBILITIES

The prime responsibility for the safety of radioactive sources and compliance with the laws and regulations governing radiation safety and nuclear safety has been assigned to the authorization holder according to the Law. Furthermore, responsibilities of authorization holders and employers (for itinerant “outside” workers) are clearly described in the regulations. The Reg Outside workers requires the authorization holder and the employer to cooperate as necessary to ensure the radiation protection of the exposed workers.

Regarding involvement and responsibilities of workers, some areas of improvement have been observed. Although training is obligatory to be provided and written procedures and rules have to be made available to workers, there is no procedure on involvement of workers e.g. in optimization, nor to facilitate or impose compliance by workers.

Consultation and co-operation with workers, stimulating experience feedback from workers on circumstances that could adversely affect protection and safety, and informing workers on their own dose records and results of workplace monitoring, could facilitate the promotion of safety culture. With this respect, the experience feedback foreseen in Reg RP and MP Services may serve as a good example to be generalized to other facilities and activities.
Moreover, in the regulation as well as during training in local procedures and rules, the responsibility of the workers to make their full contribution towards the radiation protection of themselves and others, should be explicitly addressed, without prejudice to the responsibilities of authorization holders and employers. This includes also the compliance with the radiation protection programme and the proper use of monitoring equipment, personal protective equipment (PPE) and clothing provided by the employer. An article in this sense has been foreseen for outside workers (Reg Outside Workers), but it should be generalized for all workers.

DOSE LIMITATION AND OPTIMIZATION

Dose limits are defined in the Reg Occ. The annual dose limit for exposed workers is 20 mSv. Exceeding the limit and averaging over 5 years needs special authorization. In addition, specific dose limits have been specified for apprentices and students between 16 and 18 years. However, the Regulations do not address that a person under the age of 16 is or could be subject to occupational exposure.

There are no specific requirements for workers exposed to radiation from sources within a practice that are not required by or directly related to their work. They are considered as exposed workers if they enter into controlled areas. If not, they are considered as members of the public.

Dose constraints are set in the “Regulation on the radiation protection in occupational exposure and public exposure” (Reg Occ) for all types of practices and are merely used as an investigation level. However, dose constraints should be established and used by the end-users for optimization of radiation protection. The regulatory body could provide for guidance on how to set dose constraints.

Information to female workers is addressed in the regulation. However, the wording “The authorisation holder shall ensure that the female exposed worker report their pregnancy timely” of Reg Occ could be reformulated to emphasise the obligation to ensure that the female worker is informed about the importance of the timely notification of the pregnancy or breastfeeding.

RADIATION PROTECTION PROGRAMME

Requirement on the classification of areas in controlled and supervised areas is based on exposure risk, considering the probability and magnitude of potential risk.

Controlled and supervised areas should be delineated. To restrict access to controlled area, either administrative procedures or physical barriers such as locks or interlocks should be in place.

A graded approach should be applied: warning signs, warning lights for CT and interventional, interlocks for radiotherapy, etc. Access to controlled areas is limited to exposed workers. Persons under 18 cannot be assigned tasks for exposed workers. Appropriate monitoring equipment and personal protective equipment is addressed in Reg Use. There is no requirement on respiratory protective equipment since this is not applicable in the current authorized practices.
Supervision by and designation of RPO is addressed.

WORKPLACE MONITORING

Although all exposed workers are required to be individually monitored, workplace monitoring is also required for radiation safety assessment and estimation of workers’ dose. Workplace monitoring is included in the tasks of TSOs authorized for radiation safety control.

As part of worker’s involvement in radiation protection, it is recommended to make records of the workplace monitoring available to them.

INDIVIDUAL DOSE MONITORING

All exposed workers, approximately 3100 in total, are individually monitored by one of the three TSOs authorized for individual monitoring.

As it is the case for all TSOs, accreditation ISO/IEC 17025 is required for individual monitoring services. Not all individual monitoring services have obtained the accreditation up to this moment, but they are all in the process of attaining accreditation (to date only one of the TSOs has accreditation).

The scope of the authorization for individual monitoring should not differ from the scope of the accreditation.

It was observed that the recording level in Reg NDR (0.10 mSv in 1 month or 0.30 mSv in 3 months) is not the same as the one Reg Occ (0.08 mSv in 1 month).

Monitoring for intake (committed dose) is addressed in the regulation but is not available in practice since there is no technical capability or capacity for such monitoring. Serious consideration should be given to provide monitoring for intake in routine situations and at minimum in the case of accidental intake.

HEALTH SURVEILLANCE

Health surveillance is required for all exposed workers and is based on general principles of occupational health. For category A workers, a health check is conducted by an authorized health-care institution. Specific training is required for occupational physicians performing this specific health surveillance.

The Safety Standards require employers to make reasonable efforts to provide workers with suitable alternative employment if, for health reasons, they may no longer continue in the activity. The general labour regulations at entity level cover this. SRARNS will look for the appropriate way to integrate this in the legal framework for ionizing radiation.

INFORMATION AND TRAINING

Reg Occ addresses the obligation for authorization holders to inform and provide training to workers, apprentices and students. Reg Training details the training programmes on all levels, including a 4 hour-training of the management of the authorization holders. This should facilitate commitment of the management in promoting safety culture.
Information and training of workers seems well established, but it should include the obligations and responsibilities of the worker, as well as the significance of the worker’s actions for protection and safety.

RECORD KEEPING

Reg Record lists the documents that authorisation holders have to record including data on equipment and sources, workplace monitoring and on exposed workers, their personal dose, medical fitness and training.

However, there are there no specific requirements about recording of decisions on measures regarding optimisation of protection by the authorization holders and the employers. It is recommended to record this type of decisions. The ORPAS team acknowledges the need to develop guidance on what is expected.

The authorisation holder shall archive the register of individual doses for the time specified in Reg Occ. However, no requirement has been specified in case of ceasing of activities. This needs to be addressed in the regulations.

The worker is permitted to access the register of received doses that is kept by the authorisation holder. It is, however, recommended that the worker is actively informed on his exposure records.

Reg Records also includes requirement on reporting to SRARNS the above cited records. SRARNS is recommended to reconsider the level of details of reporting, according to the objective.

NATIONAL DOSE REGISTRY

Reg NDR provides the regulation for the functioning of the National Dose Registry (NDR). However, the NDR has not yet been established. SRARNS is using the RAIS 3.3 web system and has a list of all exposed workers for each facility. Their medical fitness and training records are included, but not their occupational dose records.

A NDR is an important tool to:

— allow workers to retrieve information on the doses they received
— prevent the loss of data on individual doses in the event an authorization holder ceases its activities
— allow analysis of all exposure data collected at the national level in order to characterize the situation with regard to occupational exposure.

Therefore, the ORPAS Team encourages SRARNS to continue the establishment of a NDR.

CONDITIONS OF SERVICE

Some exposed workers in public hospitals have benefits, according to the different Laws on Labour, collective agreements between the Ministry and the workers (branch agreements) and
local corporate decisions on hazardous workplaces. These benefits are not being used as substitute for protection measures.

OCCUPATIONAL EXPOSURE IN EMERGENCY EXPOSURE SITUATIONS

Emergency workers are not as such defined in the regulation. According to Reg Occ, intervention in radiological or nuclear emergencies is limited to exposed workers. Conditions under which dose limit for exposed workers can be exceeded are specified in Reg Occ.

Requirements for the recording of doses of exposed workers is foreseen for authorisation holders but not by response organizations. The nearest NPP is Krsko in Slovenia, which is at 80 km from the border. Emergency exposure situations may, however, also occur in other types of practices, such as transport, medical, industrial radiography, etc., where other emergency responders could be involved. The exposure of emergency workers should be considered in the regulations. As is the case in general, also the emergency workers should be informed about their exposure.

The regulatory framework for emergency situations with respect to occupational exposure is well developed. However, it could be necessary to develop guidance for the implementation of the RPP and for the notification of events.

OCCUPATIONAL EXPOSURE DUE TO RADON, NORM AND COSMIC RADIATION

The ORPAS Team has observed that the regulatory framework does not fully address the GSR Part 3 in terms of occupational exposure in existing exposure situations. SRARNS has commenced a process of identifying such situations.

The following list of industries, potentially involving NORM, currently under consideration by SRARNS includes, but is not limited to:

— Coal mines,
— Coal fired power plants,
— Production of aluminium and aluminium alloys,
— Bauxite mines,
— Gypsum industries,
— Steel production,
— Production of electrodes,
— Thermal spas,
— Welding,
— Geothermal energy production,
— Cement production,
— Ground water filtration facilities,
— Fertilisation production, and
— Maintenance of engines that may contain thorium.

A project is in progress to evaluate radon exposure in Bosnia and Herzegovina, in dwellings and workplaces. The ORPAS Team acknowledges the ongoing work in this field. However, it
is noted that no consideration has been given to occupational exposures from mining legacy sites.

Drafting of new regulations is in progress. This proposed new regulation will replace several current regulations. NORM sites will be included in these revisions, as well as the monitoring of radon in workplaces. Caution should be given to setting the exception levels for existing exposure situations.

Reg Occ defines a reference level of 1 mSv per year, above which actions have to be taken for air crew. However, this article is not put into practice. No methodology for assessment has been determined, in the first place to verify doses with respect to the reference level. No methodology for recording has been determined. Currently, there are no airline companies in Bosnia and Herzegovina, therefore it is not a priority. It is recommended to consider having a strategy for developing regulation or technical guidance in case air companies will start.

RECOMMENDATIONS

Important
1. Human resource planning and adequate staffing for future activities under the remit of SRARNS needs to be addressed.
2. Priority should be given to the full implementation of the regulations into practice.
3. SRARNS should establish a National Dose Registry
4. The Regulations should be improved to address the requirements of the employers to provide formal reports on the results of individual monitoring and workplace monitoring.
5. The regulations should be strengthened to enhance the involvement and responsibility of exposed workers.
6. The regulations should be amended to fully address occupational exposures in existing exposure situations.

Advised
1. Stakeholder involvement should be more incorporated during the drafting of regulations
2. Graded approach for reporting requirements to SRARNS should be established.
3. Regulatory guidance should be developed for the following technical areas;
   a. Design criteria and features,
   b. Establishment and use of dose constraints ,
   c. Formal recording of decisions made with respect to radiation protection, and
   d. Mechanism for the notification of radiological incidents
4. Regulations should clearly specify that persons under 16 should not be subject to occupational exposure.
5. Requirements on information to female workers should be clarified.
6. Scope of the authorizations for TSOs should be aligned with the scope of their accreditation.
7. SRARNS should assess the need for the capacity for internal exposure assessment, both in routine conditions and in accidents.
8. The exposure of emergency workers should be considered in the regulations.
9. SRARNS is encouraged to continue to develop the list of industries involving NORM.
Good practice
1. Policy on the Safety of Ionising Radiation Sources in Bosnia and Herzegovina as a commitment from the Council of Ministers
2. Broad range of authorizations of TSOs and requirement of appropriate accreditation.
3. The requirement that managers of authorisation holders have radiation protection training.
APPENDIX – II: PUBLIC HEALTH INSTITUTE OF FEDERATION BOSNIA AND HERZEGOVINA, RADIATION PROTECTION CENTER

Facilities and Service: PHI of Federation Bosnia and Herzegovina, Radiation Protection Center
Location: Sarajevo
Date: 9th October 2018
ORPAS Team: E. Carinou, V. Chumak (Facilitator: A. Lagumdzija)
RPC Staff: S. Hasanovic, M. Redzic, Z. Ilic

INTRODUCTION

The scope of the visit to the Radiation Protection Center (RPC) was to assess their ability to provide radiation protection services (specifically individual and workplace monitoring) for the end users in Bosnia and Herzegovina. The visit started with an entrance meeting to provide participating RPC staff an introduction 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:

- Registration certificate
- Quality management system
- The laboratory quality manuals
- The results of interlaboratory comparison exercises and proficiency tests
- Calibration and system performance assessments
- The results of quality assurance checks
- Dose reports
- Calibration reports
- Interaction with the customers, and
- Specimen of dosimeters.

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

GENERAL INFORMATION

The Public Health Institute of Federation of Bosnia and Herzegovina was founded in 1997 by Law on Health protection (1997) within the premises of former Public Health Institute of Bosnia and Herzegovina which had existed in former period. The RPC is authorized for the following services in the field of occupational exposure:

- Individual monitoring and
- Radiation Safety Control (workplace monitoring)

Before 1992, the RPC provided individual monitoring services using film badge dosimeters. The service resumed in 1999 with TLD dosimetry using Harshaw 4500 manual reader and a pool of 3,000 two-element Harshaw dosimeters (0110 cards + 8814 holders). In 2017 RPC acquired a new automated Harshaw 6600 reader compatible with the existing pool of dosimeters.
APPRAISAL FINDINGS

LEGAL REQUIREMENTS

According to the regulations the technical services that provide individual monitoring are required to be authorized by SRARNS. RPC has a registration certificate which expires on 15.11.2018. To receive a renewal in the registration an accreditation certificate is required. RPC is in the process of being accredited. The ORPAS Team reviewed briefly the quality manual.

The ORPAS Team observed that the registration certificate describes the scope of registration very roughly as individual monitoring of occupationally exposed workers which is very wide compared to the services provided by RPC (i.e. the measurement and reporting of personal dose equivalent at depth, 10 mm, Hp(10), and in some cases of the Effective dose (E)).

DOSIMETRIC QUANTITIES

The dosimetric quantity used for monitoring and reporting occupational exposure is Hp(10) for photon (gamma and x-ray) radiation. Skin doses (quantity Hp(0.07)), extremity doses (Hp(0.07)), eye lens doses (Hp(3)) and doses of neutron exposure (Hp(10)) are not measured nor reported. The dosimetry system is capable of measuring doses up to 10 Sv for emergency exposure situations. Double dosimetry is provided to some customers. Effective dose is estimated in this case using a common algorithm (Niklason et al, 1994).

There is a number of extremity dosimeters, but no regular monitoring is provided for this type of exposure.

MONITORING FREQUENCY

Monitoring periods depend on the category of exposed workers and is one month for Category A workers and up to three months for Category B workers. As of the conduct of appraisal, approximately 600 Category A workers are monitored on monthly basis and 400 Category B on 3-month periods.

CALIBRATION

Calibration is provided by the Ruder Boskovic Institute (Zagreb, Croatia) calibration laboratory using a $^{137}$Cs source. The calibration his performed annually. 10 dosimeters (so called ‘gold cards’) are used for the annual calibration of the reader. All personal dosimeters are calibrated using the built-in $^{90}$Sr source to calculate and use the Element Correction Coefficients (ECC) that are determined annually. The calibration of equipment used in workplace monitoring is performed in RTI, Sweden.

TYPE TESTING

No type testing is performed except the one provided by the manufacturer and available from the instrument manuals.

PERIODIC AND PERFORMANCE TESTING

Daily equipment checks are performed. This includes instrument self-checks and readout of the control cards (dosimeters) at the beginning of each working day.
INTERCOMPARISON

RPC takes part in the biannual whole-body dosimetry (photons) interlaboratory comparisons organized by EURADOS since 2008. The published IC2014ph results were presented to the ORPAS Team for review. All data points are within the respective trumpet curves and thus RPC performance is considered to meet the ISO 14146 performance requirements.

However, analysis of the results for S-Cs quality shows quite large scatter of individual quotients and systematic underestimation of conventionally true dose. Both calibration and reproducibility of the measurements can be improved.

DOSE RECORD KEEPING AND REPORTING

Dose records are stored in a form of MS Excel file where only names and dose values are recorded. The data is entered manually from the printouts generated by the Harshaw software, which leads to a high probability for human error. Raw results, including glow curves and applicable correction parameters and calibration factors (ECC, RCF) are stored in the Harshaw instrument software.

The results of the readout of the dosimeters and the estimation of the effective dose (in case of double dosimetry) are hand written in special logbooks in respective cells (the book is organized in the following manner: each page corresponds to a person, the columns correspond to the dosimeters assigned to this person, cells correspond to a given monitoring period). Again, this may lead to human error. Any abnormalities are also recorded in this logbook. Reports are provided to the customers after completion of each monitoring period and are sent in a paper form along with the new batch of dosimeters.

All dosimetry results for a given customer (e.g. hospital) are printed in the same report. The reporting level is 0.01 mSv which is assigned for every monitoring period (i.e. every month for Category A workers and every 3 months for Category B workers). Doses above investigation level (1 mSv per monitoring period) are immediately reported to the customer and to SRARNS.

In case a dose value is missing (dosimeter loss, abnormal readout) the average value for this particular person is recorded as notorious value with respective marking.

The laboratory prepares summary reports for 1 year and 10 year periods.

As there is no national dose registry in Bosnia and Herzegovina, the results of individual measurements are reported to SRARNS but not on a regular basis.

STAFFING AND TRAINING

The staff of the laboratory consists of two persons. The staff has received “on the job” training in Croatia. Currently one of the staff members is participating in a post graduate course organized by IAEA for six months. The number of the staff is enough for the services provided. However, the ORPAS Team noticed that the methodology, the readout process and the software are not fully mastered by the staff who use it.

WORK PROCESSES IN THE LABORATORY

Each monitoring period begins after receiving written formal request from a customer with the names of persons requiring monitoring (handwritten in the standard form). The dosimeters are
issued only for the persons included to the request. Each person is assigned with two specific dosimeters used in turns. Each dosimeter holder has a permanent label with the name of the monitored person on it. Once dosimeters are assembled (numbered dosimeter slide is put inside the holder with a name tag on it), the dosimeter is ready for issue. No automation or double check of link between dosimeters and workers are in place. Dosimeters aimed for one customer are sent all together by regular post with measurements report for the previous monitoring period (one month or three months). When dosimeters are returned for readout they are accompanied with the request for a next monitoring period.

No dosimeter surface contamination monitoring is performed though this is essential for nuclear medicine workers.

OPERATION OF THE TLD SYSTEM

Readout of dosimeters is performed 24 hours upon arrival. No preheat of dosimeters for elimination of low temperature TL peaks is applied. No TTP (time-temperature profile) optimization (like setting pre-heat, after-annealing or setting region of interest) is applied. No fading correction factor is applied. These issues are not addressed adequately.

Results of readout are printed out on paper. Glow curves are available for a period since 2016 (the last system re-installation). The annealed dosimeters are stored for about a month before the issue for the next monitoring period. In order to separate occupational dose the estimated natural background dose corresponding to two respective monitoring periods (two or six months) is subtracted.

UNCERTAINTY ASSESSMENT

Uncertainty estimate is neither required by the regulations nor requested by the customers. Uncertainty estimated for in-house use includes only calibration uncertainty provided by the calibration laboratory (included in the calibration certificate).

CUSTOMER FEEDBACK

The customers are provided with all necessary instructions and consultation if needed. Complaints and customer feedback are considered by the quality manager (position at the level of the Public Health Institute).

RELIABILITY OF SERVICE

Sustainability of the service is warranted by the presence of back-up reader (manual Harshaw 4500 instrument). The laboratory is in general satisfied by the level of cooperation and responsiveness of the vendor (Thermo Fisher Europe).

RECOMMENDATIONS FOR THE TSO

Essential
1. RPC shall revise the methodology for measurement, assessment and recording of doses received by the exposed workers in order to minimize the probability of human errors.
2. RPC staff should be trained in the procedures regarding the basic physics of TL dosimetry measurements and the specific software that is used for the assessment of the doses.
Important
1. RPC should develop the method for the uncertainty calculation taking into account all relevant factors.
2. RPC should develop, establish and implement a management system according to ISO/IEC 17025 and apply for accreditation.

Advised
1. RPC should develop a process for assigning random dosimeters to monitored workers in order to avoid errors, reduce workload and make appropriate use of all dosimeters available at the laboratory.
2. RPC need to establish a procedure for surface contamination monitoring.
3. RPC need to assess the cause of the systematic underestimation of the doses in the gamma field.
4. RPC need to develop their methodology for ring dosimetry.

RECOMMENDATIONS FOR SRARNS

Important
1. SRARNS should make resources available to develop a national dose registry.
2. SRARNS should revise the regulations on the national dose registry and the authorization of TSOs in order to remove discrepancies related to:
   a. the responsibilities of the persons or organizations to send the workers’ dose records and correct the dose results,
   b. the scope of authorization as written in the respective certificate and
   c. the duration of the registration certificate.

Advised
1. SRARNS should consider organizing an interlaboratory comparisons and a round table discussion with the TSOs in individual monitoring to harmonize this kind of service in the country.
INTRODUCTION

The scope of the visit to the Radiation Protection Center (RPC) was to assess their ability to provide radiation protection services (specifically individual and workplace monitoring) for end users in Bosnia and Herzegovina. RPC is also authorized for the following activities;

- Medical Physics in Diagnostic Radiology
- Radiation Safety Control
- Radiation Monitoring of the Environment
- Individual Monitoring of occupationally exposed workers
- Radiation Protection Training
- Protection and Quality Control in Intraoral Dental Radiology

The visit started with an entrance meeting to provide participating RPC staff and introduction 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:

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

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

GENERAL INFORMATION

Radiation Protection Center (RPC) was founded in April 2001. RPC is one out of ten operational units of Public Health Institute in the Republic of Srpska.

The individual monitoring service started in 2012 with TLD dosimetry using a RADOS RE-2000 automated reader and a pool of 3000 two-element MTS-N dosimeters.

Individual monitoring is performed for more than 1000 occupationally exposed workers.

APPRAISAL FINDINGS

LEGAL REQUIREMENTS

According to the regulations the technical services that provide individual monitoring are required to be authorized by SRARNS. The RPC has a registration certificate which has
recently expired. The facility has already applied for the new one and the pre-authorization inspection has already been performed by SRARNS. The facility is accredited by the Institute for Accreditation Bosnia and Herzegovina (BATA) according to ISO/IEC 17025 to perform measurements of personal dose equivalent at the depth of 10 mm, Hp(10).

**DOSIMETRIC QUANTITIES**

The dosimetric quantity used for monitoring and reporting occupational exposure is Hp(10) for photon (gamma and x-ray) radiation. Skin doses (quantity Hp(0.07)) is measured, but not reported to the customers. Eye lens doses (Hp(3)) and doses of neutron exposure (Hp(10)) are not measured and reported. There is a small number of extremity dosimeters, but no regular monitoring is provided for this type of exposure. The customers are not satisfied with the specific type of ring dosimeter that is used. The facility loses a lot of detectors (MCP type) that are used in these ring dosimeters. Double dosimetry is provided to some customers. The facility uses MTS type detectors for ring dosimeters and distributes it on regular basis for interventional radiology and cardiology and nuclear medicine of Clinical Center of Republic of Srpska. The dosimetry system is capable of measuring doses up to 10 Sv for emergency exposure situations.

**MONITORING FREQUENCY**

Monitoring periods depend on the category of exposed workers and is one month for Category A workers and up to three months for Category B workers. Initial categorization of the workers is performed based on the results of workplace monitoring. Optionally categorization can be performed by issuing dosimeters to all workers and the final categorization is then based on the results of the safety assessment.

**CALIBRATION**

Calibration is provided by Vinca Institute of Nuclear Sciences (Belgrade, Serbia) calibration laboratory using $^{137}$Cs source. The calibration is performed every two years. 15-20 dosimeters are used for calibration purposes irradiated to doses in a range of 2-5 mSv.

All personal dosimeters are calibrated using the stand-alone $^{90}$Sr source and individual sensitivity of detectors is determined at specific intervals.

**TYPE TESTING**

In addition to the type testing provided by the manufacturer and available from the instrument manuals, in-house type testing is conducted covering linearity of response, reader stability and zero signal evaluation.

This type testing is performed in cooperation with SCK-CEN research center (Mol, Belgium) and local calibration laboratory of the Institute of Metrology (IMBiH).

**PERIODIC AND PERFORMANCE TESTING**

Daily equipment checks are performed. These include instrument self-checks and readout of the control cards (dosimeters) at the beginning of each working day.
INTERCOMPARISON

RPC takes part in the biannual whole-body dosimetry (photons) intercomparisons organized by EURADOS since 2014 (IC2014ph, IC2016ph, IC2018ph). The published IC2016ph results were presented for review at the ORPAS Team. All data points are within the respective trumpet curves and thus RPC is considered to meet the ISO 14146 performance requirements.

Analysis of the results for S-Cs quality shows very low scatter of individual quotients. However, a systematic underestimation of conventionally true dose is observed which can be improved.

In addition to international EURADOS intercomparison a bilateral intercomparison with SCK-CEN was performed with similar outcome.

DOSE RECORD KEEPING AND REPORTING

All operation of the laboratory is controlled by software called “IKSION – Dosimetry portal”, supplied by a Slovenian developer. In general, the RPC is satisfied by the performance of the software; some minor issues are planned to be resolved soon.

The readouts of dosimeters are exported from RADOS software in an ASCII (comma delimited) format and imported into IKSION with possibility to review consistency of data.

Dose records are stored in IKSION with reliable unique identifiers (Unique Personal Numbers). Dose reports are generated by IKSION automatically. They include the dose results of the current monitoring period. The reporting level is 0.08 mSv.

Reports are provided to the customers after completion of each monitoring period and are sent in a paper form separately from the new batch of dosimeters.

All dosimetry results for a given customer (e.g. hospital) are printed in the same report.

Doses above investigation level (1 mSv per monitoring period) are immediately reported to the customer and SRARNS.

As there is no national dose registry in Bosnia and Herzegovina, the results of individual measurements are reported to SRARNS but not on regular basis.

STAFFING AND TRAINING

RPC has 12 employees distributed among 4 laboratories. Individual monitoring laboratory has 2 persons with university degree and one technician. The ORPAS Team acknowledges the RPC’s staff commitment to improve their procedures and be at the state of the art in the field by using sophisticated software, seeking advice and networking.

WORK PROCESSES IN THE LABORATORY

The monitoring begins from receiving written formal request from a customer with the names of persons requiring monitoring (handwritten in the standard form), their unique IDs and their occupational category.
Upon contracting, the dosimeters are prepared and sent to the customer along with the list of dosimeters to be issued and to be returned (from the previous monitoring period). Each dosimeter has a label with name and unique bar code on the holder. The IDs of holders (persons) and dosimeter slides are linked automatically by scanning both barcodes. Prepared dosimeters are put into outgoing box, from where they are transported to PHI headquarters for mailing to the customers. The report for the preceding monitoring period in a paper as soon as it is finished (up to seven days from the measurement) is sent to the customer’s person responsible. After the end of the monitoring period, dosimeters incoming via various channels (through PHI headquarters, P.O. box or RPC postal address) are getting to the incoming box. The measurements are initiated by the written order; the form has place for putting remarks about any deviations from standard procedure, abnormal readout, damage of dosimeters etc.

After the readout of the dosimeters, the results are reviewed and approved, included into a report (signed by two persons and sealed by a stamp) and forwarded to headquarters for invoicing and official mailing to the customers.

Surface contamination monitoring is performed only for nuclear medicine workers.

OPERATION OF THE TLD SYSTEM

No preheat of dosimeters for the elimination of low temperature TL peaks is applied, however pre-measurement heating of each detector is included into the TTP (time-temperature profile). Glow curves are stored and backed-up for a whole period of operation since 2012. The annealed dosimeters get to the pool of dosimeters ready for issue. The estimated natural background dose corresponding to the time between two readouts of a dosimeter is subtracted.

UNCERTAINTY ASSESSMENT

Uncertainty is estimated based on IEC TR 62461:2015 “Radiation protection instrumentation - Determination of uncertainty in measurement” and includes various types of factors from type testing results.

CUSTOMER FEEDBACK

The customers are provided with all necessary instructions and consultations. Complaints and customer feedback are considered by the RPC personnel.

RELIABILITY OF SERVICE

Since the laboratory possesses only one reader, sustainability of the service is under question. Minor malfunctions of the reader are addressed by a local service engineer with necessary support from the vendor. To deal with the case of major breakdown of the instrument, attempts have been made to reach agreement with another institution using similar equipment, however, this agreement has not been successful.

The laboratory is in general satisfied by the level of cooperation and responsiveness of the vendor.
RECOMMENDATIONS FOR THE TSO

Important
1. RPC should seek a service level agreement with another provider with a similar TLD system to ensure sustainability of service.

Advised
1. RPC need to assess the cause of the systematic underestimation of the doses in the gamma field.
2. RPC need to develop their methodology for ring dosimetry.

RECOMMENDATIONS FOR SRARNS

Important
1. SRARNS should make resources available to develop a national dose registry.
2. SRARNS should revise the regulations on the national dose registry and the authorization of TSOs in order to remove discrepancies related to:
   a. the responsibilities of the persons or organizations to send the workers’ dose records and correct the dose results,
   b. the scope of authorization as written in the respective certificate and
   c. the duration of the registration certificate.

Advised
1. SRARNS should consider organizing an interlaboratory comparison exercises and a round table discussion with the TSOs in individual monitoring to harmonize this kind of service in the country.

Good practice
1. The ORPAS Team acknowledges that the regulator requires all technical support organizations to be accredited according to the ISO/IEC17025 standard in measuring the operational quantities for individual monitoring and performing calibration of equipment used in ionizing radiation measurements.
APPENDIX – IV: EKOTEH D.O.O.

Facilities and Service: EKOTEH D.O.O.
Location: Mostar
Date: 10th October 2018
ORPAS Team: E. Carinou, V. Chumak, B. Okyar (IAEA coordinator)
(Facilitaror: A. Lagumdzija)
EKOTEH D.O.O. Staff: M. Rudan, A. Coric, A. Sunjic

INTRODUCTION

The scope of the visit to EKOTEH D.O.O. company was to assess their ability to provide radiation protection services (specifically individual monitoring) for end users in Bosnia and Herzegovina.
The visit started with an entrance meeting to provide participating EKOTEH D.O.O. staff an introduction 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:
- Registration certificate
- Quality management system
- Dose reports, and
- Specimen of dosimeters

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

GENERAL INFORMATION

EKOTEH D.O.O. was founded in 2014 as a daughter company of the international company EKOTEH DOZIMETRIJA D.O.O (founded in 1990) with headquarters in Zagreb, Croatia. There is a good collaboration with Institute for Medical Research and Occupational Health, the Ruder Boskovic Institute, in Zagreb (Croatia), and the Jozef Stefan Institute, in Ljubljana (Slovenia).

The individual monitoring service started in 2014 with TLD dosimetry using Panasonic automated reader and a pool of 2400 four-element dosimeters (two Li2B4O7, two CaSO4: Dy granular detectors).

Individual monitoring is performed for 1030 occupationally exposed workers (810 workers of Category A workers and 220 Category B workers).

APPRAISAL FINDINGS

LEGAL REQUIREMENTS

According to the regulations the technical services that provide individual monitoring are required to be authorized by SRARNS. EKOTEH D.O.O. has a registration certificate which expires on 17.04.2019. In order to receive a renewal in the registration an accreditation certificate is required. The company is in the process of being accredited.
It should be mentioned that the registration certificate describes the scope of registration very roughly as individual monitoring of occupationally exposed workers which is very wide compared to the services provided by EKOTEH D.O.O. (i.e. the measurement and reporting of personal dose equivalent at depth, 10 mm, Hp (10))

**DOSIMETRIC QUANTITIES**

The dosimetric quantity used for monitoring and reporting occupational exposure is personal dose equivalent at depth 10 mm, Hp(10), for photon (gamma and x-ray) radiation. Skin doses (quantity Hp (0.07)) is measured, but not reported to the customers on a regular basis. Eye lens doses (Hp(3)) and doses of neutron exposure (Hp (10)) are not measured and reported. Double dosimetry is occasionally provided to some customers. No assessment of effective dose is performed by EKOTEH D.O.O. staff, feeding instead end-user’s radiation protection officer with results of both dosimeters for their own estimation of the effective dose, E. There is limited number (six) of extremity dosimeters currently in use, with more available should the demand among the clients arise, but no regular monitoring is provided for this type of exposure.

**MONITORING FREQUENCY**

Monitoring periods depend on the category of exposed workers and is one month for Category A workers and three months for Category B workers.

**CALIBRATION**

Calibration is provided by the Jozef Stephan Institute (Ljubljana, Slovenia) calibration laboratory using $^{137}$Cs source. This is performed on an annual basis.

In house calibration is performed by the reading of the batch (50) pre-irradiated dosimeters supplied by mother company from Zagreb on an irregular basis (irradiated by the Institute of Occupational Health calibration laboratory).

**TYPE TESTING**

In addition to the type testing provided by the manufacturer and available from the instrument manuals, limited in-house type testing is conducted for new dosimeters infused into the pool. This procedure is used for the estimation of detector correction factors.

**PERIODIC AND PERFORMANCE TESTING**

Daily equipment checks are performed. These include instrument self-checks performed at the beginning of each measurement. Also, the review and approval of all readout results is done by checking ratio of the readouts of the two different detector types (it should be within tolerance limits around the value of 50) and by visual inspection of the shape of glow curves.

**INTERCOMPARISON**

EKOTEH D.O.O. as a separate entity that takes part in the biannual whole-body dosimetry (photons) interlaboratory comparisons organized by EURADOS since 2018. Before that (IC2014ph, IC2016ph), EKOTEH D.O.O. took part in the EURADOS intercomparisons under the name of the mother company. The results of IC2018ph are not yet available.
DOSE RECORD KEEPING AND REPORTING

All operation of the laboratory is controlled by the software developed by the mother company EKOTEH DOZIMETRIJA D.O.O. The readouts of dosimeters are exported from Panasonic software and imported into an SQL database with the possibility to review consistency of data.

Dose records are stored in the system with reliable unique identifiers (Unique Personal Numbers). Dose reports are generated by the system automatically. They include the dose of the current monitoring period, dose since the beginning of the current calendar year, cumulative dose over the last 60 months. The latter may include the historical data, if provided by the end-user. Unfortunately, there is no note regarding the completeness of the 60-month dose record in the report table. However, specific signs exist for non-returned dosimeters, for dosimeters returned in the same monitoring period etc. The reporting level is 0.08 mSv.

Reports are provided to the customers after completion of each monitoring period and are sent in a paper form along with the new batch of dosimeters. All dosimetry results for a given customer (e.g. hospital) are printed in the same report. Doses above investigation level (1 mSv per monitoring period) are immediately reported to the customer and to SRARNS.

STAFFING AND TRAINING

EKOTEH D.O.O. has 4 employees including 2 persons with university degree and two technicians. The ORPAS Team acknowledges the well-trained expert.

The number of the staff and their training is considered appropriate for the services they provide.

WORK PROCESSES IN THE LABORATORY

The monitoring service begins from receiving written formal request from a customer with the names of persons requiring monitoring (handwritten in the standard form) and their unique IDs. Upon contracting, the dosimeters are prepared and sent to the customer along with the list of dosimeters to be issued.

Each dosimeter has a label with the name of the monitored worker. The persons and dosimeter slides are linked manually by inserting dosimeters from the numbered dispatch list to the named badges. Correctness of links is checked by operator.

Each monitoring period is colour coded by inserting dosimeter into a PVC cover (hermetically sealed) of particular colour. The dispatch list and the report for preceding monitoring period in a paper form are included into the outgoing package. After the readout of the dosimeters, the results are reviewed and approved and included into the report. Fading is automatically accounted for by Panasonic software. Regional natural background is calculated and subtracted from the dosimeter readings.

No dosimeter surface contamination monitoring is performed at the moment. There is a plan to implement incoming check for surface contamination (essential for nuclear medicine workers).
OPERATION OF THE TLD SYSTEM

No preheat of dosimeters for elimination of low temperature TL peaks applied since this is performed inherently, as a part of the glow curve generation i.e. the read-out process, by the Panasonic system and is automatically acknowledged during dose calculations by the dose calculation software. Glow curves are stored and backed-up for a whole period of operation since 2014. The annealed dosimeters get to the pool of dosimeters ready for issue. They are stored in the magazines (50 dosimeters each) in a steady sequence for the link between the available dosimeters and the monitored persons. All dosimeters are re-read after original readout. The dosimeters which show residual signal more than 100 μSv are filtered out as non-operational. The ORPAS Team acknowledges the sophisticated software which enables safe management of the dosimeter handling.

UNCERTAINTY ASSESSMENT

Uncertainty, though not required by the regulations, has been estimated for in-house use in accordance with ISO/IEC 17025 requirements.

RELIABILITY OF SERVICE

Since the laboratory possesses only one reader, special arrangements are in place to secure sustainability of the service. Minor malfunctions of the reader are addressed by the company’s personnel. In the case of major breakdown of the instrument, it will be immediately replaced by the spare one from the mother company in Zagreb. All customs formalities are pre-arranged, so the replacement can be done in a short time. Although this type of Panasonic readers is discontinued, the EKOTEH D.O.O. staff is satisfied with the reliability and endurance of the equipment.

RECOMMENDATIONS FOR THE TSO

Advised
1. RPC need to establish a procedure for surface contamination monitoring.
2. RPC need to develop their methodology for ring dosimetry.

RECOMMENDATIONS FOR SRARNS

Important
1. SRARNS should make resources available to develop a national dose registry.
2. SRARNS should revise the regulations on the national dose registry and the authorization of TSOs in order to remove discrepancies related to:
   a. the responsibilities of the persons or organizations to send the workers’ dose records and correct the dose results,
   b. the scope of authorization as written in the respective certificate and
c. the duration of the registration certificate.
Advised

1. SRARNS should consider organizing an interlaboratory comparison exercise and a round table discussion with the TSOs in individual monitoring to harmonize this kind of service in the country.
APPENDIX – VI: INSTITUTE OF METROLOGY OF BOSNIA AND HERZEGOVINA, SECONDARY STANDARD DOSIMETRY LABORATORY

Facilities and services: Secondary Standard Dosimetry Laboratory
Location: Banja Luka
Mission dates: 10th October 2018
ORPAS Team: E. Carinou, V. Chumak
(Facilitator: A. Lagumdžija)
Representatives: A. Sabeta, V. Makaric

INTRODUCTION

The Secondary Standard Dosimetry Laboratory is part of the Institute of Metrology of Bosnia and Herzegovina (IMBIH) which represents the National Metrology Institute (NMI) in Bosnia and Herzegovina (Sarajevo). It is directly responsible to the Council of Ministers.

The current institutional structure of the metrology system consists of:
— The Institute of Metrology of Bosnia and Herzegovina (IMBIH);
— The Entity Bureaus of Metrology: Bureau of Metrology of Federation of B&H and Republic Bureau of Standardization and Metrology of Republic of Srpska;
— Nominated metrological Laboratories and Bodies (verification laboratories);
— Conformity assessment bodies for measuring instruments;
— Calibration laboratories.

The legislative framework consists of:
— The Law on Metrology of Bosnia and Herzegovina (BiH Official Gazette, No. 19/2001)
— The Law on Measurement Units of Bosnia and Herzegovina (BiH Official Gazette, No. 19/2001)
— The Law on establishment of the Institute of Metrology of Bosnia and Herzegovina (BiH Official Gazette, No. 43/2004) and
— 22 Bylaws

GENERAL INFORMATION

The Secondary Standard Dosimetry Laboratory is located in Banja Luka. The laboratory premises are rented by the Ministry of Health and Social Welfare of Republic Srpska.

The main laboratory equipment consists of:
— A S-Cs (740 GBq at 2012)
— An x-ray generator missing filters and diaphragms (inherent or secondary) – expected to be supplied by IAEA
— Chambers (one chamber of 10 litters, 2 chambers of 2 litters, one farmer type, two diagnostic chambers) and N, W, W and L series of filters for x-rays
— Phantoms and
— Thermometers and barometers

There is a quality management system in place for the IMBIH based on ISO 9001 since 2010. Moreover, some of laboratories of the National Metrology Institute has been accredited according to standard ISO/IEC 17025 but this does not include the Standard Dosimetry Laboratory.
During the visit, the ORPAS Team had the opportunity to review documentation which assisted in the evaluation, including:
— Draft working instructions for calibrating radiation protection equipment;
— Template of the certification that will be used when services are provided
— Intercomparison results (protection level bilateral comparison with IAEA), and
— Uncertainty budget estimation.

APPRAISAL FINDINGS

LEGAL REQUIREMENTS

The Standard Dosimetry Laboratory is licensed by SRARNS for the possession and use of the radiation sources.

According to the Regulation on Technical Services for Ionizing Radiation Protection the calibration of measuring instruments and/or individual monitoring equipment is considered as a technical service and, as such, it should be granted with a license by the regulatory body. One of the requirements of the above-mentioned regulations is for the TSO to be accredited according to ISO/IEC 17025.

The Secondary Standard Dosimetry Laboratory is in the process of developing a management system based on ISO/IEC 17025. There are experienced personnel who can help in this direction and up to now the personnel involved in the technical part has already drafted the working procedures. The ORPAS Team was informed that there may be a management decision to apply for the Calibration and Measurement Capabilities (CMCs) instead of the accreditation process, however, due to the regulatory framework in the host country authorization is needed by SRARNS with the relevant accreditation which is encouraged by the ORPAS Team.

CALIBRATION

The calibration of the chambers is performed at IAEA. The ORPAS Team was informed that, after receiving the accreditation or applying for the CMCs they will be able to provide services in the calibration of radiation protection equipment and personal dosimeters.

PERIODIC AND PERFORMANCE TESTING

A periodic and performance testing programme is established.

INTERCOMPARISON

The laboratory has recently participated in the intercomparison exercise for radiation protection organized by IAEA with excellent results (relative response 100%). The ORPAS Team was informed that the laboratory plans to apply for the IAEA WHO SSDL network.

RECORD KEEPING AND REPORTING

Services are not provided at the moment. The quality control files are locally kept on a personal computer.
STAFFING AND TRAINING

The personnel of the Secondary Standard Dosimetry Laboratory consist of two persons. The minimum staffing level for the laboratory follows the general staffing legislation for the public sector. No extra qualifications are required.

However, the staff of the lab has received two on the job trainings (five-day scientific visit to Seibersdorf laboratories and one-month fellowship to EEAE) performed within projects of technical cooperation with IAEA. The staff size is appropriate for the time being but it should be considered to hire extra persons when services start at full rate.

RECOMMENDATIONS FOR THE TSO

Advised
1. The Standard Dosimetry Laboratory should develop a quality management system based on ISO/IEC 17025.
2. The Standard Dosimetry Laboratory should apply for accreditation in order to be licensed by the regulatory body and be able to provide services in radiation protection.
APPENDIX – VI: FACULTY OF VETERINARY MEDICINE, UNIVERSITY OF SARAJEVO

Facilities and services: Department of Radiobiology, Biophysics and Environmental Protection, Faculty of Veterinary Medicine, University of Sarajevo
Location: Sarajevo
Mission dates: 9th October 2018
ORPAS Team: M. Boguslaw, F. P. Carvalho
Representatives: N. Gradascevic, Deputy head of the Laboratory for Radioactivity Control
N. Mujic, Gamma spectrometry analyst.
SRARNS Representative: M. Isovic

INTRODUCTION

The Department of Radiobiology, Biophysics and Environmental Protection, Faculty of Veterinary Medicine, University of Sarajevo is responsible for monitoring radioactivity in foods of animal origin, feed, and water intended to be used for livestock watering. The monitoring of radioactivity in these matrices makes about 80% of the radio analysis performed in this Department. The Department carries out environmental radioactivity monitoring under contract for the Thermal Power Plants of Kakanj and Tuzla, both in the Federation of Bosnia and Herzegovina. Two other Thermal Power Plants do exist and are in operation in the country, located in the Republika of Sprska.

This laboratory for radioactivity control of the Department of Radiobiology was set up in 1949 and is continuously developed till present.

GENERAL INFORMATION

Currently, this laboratory can carry out radioanalytical measurements using high resolution gamma spectrometry, total alfa and total beta analysis using a proportional counter, and ambient dose rate measurements using portable detectors.


The laboratory is equipped with:
— a gamma spectrometer and low energy detector.
— Alpha/beta counter/type/: Proportional counter multidetector system: Ultra low-level Alpha/Beta counter MPC 9604 ORTEC/AMETEC.
— Portable radiometers used for ambient dose rate measurement.

Testing of radiometers for ambient dose rate measurements is periodically made in the laboratory with point sources only, because the national Metrological Laboratory currently is not able to provide calibration of this type of instruments.
APPRAISAL FINDINGS

Besides the main radio analytical activity on feed and food of animal origin the Laboratory has also been involved for many years in research activities dealing with enhanced natural radioactivity in the environment. In this field the Laboratory has carried out, under contract, environmental radioactivity annual surveys around two coal fired power plants (CFPP) in the Federation of Bosnia Herzegovina.

For the last 15 years detailed reports containing results of measurements include:

— activity concentration natural radionuclides in coal combustion products (CCP), soil sampled around CFPP, samples of food of plant origin and milk, and
— activity concentrations of radon ($^{222}\text{Rn}$) in houses around the CFPPs.

These reports are provided to the CFPP operator, including evaluation of effective dose to the members of the public living around the CFPP. A summary of this report is also provided to SRARNS. During the last years the scope of investigation was continuously broadened as well as the number of samples analysed.

The contract with coal fired power plants (CFPP) is established following public tenders. The monitoring programmes implemented by the laboratory for contractors do not include occupational radiation protection aspects.

LEGAL REQUIREMENTS

There is regulation on the radiation protection in occupational exposure and public exposure, however, there is no direct connection between this requirement set by SRARNS and the scope of the abovementioned research.

Nevertheless, it was pointed out that the investigation that is being currently carried out on radioactivity constitutes is part of a wider complex research which is required by BiH Federation’s Ministry of Environment as a yearly appraisal of industries releasing waste (non-radioactive) to the environment.

Currently the Laboratory is expecting more detailed regulations setting ground for the monitoring of occupational exposure caused by NORM. The Laboratory staff declared their intention to support SRARNS to develop guidelines.

STAFFING AND TRAINING

Laboratory staff consists of 6 persons. A significant staff shortage is currently observed, and no new employees can be hired due to an ongoing moratorium on recruitment. The lack of staff renewal will impact on potential medium to long term laboratory activities.

Laboratory management is aware about existing requirements to be met to achieve preparedness to carry out occupational exposure monitoring in industries coping with NORM.
RECOMMENDATIONS FOR THE TSO

Advised
1. Faculty of Veterinary Medicine is encouraged to modify the monitoring programmes to include the assessment of occupational radiation exposure in the CFPPs.

RECOMMENDATIONS FOR SRARNS

Advised
1. SRARNS is encouraged to continue to develop the list of industries involving NORM
2. SRARNS should develop a guideline on the prior radiological characterization to be performed by NORM industries, which could serve as the basis for regulatory decision making.
APPENDIX – VII: CLINICAL CENTRE OF SARAJEVO UNIVERSITY

Facilities and services: Clinical Centre of Sarajevo University
Location: Sarajevo
Mission dates: 9th October 2018
ORPAS Team: O. Ciraj-Bjelac; P. Egan
Representatives: A. Beganovic (RPO and RPE); A. Drljevic (RPE); A. Skopljak-Beganovic; M. Gazdic-Santic(RPE); S. Halilovic-Atic; R. Jasic; A. Mekic-Krejovic; B. Metlic; S. Sunjic; S. Vranic; N. Salkica, A. Brgic

INTRODUCTION

The scope of the appraisal at Clinical Centre of Sarajevo University was to review the occupational radiation protection program in place for workers. The visit started with an entrance meeting at the Medical Physics and Radiation Protection Department; providing participating staff with an introduction of the team, the purpose of the visit and how the appraisal would be conducted. 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 program, standard operating procedures for various practices, individual dose records and workplace monitoring records. At the end of the visit, an exit briefing was held to introduce the findings, conclusions, and recommendations.

GENERAL INFORMATION

The Clinical Centre of Sarajevo University (CCSU) is a public hospital which provides both diagnostic radiology and treatment for cancer patients. It is the largest hospital in the country. It has three main departments where radiation is used: Nuclear Medicine, Radiotherapy and Radiology including a number of other departments using x-rays.

The nuclear medicine service includes SPECT and hybrid imaging (PET/CT and SPECT/CT) for diagnostic procedures and radionuclide therapy for inpatients and outpatients. The following radionuclides are used: $^{99m}$Tc, $^{18}$F, $^{123}$I, $^{131}$I, $^{125}$I, $^{89}$Sr.

The Radiotherapy department uses 2 linear accelerators, a $^{60}$Co unit used for external beam therapy, a High-Dose-Rate brachytherapy system and two simulators (CT and radiography/fluoroscopy). The hospital is equipped with approximately 40 different diagnostic and interventional x-ray units.

There are 321 exposed workers employed at CCSU (a total of 355 with residents). Approximately 70% of exposed workers are categorised as category A and 30% as category B.

APPRAISAL FINDINGS

LEGAL REQUIREMENTS

CCSU is a public hospital and has authorisation for use of ionising radiation for the following radiation practices: Radiotherapy, Nuclear Medicine and Diagnostic Radiology. All three licenses are amended, as appropriate, by approvals for use of radiation sources within a specific practice. The hospital is subject to occasional site inspections by SRARNS.
RADIATION PROTECTION PROGRAM

CCSU has a well-structured Radiation Protection Program (RPP) developed by the Radiation Protection and Medical Physics Department. This Department is responsible for taking care of all radiation protection matters in CCSU, including: workplace monitoring, training, project planning, managing individual dosimetry, managing health surveillance etc. The Department employs 10 medical physicists, including a radiation protection officer.

The cornerstone of the RPP is the Radiation Protection Manual (RPM), a copy of which was provided to the ORPAS Team for review. This extensive document contains general information related to all three types of radiation practices (e.g. basic radiation physics, radiation quantities and units, basic radiation protection principles, criteria for classification of areas, categorisation of workers, detection of ionising radiation, individual monitoring arrangements, organization of radiation protection, roles and responsibilities, education and training, records, equipment used etc). The RPM is available to all staff online.

Duties and responsibilities have been assigned to the General Manager of CCSU and the Radiation Protection Officer (RPO), who directly reports to the General Manager. Their duties, as well as those of occupationally exposed workers, are defined in the RPM, however, there is no overarching governance between them.

The RPO is also a Radiation Protection Expert (RPE) for diagnostic and interventional radiology; he is supported in his work by an RPE for training and a Medical Physicist for Diagnostic Radiology and Nuclear medicine (both therapy and diagnostics). It is noted the duties of the RPE are not outlined in the RPM.

The RPO has shown excellent knowledge and skills in conducting the radiation protection duties at the centre. He is dedicated, innovative and proactive in having records maintained electronically. Even though there are several diagnostic and therapy services in the centre, where he must take responsibility as the RPO, he has performed such duties very well and is supported by the wider medical physics team in achieving this. He, his team and the wider radiography team provided very good responses to the questions asked by the ORPAS Team. It was noted that there is good trust-based communication between occupationally exposed workers and the RPO.

The RPO has prepared standard operating procedures (SOPs) for various practices at the centre, some of which are specific to radiation protection, for example, SOPs for the access to the radiation sources, emergency response, work with different radiation sources, categorisation of workers, radioactive waste management, cleaning of working areas, dealing with spillage, decontamination of workers, use of personal protective equipment, reporting of pregnancy etc.

STAFF SELECTION, INFORMATION, AND TRAINING

Professional occupationally exposed workers are selected according to their qualifications; others are selected on their potential to be exposed to ionising radiation. Basic radiation safety training is provided by the Department. Training in 5-year intervals is a regulatory requirement. The training programme is well structured and tailored according to the needs of different professional groups.
RADIATION PROTECTION MEASURES

An inventory of all radiation sources, including sealed and unsealed radioactive sources was observed.

Radiation protection measures are provided throughout the centre. All exposed workers have confirmed by a signature that they are aware of these measures.

The personal protective equipment (PPE) such as lead aprons and lead glasses are available in the areas where they are required. Instructions are posted at each of the interventional rooms on how to wear PPE and the TLD. They are checked annually, and a report is supplied to the relevant head of department detailing which PPE (lead protective jackets, skirts, thyroid collars) need to be replaced. PPE is not uniquely identified unless required to be removed from use.

In areas where unsealed radioactive sources are used, warning signs are posted on staff entrances and personnel contamination monitoring devices, as well as protective equipment, were provided at the entrance. The SOP for contamination and decontamination has been developed. Contamination monitoring is regularly performed.

Controlled and supervised areas are clearly marked. An SOP for area classification has been developed. The classification for areas is either by room (in the case of fixed systems) or is based on workplace monitoring (for mobile units).

Arrangements for pregnant workers are in place.

WORKPLACE MONITORING PROGRAM

Workplace monitoring is performed in areas where either radioactive sources or X-ray units are used. This is provided by the staff of the Medical Physics and Radiation Protection Department (which is a licensed TSO for this activity). Results of these radiation measurements are recorded and kept electronically. The records of the results of workplace monitoring were observed. Workplace monitoring encompasses H*(10) surveys and monitoring for contamination. Some equipment used for this purpose is not calibrated regularly.

For the area where radioactive contamination is suspected, or found, to exceed the limit stated in the RPM, decontamination will be conducted. There is radioisotope monitoring in the iodine therapy suite which alerts staff if any of the I-131 patients attempt to leave the unit prior to having completed duration of stay. There is also a contamination monitor for feet and hands upon exit from the controlled area of the iodine therapy suite.

INDIVIDUAL MONITORING PROGRAM

The department is responsible for managing individual dosimetry in CCSU, which includes communication with technical support organizations (TSO); ordering and distributing of individual dosimeters; maintaining the database related to exposed workers (doses and other relevant data) and issuing reports. All data related to exposed workers is collected and maintained in an Access® database, developed by the current RPO in 2009. This database also includes records on health surveillance and training.
Thermoluminescent dosimeters (TLDs) are used as personal dosimeters for all exposed workers. These dosimeters are supplied and read by the TSO. Only Hp (10) data is available. Although foreseen by a RPP, double dosimetry is not available. In addition, extremity (TLD) rings are available for relevant occupationally exposed workers, as required e.g. those working in the radiopharmacy or with administration of radiopharmaceuticals (\(^{18}\)F, \(^{131}\)I etc). However, results are not available on a regular basis. Currently, eye lens and an internal dose monitoring program is not available in this hospital. Individual dose records are reviewed, and investigated as required, by the RPO. Individual dose reports are distributed to the workers.

**INTERVENTION IN EMERGENCY**

An SOP for emergency situations such as incidents with brachytherapy source, spillage of a radioactive source and radioactive contamination of personnel has been prepared. 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 from time to time.

**HEALTH SURVEILLANCE**

A medical check-up based on general principles of occupational medicine, every year, is compulsory for both Category A and Category B workers. Specialized health surveillance for Category A exposed workers provided by a licensed TSO is required by the national regulations. Results are recorded on the Access® dose database.

**QUALITY ASSURANCE**

A Quality assurance (QA) program is described in the Radiation Protection Manual. The QA program is performed by medical physics staff.

**RECOMMENDATIONS FOR THE END USER**

**Important**

1. The formal agreement between the authorization holder and the relevant educational institution should cover occupational radiation protection arrangements for residents.

**Advised**

1. The authorization holder should conduct radiation safety assessment with consideration for the monitoring needs for exposed workers.
2. The ORPAS Team advise the establishment of a Radiation Advisory Committee to encompass all areas identified on the licence for use of ionising radiation.
3. The authorization holder should consider development of
   a. an internal dose monitoring program for the exposed workers in Nuclear Medicine
   b. an eye lens monitoring program for exposed workers who intensively use fluoroscopy
   c. an extremity monitoring program for exposed workers working in nuclear medicine and radiology as appropriate.
4. The authorization holder should arrange calibration for radiation survey meters and contamination monitors used in the hospital.
5. The RPO should evaluate the effective dose based on the radiation dose reports provided by the TSO.
INTRODUCTION

The scope of the appraisal at University Clinical Centre of the Republic of Srpska was to review the occupational radiation protection program for in place workers. The visit started with an entrance meeting at the Medical Physics and Radiation Protection Department; this provided participating staff with an introduction of the team, the purpose of the visit and how the appraisal would be conducted. 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 radiation protection. The documents provided included: the license, the radiation protection program, standard operating procedures for various practices, individual dose records and workplace monitoring records. At the end of the visit, an exit briefing was held to introduce the findings, conclusions, and recommendations.

GENERAL INFORMATION

University Clinical Centre of the Republic of Srpska (UCCRS) is a public general hospital. It has two main departments where radiation is used: Nuclear Medicine and Radiology (including Cardiology). In nuclear medicine, UCCRS uses SPECT and hybrid imaging (PET/CT and SPECT/CT) for diagnostic nuclear medicine and radionuclide therapy for inpatients and outpatients. Following radionuclides are used: $^{99m}$Tc, $^{64}$Cu, $^{67}$Ga, $^{123}$I, $^{111}$I, $^{133}$Xe, $^{131}$I, $^{177}$Lu, $^{68}$Ge, $^{125}$I, $^{89}$Sr.

The hospital is equipped with approximately 30 different x-ray units used for diagnostic and interventional procedures.

There are 324 exposed workers employed at UCCRS (without residents), out of whom 160 workers are classified as category A and 164 as category B.

APPRAISAL FINDINGS

LEGAL REQUIREMENTS

UCCRS is licensed for the following specific radiation practices: Nuclear Medicine and Diagnostic Radiology. The licenses are amended, as appropriate, by approvals for use of radiation sources within a specific practice. The hospital is subject to occasional site inspections by SRARNS.
RADIATION PROTECTION PROGRAM

UCCRS has a well-structured Radiation Protection Program (RPP) developed by the Medical Physics and Radiation Protection Department. The radiation protection manual (RPM) contains general information related to radiation practices (basic radiation physics, radiation quantities and units, basic radiation protection principles, criteria for classification of areas, categorisation of workers, detection of ionising radiation, individual monitoring arrangements, organization of radiation protection, roles and responsibilities, education and training, records, equipment used etc). Radiation safety responsibility has been assigned to the General Manager of the UCCRS and Radiation Protection Officer (RPO), who directly reports to the General Manager. Although the definition Radiation Protection Expert (RPE) is mentioned in the RPM, the role in the RPP is not clear.

The RPO has prepared standard operating procedures (SOPs) for various practices at the centre and some are specifically for radiation protection purposes. These are provided in the annexes of the RPM. For example, SOPs for different diagnostic and therapeutic procedures, emergency response, work with different radiation sources, categorisation of workers, radioactive waste management, cleaning of working areas, dealing with spills, decontamination of workers, use of personal protective equipment, reporting of pregnancy are included.

The RPO is knowledgeable and skilled in conducting the radiation protection duties at the centre; however, there are limited resources considering the breadth of services offered. He also provided very good responses to the questions asked by the team. A good working relationship was evident with other members of the wider team.

STAFF SELECTION, INFORMATION, AND TRAINING

Basic radiation safety training is provided by the Medical Physics and Radiation Protection Department and good examples of such training have been presented to the ORPAS Team. However, there is no evidences that all workers have been trained according to the national regulations. Training in 5-year intervals is a regulatory requirement.

RADIATION PROTECTION MEASURES

An inventory of all radiation sources, including sealed and unsealed radioactive sources was observed.

Radiation protection measures are generally provided throughout the hospital. The Radiation Protection Manual is available electronically; a concise version of it is also available online to all workers. There is no evidence that exposed workers have accessed or read either version.

The ORPAS Team observed that proper and sufficient radiation safety equipment, including personal protective equipment (PPE) that has been provided in each department. This PPE is occasionally checked by the RPO. However, the radiation measuring devices are not regularly calibrated.

An SOP for area classification has been developed, however the controlled and supervised areas are not clearly marked. The basis for classification for areas is either by shielded room (for fixed x-ray units or SPECT camera room) or is based on workplace monitoring performed by the RPO (for mobile units).
Well-designed engineering barriers have been observed in the area where unsealed radioactive sources are used, however, the warning signs were not posted. The area monitoring devices are available and protective equipment is provided at the entrance/exit area. The SOP for contamination and decontamination has been developed. Contamination monitoring is regularly performed.

Arrangements for pregnant workers are in place.

WORKPLACE MONITORING PROGRAM

Workplace monitoring is performed in areas where either radioactive sources or x-ray units are used. This is provided by a licensed external TSO. Results of these radiation measurements are recorded and kept by Medical Physics and Radiation Protection Department. The records of the results of workplace monitoring were observed. Workplace monitoring encompasses H*(10) surveys and monitoring of contamination. Additional monitoring by a Medical Physics and Radiation Protection Department is performed occasionally. Equipment used in the workplace monitoring is not calibrated regularly.

INDIVIDUAL MONITORING PROGRAM

Thermoluminescent dosimeters provided by an external TSO (PHI Banja Luka) are used for individual external dose monitoring purpose. The dose records are reviewed by the RPO and retained. The whole body and extremity dosimetry data is available. In addition, double dosimetry is available to the exposed workers performing interventional procedures and extremity dosimetry is provided for nuclear medicine exposed workers. However, this is not described in the radiation protection manual. Currently, eye lens and an internal dose monitoring program is not available in this hospital, although the latter is mentioned in the Radiation Protection Manual.

INTERVENTION IN EMERGENCY

An SOP for emergency situations such as radioactive spills and radioactive contamination of personnel has been prepared. 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 from time to time.

HEALTH SURVEILLANCE

A medical check-up based on general principles of occupational medicine, every year, is compulsory for Category A workers. It is provided by a licensed TSO according to national regulations.

QUALITY ASSURANCE

A quality assurance program is described in the Radiation Protection Manual, including periodic checks of contamination, radioactive source and radioactive waste inventory. For nuclear medicine it is performed by Medical physics and radiation protection department staff, whereas for diagnostic radiology it also involves an external licensed TSO. The hospital has established the QA committee, however, the involvement and role of the RPO within the committee is not clear.
RECOMMENDATIONS FOR THE END USER

Essential
1. Controlled and supervised areas should be clearly marked with warning signs as per regulatory requirements.

Important
1. The formal agreement between the authorization holder and the relevant educational institution should cover occupational radiation protection arrangements for residents.
2. The authorization holder should formalise the classification of areas and radiation protection arrangements for mobile units.

Advised
1. The authorization holder should conduct radiation safety assessment with consideration for the monitoring needs for exposed workers.
2. The ORPAS Team advise the establishment of a Radiation Advisory Committee to encompass all areas identified on the licence for use of ionising radiation.
3. The authorization holder should consider development of
   a. an internal exposure monitoring program for the exposed workers in Nuclear Medicine.
   b. an eye lens monitoring program for exposed workers who intensively use fluoroscopy
   c. an SOP for the requirements for additional individual monitoring
   d. a program to test integrity of PPE
4. The authorization holder should arrange calibration for radiation survey meters and contamination monitors used in the hospital.
5. The RPO should evaluate the effective dose based on the radiation dose reports provided by the TSO.
6. The authorization holder should establish a robust method of internal communication with respect to radiation protection manual to exposed workers.
APPENDIX – IX: INTERNATIONAL MEDICAL CENTRE OF AFFIDEA

Facilities and services: International Medical Centre of Affidea
Location: Banja Luka
Mission dates: 10th October 2018
ORPAS Team: P. Egan, O. Ciraj-Bijelac, B. Okyar,
Representatives: Z. Kuzmanovic, medical physicist, RPO
G. Kolarevic, head of medical physics department
D. Stricic, chief operation officer (COO)

INTRODUCTION

The scope of the appraisal at the International Medical Centre of Affidea (IMCA) was to review the occupational radiation protection program in place for workers. The visit started with an entrance meeting with centre representatives; this provided participating staff an introduction to the team, the purpose of the visit and how the appraisal would be conducted. 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 radiation protection. The documents provided included: the license, the radiation protection program, standard operating procedures for various practices, individual dose records and workplace monitoring records.

At the end of the visit, an exit briefing was held to introduce any findings, conclusions, and recommendations.

GENERAL INFORMATION

IMCA is a private radiotherapy clinic located on the site of University Clinical Centre of Republic of Srpska. It provides treatment for cancer patients. It has a licence for Radiotherapy only. The department uses 3 linear accelerators, HDR Brachytherapy, a CT simulator and disused planning system.

All 34 employees of the centre are classified as Category A. The majority of staff are not exposed workers.

APPRAISAL FINDINGS

LEGAL REQUIREMENTS

IMCA is a private clinic and has authorisation for use of ionising radiation for Radiotherapy. The license is amended, as appropriate, by approvals for use of radiation sources within the specific practice. The clinic is subject to occasional site inspections by SRARNS.

RADIATION PROTECTION PROGRAM

IMCA has a well-structured Radiation Protection Program (RPP) developed by the Radiation Protection Officer. The RPO is responsible for taking care of all radiation protection matters including: training, managing individual dosimetry, managing health surveillance etc.

The cornerstone of the RPP is the Radiation Protection Manual (RPM), a copy of which was shown to the ORPAS Team for review. This document contains general information related to radiotherapy practice (e.g. basic radiation physics, radiation quantities and units, basic radiation
protection principles, criteria for classification of areas, categorisation of workers, detection of ionising radiation, individual monitoring arrangements, organization of radiation protection, roles and responsibilities, education and training, records, equipment used etc). The RPM is available to all staff and they must sign to confirm that they have both read and will comply with the RPM.

Duties and responsibilities have been assigned to the Chief Operations Officer (COO) and the Radiation Protection Officer (RPO), who directly reports to the COO. Their duties, as well as those of exposed workers, are defined in the RPM.

The RPO has shown good knowledge and skills in conducting the radiation protection duties at the centre. The COO is also very knowledgeable of both the RPM and wider regulatory requirements.

The RPO has prepared standard operating procedures (SOPs) for various practices at the centre.

STAFF SELECTION, INFORMATION, AND TRAINING

Staff is selected based on their qualifications. Information is provided and radiation protection training is mandatory and recorded.

RADIATION PROTECTION MEASURES

An inventory of all radiation sources is detailed in the RPM. Radiation protection measures are provided throughout the centre. All workers have confirmed, by a signature, that they are aware of those measures.

Warning signs are posted on staff entrances to all rooms containing licenced equipment. Controlled and supervised areas are clearly marked. An SOP for area classification has been developed. The classification for areas is by room as all equipment is fixed.

Arrangements for pregnant workers are in place.

WORKPLACE MONITORING PROGRAM

Workplace monitoring is performed by a licensed TSO. Results of this activity is provided to the clinic; records of this service were observed.

INDIVIDUAL MONITORING PROGRAM

Thermoluminescent dosimeter (TLDs) are used as personal dosimeters for all workers. These dosimeters are supplied and read by the TSO.

The RPO is responsible for managing individual dosimetry in IMCA, which includes communication with technical support organizations (TSO); ordering and distributing of individual dosimeters and issuing reports. Electronic personal dosimeters are available.

INTERVENTION IN EMERGENCY

An SOP for emergency situations such as incidents with brachytherapy source has been prepared. 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 from time to time.

HEALTH SURVEILLANCE

A medical check-up based on general principles of occupational medicine, every year, is compulsory for Category A workers. It is provided by a licensed TSO according to national regulations and records are maintained locally.

QUALITY ASSURANCE

A Quality assurance program is described in the Radiation Protection Manual.

RECOMMENDATIONS FOR THE END USER

Advised

1. The authorization holder should conduct radiation safety assessment with consideration for the monitoring needs for exposed workers.
APPENDIX – X: UNIVERSITY CLINICAL HOSPITAL MOSTAR

Facilities and services: University Clinical Centre
Location: Mostar
Mission dates: 11th October 2018
ORPAS Team: B. Okyar; O. Ciraj-Bjelac; P. Egan
Representatives: S. Galic, Head of Medical Physics and Radiation Protection Office, RPE, RPO; I. Lasic, medical physicist, diagnostic radiology; M. Kovacevic, medical physicist, radiotherapy; M. Sesar, medical physicist, nuclear medicine

INTRODUCTION

The scope of the appraisal at University Clinical Hospital Mostar (UCHM) was to review the occupational radiation protection program for in place workers. The visit started with an entrance meeting at the Medical Physics and Radiation Protection Department; this provided participating staff with an introduction of the team, the purpose of the visit and how the appraisal would be conducted. 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 radiation protection. The documents provided included: the radiation protection program, standard operating procedures for various practices and individual dose records. At the end of the visit, an exit briefing was held to introduce the findings, conclusions, and recommendations.

GENERAL INFORMATION

UCHM is a public hospital which provides both diagnostic radiology, nuclear medicine and radiotherapy service for patients. It has three main departments where radiation is used: Nuclear Medicine, Radiotherapy and Radiology and number of departments using x-rays and interventional radiography. In nuclear medicine, UCHM preforms imaging procedures (with one gamma camera) using following radionuclides: $^{99m}$Tc, $^{201}$Tl, $^{67}$Ga, and radioiodine therapy for inpatients using $^{131}$I.

The hospital is equipped with approximately 17 different diagnostic and interventional x-ray units. The Radiotherapy department uses 2 linear accelerators, Low-Dose-Rate brachytherapy system and one CT simulator.

There are 170 exposed workers employed at UCHM (without residents). Approximately 75% of workers are category B and 25% category A.

APPRaisal FINDINGS

LEGAL REQUIREMENTS

UCHM is a public hospital and has authorisation for use of ionising radiation for the following radiation practices: Radiotherapy, Nuclear Medicine and Diagnostic Radiology. All three licenses are amended, as appropriate, by approvals for use of radiation sources within a specific practice. The hospital is subject to occasional site inspections by State Regulatory Agency for Radiation and Nuclear Safety.
UCHM has a well-structured Radiation Protection Program (RPP) developed by the Radiation Protection and Medical Physics Department. This Department is responsible for all radiation protection matters at UCHM, including: workplace monitoring; managing individual dosimetry; managing health surveillance etc. The Department employs 6 medical physicists, including the Radiation Protection Officer.

The cornerstone of the RPP is the Radiation Protection Manual (RPM), a copy of which was provided to the ORPAS Team for review. Three separate documents are available, related to specific radiation practices: diagnostic radiology, nuclear medicine, radiotherapy. These are extensive documents contain general information related to radiation practices (basic radiation physics, radiation quantities and units, basic radiation protection principles, criteria for classification of areas, categorisation of workers, individual and workplace monitoring arrangements, organization of radiation protection, roles and responsibilities, education and training, records, emergency procedures, etc). SOPs for different procedures are also included in the manuals. The RPM has been made available to all staff by email, however there is no evidence that it has been acknowledged or read.

Duties and responsibility have been assigned to the General Manager of UCHM and Radiation Protection Officer (RPO), who directly reports to the General Manager. Their duties, as well as those of exposed workers, are defined in the RPM. The RPO reports directly to the General Manager.

The RPO has shown excellent knowledge and skills in conducting the radiation protection duties at the centre. He, his colleagues and the wider team provided very good responses to the questions asked by the ORPAS Team.

RPO has prepared standard operating procedures (SOPs) for various practices at the centre, some of which are specific to radiation protection, for example, SOPs for emergency response, work with different radiation sources, categorisation of workers, radioactive waste management, dealing with spills, decontamination of workers, use of personal protective equipment, etc.

STAFF SELECTION, INFORMATION, AND TRAINING

Exposed workers are selected according their potential to be exposed to ionising radiation. The UCHM is not a licensed TSO for training, so staff training has not been done. Training in 5-year intervals is a regulatory requirement.

RADIATION PROTECTION MEASURES

An inventory of all radiation sources, including sealed and unsealed radioactive sources was observed.

The personal protective equipment such as lead aprons and glasses are available in the area where they are required. They are checked annually, and a report supplied to the relevant head of department detailing which PPE (lead protective jackets, skirts, thyroid collars) need to be replaced. PPE is not uniquely identified except upon removal.
In the area where unsealed radioactive sources are used, warning signs are posted on staff entrance. The SOP for contamination and decontamination has been developed. Contamination monitoring is regularly performed.

Controlled and supervised areas are clearly marked. An SOP for area classification has been developed. The classification for areas is either by room (in the case of fixed systems) or for mobile units it is set at 3 m from the x-ray unit, as stated in the radiation protection manual.

Arrangements for pregnant workers are in place.

WORKPLACE MONITORING PROGRAM

Workplace monitoring is performed in areas where either radioactive sources or x-ray units are used. This is provided by a TSO licensed for this activity. Results of these radiation measurements are recorded and kept by Medical Physics and Radiation Protection Department. The records of the results of workplace monitoring were observed. Workplace monitoring encompasses H*(10) surveys and monitoring of contamination.

For the area where radioactive contamination is suspected, or found, to exceed the limit stated in the RPM, decontamination will be conducted. There is an area monitor available in the nuclear medicine department and daily checks for presence of contamination is performed and recorded.

INDIVIDUAL MONITORING PROGRAM

The medical physics and radiation protection office is responsible for managing individual dosimetry in UCHM, which includes communication with technical support organizations (TSO); ordering and distributing of individual dosimeters; maintaining database related to exposed workers (doses and other relevant data) and issuing reports. All data related to exposed workers is collected and maintained in an Excel file. In addition to dose record, records on health surveillance are kept.

Thermoluminescent dosimeters are used as personal dosimeters for all exposed workers. These dosimeters are supplied and read by the TSO. Only Hp(10) data is available. Double dosimetry is not available; and extremity monitoring is not offered. Individual dose records are kept and reviewed by the RPO and distributed to the relevant heads of department.

Categorisation of workers was initially performed by a TSO, but has not been updated.

INTERVENTION IN EMERGENCY

An SOP for emergency situations such as incidents with brachytherapy source, radioactive spills and radioactive contamination of personnel has been prepared. 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 from time to time.

HEALTH SURVEILLANCE

A medical check-up based on general principles of occupational medicine, every year, is compulsory for Category A workers. It is provided by a licensed TSO according to national regulations. And records retained by the RPO.
QUALITY ASSURANCE

A quality assurance program is described in the Radiation Protection Manual for nuclear medicine, diagnostic radiology and radiotherapy departments. QA is performed by medical physics staff. There is an established multidisciplinary QA committee, dealing with quality assurance in diagnostic radiology.

RECOMMENDATIONS FOR THE END USER

Important
1. The formal agreement between the authorization holder and the relevant educational institution should cover occupational radiation protection arrangements for residents.

Advised
1. The authorization holder should conduct radiation safety assessment with consideration for the monitoring needs for exposed workers.
2. The ORPAS Team advise the establishment of a Radiation Advisory Committee to encompass all areas identified on the licence for use of ionising radiation.
3. The authorization holder should consider development of
   a. an internal exposure monitoring program for the exposed workers in Nuclear Medicine.
   b. an eye lens monitoring program for exposed workers who intensively use fluoroscopy
   c. extremity monitoring program for exposed workers working in nuclear medicine department and radiology as appropriate.
4. The authorization holder should arrange calibration for radiation survey meters and contamination monitors used in the hospital.
5. The RPO should evaluate the effective dose based on the radiation dose reports provided by the TSO
6. The procedure for urgent medical care to a patient undergoing radioiodine therapy should be developed.
APPENDIX – XI: JELŠINGRAD LIVAR STEEL FOUNDRY

Facilities and services: Jelšingrad Livar steel foundry
Location: Banja Luka
Mission dates: 10th October 2018
ORPAS Team: R. van Sonsbeek
Representatives: M. Babic (Safety Manager), M. Ilić (RPO, RT level 2), N. Čelić (RT level 1), M. Brdar (Area Sales Manager), S. Marković-Bojanić (General Manager)

INTRODUCTION

The purpose of the ORPAS mission to Jelšingrad Livar steel foundry (further referred to as Jelšingrad) was to review their arrangements for occupational radiation protection and to provide an appraisal report incorporating findings, conclusions and recommendations for strengthening the Occupational Radiation Protection Programme of the company.

Jelšingrad Livar is a private company established in 1937. The company produces steel castings. 75% of the steel castings are exported, respectively to Italy, Germany, France, Spain, Croatia, Serbia, Hungary and Russia (via an Austrian agent). The steel castings have weights between 1 kg and 6 tons. The capacity of the foundry is about 120 tons per month.

Jelšingrad Livar has a quality management system that is certified according to ISO 9001 (2015).

The quality of the castings is performed by means of non-destructive testing. Ultrasonic Testing (UT) and Magnetic Testing as well as Metallographic tests (PMI) are always performed on each produced casting.

Radiographic Testing (RT) is only performed on request and directions of the customer, in which case the radiographs are sent to the customer together with other relevant product documentation about the dimensions of the castings. RT is performed by means of gamma radiography with an \( \text{^{192}Ir} \) source in a shielded enclosure which they call the NDT laboratory. They estimate to perform on average 20 exposures per day (5 days per week). The radiographic testing is performed during normal working hours, i.e. there are no night or weekend shifts.

GENERAL INFORMATION

Prior to the appraisal, Jelšingrad were requested to complete ORPAS questionnaires for end-users, and a questionnaire that was designed by the ISEMIR WG 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, and
— Emergency preparedness and response.

Further documentation was provided during the mission. The ORPAS reviewer met with the Safety Manager, the RT level 2/RPO operator, the RT level 1 operators as well as the Area
Sales Manager and the General Manager. From this the ORPAS reviewer got a good impression of the Radiation Protection Program and how it was implemented. Relevant procedures and records were kept by the RPO at the NDT laboratory which were presented.

**APPRAISAL FINDINGS**

**LICENSES:**

Jelšingrad has two licenses, respectively for:

2. possession and use of radioactive source to perform industrial radiography: license number 1-1082-471/17 dated 07.03.2018, valid thru 07.03.2021.

**EXPOSURE DEVICES AND ANCILLARY EQUIPMENT:**

Jelšingrad has two exposure devices:

- ISOTOPEN TECHNIK DR. SAUERWEIN, GmbH, Type GAMMAMAT D/DB-0005B with serial number 13-578, maximum activity Ir-192: 1,85 TBq,
- ISOTOPEN TECHNIK DR. SAUERWEIN, GmbH, Type GAMMAMAT D/DB-0025B(U) with serial number 22-955, maximum activity Ir-192: 1,85 TBq.

Furthermore, they have several types of collimators that are used depending on the type of exposure, e.g. directional or panoramic.

It should be noted that these exposure devices do not meet the requirements of ISO 3999:2004, or equivalent, which is a requirement in IAEA SSG-11.

**RADIATION SOURCES**

Every 6 months one of the two $^{192}$Ir sources is exchanged for a new one. The source container is picked up by Vinča Institute of Nuclear Sciences in (Belgrade, Serbia). The sources originate from Isotope Technologies (Minsk, Belarus). They are delivered with a source certificate, which states that the ISO 2919 classification is C(E) 65546 and that the source meets the requirements for Special Form Radioactive Material and SSG 6 requirements.

**TRAINING**

The company has one RT level 2 operator and one RT level 1 operator for which they could show valid certificates that were obtained from the Vinča institute of nuclear science. The RT level 2 operator also acts as RPO.

The company does not currently comply with the regulation on the training in ionizing radiation protection. Neither the general manager, the RPO nor the RT operators follow a training course at an authorized technical service for the training in ionizing radiation protection.
INDIVIDUAL MONITORING AND HEALTH SURVEILLANCE

The RT operators wear TLDs provided by an authorized TSO. The electronic dose meters cannot be considered as active individual dose meters, as these are mainly used as survey meter, e.g. to check whether the source is back in its shielded enclosure.

Exposed worker doses are recorded on the “Annex 7” form taken from the Regulation on Record Keeping, the annual effective dose of the RT level 1 operator was 0.38 and 0.4 mSv, respectively in 2015 and 2017. The average annual effective dose of the RT level 2 operator in the period 2009-2017 was 1.56 mSv, with a maximum of 4.31 mSv in the year 2012. According to the RT level 2 operator the relatively high dose in 2012 was due to an incident in which the guide tube was disconnected from the exposure device and he had to approach the exposure device to re-connect it.

A medical check-up based on general principles of occupational medicine, every year, is compulsory for the RT operators. They are also informed about their dose records on a monthly basis.

SHIELDED ENCLOSURE

At Jelšingrad industrial radiography is only performed in a shielded enclosure. This shielded enclosure consists of a concrete building with walls of 0.5 m thickness. The radiation area in which objects are tested is about 10 m x 7m. There is crane with a maximum load of about 3.2 tons, which is used to position the objects. An object enters the radiation area via a sliding door that is shielded with lead. When that door is closed, persons can only enter the radiation area via a labyrinth. The control room from which the exposure device is operated is located behind the wall that is at the opposite side of the sliding door. The roof of the control room is also shielded. The control cable is guided under that wall through a gutter until it reaches the connection with the exposure device. The exposure device is shielded. There is also a mobile shield available in the radiation area for special circumstances.

OPERATING PROCEDURES

During the visit the ORPAS reviewer witnessed one exposure. The RT level 2 set-up the exposure by putting the end of the guide tube in the centre of a cylindrical steel casting which was covered with radiographic films at the outer surface. He unlocked the exposure device and went to the control room where he operated the remote control to transfer the radioactive source from the exposure device to the end of the guide tube. Before exposure an audible and a visible warning signal are manually activated. The audible alarm and warning light are located outside the building. During the exposure which lasted for 40 seconds the net dose rate in the control room closed to the wall was about 0.6 μSv/h. After the exposure the audible and visible warning signals are turned off. After the exposure, the industrial radiographer enters the room with his personal / survey meter to verify that the radioactive source is back in to the exposure device. He does check this also by moving his personal/survey meter along the guide tube, which is a good practice.
WORKPLACE MONITORING

Radiation safety control was last performed by the TSO on 26.3.2018. During this visit the dose rates were recorded at various locations where both the RT operators and other employees could be present.

The RT operators have two electronic dose and dose rate meters, GraetzGammaTwin. These are suitable for an energy range between 45 keV and 1.3 MeV, dose rates between 0.5 μSv/h and 70 mSv/h, and dose between 0.5 μSv and 1 Sv. These meters have an acoustic alarm which goes off at pre-set alarm threshold levels.

RADIATION PROTECTION PROGRAM

The company showed a radiation protection program that contained the elements in accordance with regulations.

MISCELLANEOUS

The warning signs and warning signals used at the shielded enclosure are not in accordance with the regulations.

RECOMMENDATIONS FOR THE END USER

Important
1. The authorization holder should ensure:
   a. The classification of areas by means of a safety assessment;
   b. The installation of safety and warning systems in compliance with regulations
   c. The revision of the radiation protection program to address routine tests and preventive maintenance on the exposure device and ancillary equipment.
   d. Further develop emergency preparedness plan to include possible emergency scenarios.
   e. Training by a TSO in accordance with regulatory requirements.

RECOMMENDATIONS FOR SRARNS

Advised
1. SRARNS is recommended to review their regulations against the IAEA Specific Safety Guide SSG-11 Radiation Safety in Industrial Radiography.
2. SRARNS should give special attention to the current arrangements for preventive maintenance of exposure devices and emergency preparedness and response.
INTRODUCTION

The purpose of the ORPAS mission to Bosnamontaža was to review their arrangements for occupational radiation protection and to provide an appraisal report incorporating findings, conclusions and recommendations for strengthening the Occupational Radiation Protection Programme of the company.

Bosnamontaža was established in 1957. It developed as a manufacture and assembly service company in the field of fabrication and assembly of steel structures, process equipment and overhaul of industrial plants.

The company employs, continuously, approximately 100 workers both in the production facility and in the field, and during the overhaul works on power plants, cement plants, sugar mills and breweries it employs additional 50 workers, or more, if needed. The structure of the workforce is: qualified fitters, pipe fitters, welders, drivers, crane operators, electricians, engineers, economics and administration staff.

In their production facility Bosnamontaža can produce heavy steel structures, storage tanks, pipelines, silos, chimneys and tanks.

Bosnamontaža is capable of testing welds by the NDT methods, such as, penetrant testing (PT), ultrasonic testing (UT) and radiographic testing (RT). Industrial radiography (RT) is not performed on a regular basis. The amount of radiographic testing is limited to about 2,000 exposures per year. About 2/3 of the RT is performed at client sites and 1/3 at their own location. All the RT can be regarded as site radiography, i.e. none of the RT is performed in shielded enclosures.

The company’s quality management system is certified against ISO 9001(2015) as well as against ISO 14001 and OHSAS 18001.

GENERAL INFORMATION

Prior to the appraisal, Bosnamontaža were requested to complete ORPAS questionnaires for end-users, and a questionnaire that was designed by the ISEMIR WG Industrial Radiography. The ISEMIR questionnaire is based on IAEA Specific Safety Guide 11 Radiation Safety in Industrial Radiography, and consisted of question 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, and
Emergency preparedness and response

Further documentation was provided during the visit. The ORPAS reviewer met with the RT level 2 operator, who also acts as RPO, the RT level 1, the General Manager and an external consultant who previously worked as RT operator for the company. Unfortunately, the ORPAS reviewer was not able to witness any RT job.

APPRAISAL FINDINGS

LICENSES

Bosnamontaža has three licenses, respectively for:

- import and export of radioactive sources (license number 3-039-045/17 dated 10.02.2017, valid thru 10.02.2020),
- transport of radioactive sources (license number 2/021-044/17 dated 10.02.2017, valid thru 10.02.2020), and

EXPOSURE DEVICES AND ANCILLARY EQUIPMENT

They have three exposure devices:

- KOLMAR GRAZ SU-50, Type B, D/DB-009B(U) with serial number 78827, maximum activity Ir-192: 1,85 TBq,
- KOLMAR GRAZ SU-50, Type B, D/DB-009B(U) with serial number 79916, maximum activity Ir-192: 1,85 TBq, and
- TELETRON SU50.

Whereas the KOLMAR devices are mentioned in license 1-1032-248/17, the TELETRON device is not. Radiographers are obliged to use collimators in order to limit the dose rate.

RADIATION SOURCES

Every 6 months one of the two $^{192}$Ir sources is exchanged for a new one. The source container is picked up by Vinča Institute of Nuclear Sciences (Belgrade, Serbia). The sources originate from Isotope Technologies (Minsk, Belarus). They are delivered with a source certificate, which states that the ISO 2919 classification is C(E) 65546 and that the source meets the requirements for Special Form Radioactive Material and SSG 6 requirements.

STORAGE OF RADIOACTIVE SOURCES

When the sources are not in use, they are stored in the storage facility at the company premises, unless they are stored at the client’s site. This storage facility consists of two vaults in a concrete structure, which has an approximate thickness of 0.5 meter in all horizontal directions. The vaults are sufficiently large to store three exposure devices and are closed with a padlock. Access to the concrete structure is prevented by a fence that is also locked by a separate padlock. The storage facility is monitored with a CCTV system. During the visit the dose rate at the fence was at background level, i.e. in normal conditions there is no exposure to a person who is present in the vicinity of the storage facility.
TRAINING

The company has one RT level 2 operator and one RT level 1 operator for which they could show valid certificates that were obtained from the Vinča institute. The RT level 2 operator also acts as RPO.

The company does not currently comply with the regulation on the training in ionizing radiation protection. Neither the general manager, the RPO nor the RT operators follow a training course at an authorized TSO for the training in ionizing radiation protection.

TRANSPORT OF RADIOACTIVE SOURCES.

During the visit the vehicle that is licensed and used for the transport of radioactive sources was located at a client site. The vehicle is also used as a mobile darkroom for developing films that are exposed on site. It was explained that an exposure device is transported in a steel case that is covered with additional lead shielding. Both RT operators hold valid ADR certificates for class 7.

WORKPLACE MONITORING

According to the information provided by the interviewees a controlled area has a barrier at the worksite. The authorisation holder has a calibrated survey meter and electronic personal devices available. It implements procedures for cordoning off the areas where exposures take place.

RADIATION INCIDENTS

In recent years, Bosnamontaža experienced two incidents. SRARNS was notified in both instances, dosimeters were sent for immediate processing. However, further investigations and root cause analysis were not conducted.

RECOMMENDATIONS FOR THE END USERS

Important
1. The authorization holder should ensure:
   a. The revision of the radiation protection program to address routine tests and preventive maintenance on the exposure device and ancillary equipment.
   b. Further develop emergency preparedness plan to include possible emergency scenarios.
   c. Training by a TSO in accordance with regulatory requirements.

RECOMMENDATIONS FOR SRARNS

Advised
1. SRARNS is recommended to review their regulations against the IAEA Specific Safety Guide SSG-11 Radiation Safety in Industrial Radiography.
2. SRARNS should give special attention to the current arrangements for preventive maintenance of exposure devices and emergency preparedness and response.
3. SRARNS should consider establishing dose rate criteria for the perimeter of the controlled area during site radiography.
APPENDIX – XIII: JAJCE ALLOY WHEELS D.O.O.

Facilities and services: Jajce Alloy Wheels D.O.O.
Location: Jajce
Mission dates: 11th October 2018
ORPAS Team: Richard van Sonsbeek
Representatives: D. Šimunović (Safety Manager, future RPO), R. Ćutuk (General Manager)

INTRODUCTION

The purpose of the ORPAS mission to Jajce Alloy Wheels D.O.O. was to review their arrangements for occupational radiation protection and to provide an appraisal report incorporating findings, conclusions and recommendations for strengthening the Occupational Radiation Protection Programme of the company.

Jajce Alloy Wheels D.O.O. is a private company established in 1988. The company produces alloy wheels for automobiles. The size of the wheels ranges from 10 to 22 inch. The production is about 2,500 pieces per day for which they melt about 25 tons of aluminium. Clients include German and Japanese car manufacturers, but they also produce for the so-called “aftermarket”. Jajce Alloy Wheels D.O.O. has a quality management system that is certified against ISO 9001 (2008).

The production of the alloy wheels continues 24 hours per day and 7 days per week. The transport of the wheels through the production line is fully automated. There is no need for physical handling of the wheels by the employees.

Jajce Alloy Wheels D.O.O. has three x-ray machines that are positioned in shielded cabinets. Although the x-ray machines are of different types, they all have a peak voltage of 160 kV and a maximum current of 4 mA. X-ray is the only method of NDT.

GENERAL INFORMATION

Prior to the appraisal, Jajce Alloy Wheels were requested to complete ORPAS questionnaires for end-users, and a questionnaire that was designed by the ISEMIR WG Industrial Radiography. The later questionnaire was based on IAEA Specific Safety Guide 11, and consisted of question 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, and
— Emergency preparedness and response.

Further documentation was provided during the mission.

Unfortunately, the quality manager who also acts as RPO was not available. However, information about the company and their radiation protection program was provided by the safety manager, who will assume the role of RPO in due time. The ORPAS reviewer had the opportunity to visit the production facility and the x-ray cabinets. The ORPAS reviewer observed the radiographic testing of some wheels, was able to do some dose rate measurements,
and got further explanation of the procedures by one of the RT operators. An exit meeting was organised with the general manager.

**APPRAISAL FINDINGS**

Jajce Alloy Wheels D.O.O. is licensed for the use of three x-ray machines:

- GROHMANN TECHNOLOGIES model XW 28,
- GROHMANN TECHNOLOGIES model XW 26, and
- TWS (TEILE AND WERKZEUG SERVICE, model DF26.

The licence (no. 1-863-011/16) was issued on 10.06.2016 by SRARNS and is valid until 10.06.2019.

The General Manager, the Quality Manager (current RPO), and the Safety Manager (future RPO) have followed training courses on radiation protection with the authorized TSO. This was proven by certificates issued by SRARNS.

Jajce employs five radiographers, one RT level 2 and four RT level 1. Qualification certificates were issued by Croatian Society of Non-Destructive Testing in accordance with HRN EN ISO 9712:2012.

A radiation safety control of all three cabinets was performed by an authorized TSO. During the radiation safety control dose rate measurements were performed with a calibrated survey meter at representative operating conditions.

Based on the aforementioned radiation safety control the radiographers were classified as category B workers with a monitoring period of three months. Doses are recorded on the “Annex 7” document according to the Regulation on Record Keeping.

Jajce Alloy Wheels has a Radiation Protection Program that contains the minimum required elements due to low risk practice.

**RECOMMENDATIONS FOR THE END USER**

**Advised**

1. The authorized holder should further develop training by an authorised TSO in accordance with regulatory requirements.

**RECOMMENDATIONS FOR SRARNS**

**Advised**

1. SRARNS is recommended to review their regulations against the IAEA Specific Safety Guide SSG-11 Radiation Safety in Industrial Radiography.
APPENDIX – XIV: ELEKTROPRIVREDA BIH KAKANJ COAL MINE

Location: Kakanj
Mission dates: 10th October 2018
ORPAS Team: F. Carvalho, B. Michalik
Representatives: Director of Mine: S. Alajbegovic; Z. Antunovic; N. Alajbegovic; K. Haracic; A. Muflizovic; E. Calso
SRARNS Representative: M. Isovic

INTRODUCTION

The purpose of the ORPAS mission to visit Kakanj Coal Mine was to review their arrangements for occupational radiation protection and to provide an appraisal report with findings, conclusions, and recommendations for strengthening the occupational radiation protection programme within the company.

Kakanj Coal Mine is a large company established in the year 1929 with the name Rudnik-Doboj, although coal mining in the region dates to Middle Age times. The Kakanj coal mine is a subordinate company and part of a consortium of coal mines and coal fired power plants held by the JP Elektroprivreda BiH d.d.

GENERAL INFORMATION

The Kakanj Coal Mine organization employs 1715 workers, organized in 5 units, which includes 1 economic unit and 4 production units.

The geological capacity of Kakanj coal deposits was estimated at 425 Mtonnes. The Kakanj Coal Mine supplies coal produced by the wet sludge method and dry grading process. Currently the coal is extracted from two mines, one open pit producing around 800 ktonnes/year, and one underground mine producing about 400 ktonnes/year.

Some analyses of radionuclides in coal were performed in BiH. Specific coal resources with high content of radium were reported. However, the available information suggests that the coal mines producing coal with the highest radioactive content are currently closed.

In Kakanj Coal Mine exploitation is carried out based on long wall mining technique. In this method of coal exploitation typical hazards observed are: induced earthquakes, underground fires, coal dust explosions, and, depending on local geological conditions, methane fire/explosions. Besides these, higher concentration of radon is observed in the mine atmosphere depending on intensity of ventilation system applied and the volume of created due to roof collapse goaf.

CONDUCT OF APPRAISAL

Prior to the ORPAS mission no questionnaire was sent to the coal mine company and no self-assessment of the company was requested about occupational radiation exposure. SRARNS requested a meeting for the ORPAS Team and agreed the time schedule with the company.
The conduct of the appraisal was preceded by an introduction made by M. Isovic explaining the role of the Regulatory Authority and introducing the national law and radiation protection regulations. This was followed by an introduction about the aim of the ORPAS mission by the ORPAS Team members. To achieve an understanding of occupational radiation protection in the company, a detailed dialogue was conducted by the ORPAS Team. The staff of the coal company present provided answers to all questions.

Potential sources of mine staff occupational exposure to natural radiation was discussed based on examples provided by the ORPAS Team.

LEGAL REQUIREMENTS

Existing “Regulation on the radiation protection in occupational exposure and public exposure” sets generic requirements concerning necessity of occupational exposure monitoring caused by the presence of natural radionuclides. Whilst the company follows the legal occupational health and safety requirements in mining it does not yet specifically address occupational radiation protection.

APPRAISAL FINDINGS

At present the coal mine company does not possess and does not use sealed radioactive sources or equipment emitting ionizing radiation in the mine and facilities. The company has the intention to acquire sealed radioactive sources for use in the coal processing, in the future.

An assessment of ambient conditions of the microclimate is periodically performed in the mine, every three years. Monitoring of chemical and physical parameters is performed under the mining specific regulations, such as measurement of methane and dioxins, but the monitoring programme does not include monitoring of radioactivity and radiation exposure.

The management of the company has no specific information about the activity concentration of radionuclides in the coal. No radioactivity analysis has ever been performed, and this includes measurements of radon in the air, determination of radioactivity in coal dust, aerosols and mine water, and external radiation dose measurements in the mines and facilities of this company.

The coal mine representatives in the meeting showed no awareness of potential occurrence of natural radioactivity in the coal, nor the need for measures to ensure radiation protection to the workers. However, general knowledge related to underground mining indicates that there is the potential for radiological exposure caused by presence of:

- radon and radon decay product in mine air,
- radium in underground water, and
- radium in sediments.

Finally, the company representatives declared the highest interest of the company management to be informed about radiation hazards and their willingness to adopt radiation protection measures. However, in the light of ongoing mining activity qualified mine personnel (such as ventilation officer) should encompass occupational radiation protection.
The willingness of the company to address some radiation protection measures is acknowledged and appreciated by the ORPAS Team. Based on the information gathered in this meeting and discussion held with the coal mine company representatives it is concluded there is a need to enhance awareness in this coal mining company about occupational radiation hazards related to presence of natural radionuclides in underground workings. However, based on details concerning existing hydrogeological conditions and ventilation systems applied potential occupational exposure is expected at the level that does not need an urgent intervention and necessary monitoring can be developed as an extension of the existing monitoring system of mine atmosphere and water quality.

RECOMMENDATIONS FOR SRARNS

Advised

1. SRARNS should develop a dissemination strategy to ensure that the entire mining sector becomes aware of the occurrence of natural radionuclides in the working environment.
2. SRARNS should establish regulation or guidance for prior radiological characterisation applicable to industries involving natural radionuclides.
APPENDIX – XV: ELEKTROPRIVREDA BIH THERMAL POWER PLANT, TUZLA

Location: Tuzla, Federation of BiH
Mission dates: 11.09.2018
ORPAS Team: F. Carvalho, B. Michalik
Representatives: A. Okanovic, M. Casurovic, H. Avidic, S. Trakic, E. Muminovic, E. Muhamedbegovic
SRARNS Representative: M. Isovic

INTRODUCTION

The purpose of the ORPAS mission visiting the Tuzla Thermal Power Plant was to review their arrangements for occupational radiation protection and to provide an appraisal report with findings, conclusions, and recommendations for strengthening the occupational radiation protection programme within the company.

GENERAL INFORMATION

The Tuzla Thermal Power Plant (TPP) is coal fired. It supplies electric power to the region of Tuzla and North of BiH Federation, thermal energy for the towns of Tuzla and Lukavac and steam for the industry. Coal is supplied by two main mines in coal basin Kreka–Banovicci, owned by the JP Electroprivreda BIH d.d. This coal basin has significant geological reserves of lignite and brown coal, which enable reliable and long-term quality supply of coal for thermal power plant.

Tuzla Thermal Power Plant consumes 3.3 M tonnes of coal per year, generating about 0.8 M tonnes of coal combustion products (CCP) per year. A fraction of the fly ash produced is supplied to cement manufacturers and incorporated in cements for infrastructure construction. Slag is deposited in final repositories in the region and uncovered.

CONDUCT OF APPRAISAL

No questionnaires were sent beforehand to the JP Electroprivreda BIH d.d., Tuzla TPP. The appraisal was concluded through a meeting held in the premises of the TPP.

In this meeting, organized by the SRARNS, Ms M. Isovic introduced SRARNS, the laws and regulations pertaining to radiation protection and the activities of the Regulatory Authority.

The ORPAS Team explained the objective of the ORPAS mission, the role of the IAEA in this respect and purpose of the visit to the Tuzla TPP. The ORPAS Team asked the TPP representatives about existing radiation sources, the TPP occupational radiation protection programme, and the awareness of radiation protection measures regarding monitoring and protection of workers from exposure to natural radionuclides.
LEGAL REQUIREMENTS

Existing “Regulation on the radiation protection in occupational exposure and public exposure” sets generic requirements concerning necessity of occupational exposure monitoring caused by the presence of natural radionuclides. Whilst the company follows the legal environmental protection requirements of the country it does not yet specifically address occupational radiation protection.

APPRAISAL FINDINGS

TPP uses radiation sources under the regulatory control of SRARNS. Due to this there is an RPO and radiation protection program in place. However, this is not within the scope of this visit.

In the TPP facilities the occupational radiation protection programme does not include any monitoring for natural radioactivity in the raw material (coal) and in ash and slag produced. No monitoring of radiation dose exposure due to contact, inhalation of dust from these materials, and inhalation of radon gas emanated from them is provided. Furthermore, no radiological risk characterization of workplaces was performed in the TPP facilities.

The TPP representatives at the meeting described an ongoing and periodic radioactivity monitoring programme ordered by the TPP and implemented under contract by a TSO which conducts radioactivity monitoring included analyses of coal, fly ash and slag and measurement of ambient radiation doses.

The annual reports from this monitoring programme meet the requirements of environmental laws and obtain the Environmental Certificate needed to maintain the TPP operation.

The environmental radioactivity annual reports prepared by the TSO, were not designed to cover the occupational radiation protection issues and therefore do not address the calculation of radiation dose received by TPP workers.

In the discussion with the TPP representatives it was clarified that the administration of the company aims to comply with the existing laws and regulations and is ready to modify the radioactivity and radiation dose monitoring programme as needed to include occupational radiation protection issues. However, they consider to not have in house expertise in the field and would appreciate receiving adequate guidance or a suitable monitoring proposal from the TSO.

RECOMMENDATIONS FOR THE END USER

Advised
1. The environmental monitoring program could be used as a basis for monitoring for occupational exposure to natural radionuclides.
RECOMMENDATIONS FOR SRARNS

Advised

1. SRARNS should develop a dissemination strategy to ensure that the entire coal combustion sector becomes aware of the occurrence of natural radionuclides in the working environment.

2. SRARNS should establish regulation or guidance for prior radiological characterisation applicable to industries involving natural radionuclides.
ANNEX–I: IAEA REFERENCE MATERIAL USED FOR THE MISSION


— INTERNATIONAL ATOMIC ENERGY AGENCY, Implications for Occupational Radiation Protection of the New Dose Limit for the Lens of the Eye (IAEA TECDOC 1731, 2013).

## ANNEX–II : PRE-MISSION PROGRAMME

### Occupational Radiation Protection Appraisal Service – ORPAS

#### Bosnia and Herzegovina

**Wednesday, 4 July 2018**

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<tr>
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<th>Session</th>
<th>Presenter</th>
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<tr>
<td>10:00 – 10:15</td>
<td>Welcome, Introductions</td>
<td>SRARNS</td>
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<tr>
<td>10:15 – 11:00</td>
<td>ORPAS Appraisal Service and the scope of the pre- &amp; full mission</td>
<td>IAEA</td>
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<tr>
<td>11:00 – 11:45</td>
<td>Current Occupational Radiation Protection status, an overview on regulatory framework in Bosnia and Herzegovina, technical services for radiation protection and typical end-user facilities</td>
<td>SRARNS</td>
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<tr>
<td>11:45 – 12:00</td>
<td>Coffee break</td>
<td>Mr Dizdarevic</td>
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<td>12:00 – 12:45</td>
<td>Technical support organizations and their operations</td>
<td>PHIRS-a, Ms Petrovic</td>
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<td>12:45 – 13:30</td>
<td>Occupational radiation protection provisions for end-user facilities</td>
<td>Clinical Hospital Sarajevo, Mr Beganovic</td>
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<td>13:30 – 14:30</td>
<td>Lunch break</td>
<td>IAEA</td>
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<tr>
<td>14:30 – 15:30</td>
<td>Occupational Exposure Control with the Agency perspective (GSR Part 3 and relevant safety guides)</td>
<td>Mr Okyar</td>
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<td>15:30 – 15:45</td>
<td>Coffee break</td>
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<td>15:45 – 18:00</td>
<td>Round table discussion (Logistics &amp; practical arrangements) for the ORPAS mission, e.g.:</td>
<td>Counterpart/ IAEA</td>
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<td>• Confirmation of the facilities to be visited during the pre-mission</td>
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<td>• Mission dates and scope</td>
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<td></td>
<td>• Roles and responsibilities of ORPAS Team members, the responsible officer and the counterparts</td>
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<td>• Self-assessment process</td>
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<td>• Hotel and local transport arrangements (including site visits etc.);</td>
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<td>• Working areas and facilities for individuals and teams (on-site and off-site, including the hotel);</td>
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<td>• IT, data-projectors, secretarial support etc.;</td>
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<td>• Arrangements for communication between ORPAS Team members and counterparts;</td>
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<td>• Translators and technical escorts, if required;</td>
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<td>• Review of the day, summary and conclusions</td>
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**Thursday, 5 July 2018**

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<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter</th>
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<tbody>
<tr>
<td>09:00 – 10:30</td>
<td>Logistics for the ORPAS mission (Cont’d)</td>
<td>Counterpart/ IAEA</td>
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<tr>
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<td>• Process of interviews and document review;</td>
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<td>• Necessary arrangements for entry to facilities, including clearance and any required training.</td>
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<td>• Initial team meeting (time, venue participants);</td>
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<td>• Entrance Meeting (time, venue participants);</td>
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<td>• Direct observation and site visits (date(s), duration, venue(s) participants);</td>
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<td>• Discussion and agreement on advanced reference material (ORPAS questionnaires)</td>
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<td>• Exit Meeting (time, venue participants);</td>
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<td>• Media relations;</td>
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<td>• Meetings with State officials etc.;</td>
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<td></td>
<td>• Social events.</td>
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</table>
10:30 – 11:00 Coffee break
11:00 – 12:15 Visit* Public Health Institute FBiH, Sarajevo Counterpart/ IAEA
12:15 – 13:30 Lunch break
13:30 – 17:00 Visit* Clinical Hospital Sarajevo Counterpart/ IAEA

Friday, 6 July 2018

09:00 – 10:30
● Review of the Detailed Mission Programme Counterpart/ IAEA
● Summary of meeting and Follow-up items

10:30 – 11:00 Coffee break
11:00 – 12:30 End of preparatory meeting SRARNS / IAEA

*In each Facility or Service (e.g. IMS, Research Reactor, 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
Bosnia and Herzegovina

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 end-users and technical support organizations against IAEA safety standards to propose recommendations and suggestions; and sharing of relevant good practices.

The ORPAS mission was requested by the Government of Bosnia and Herzegovina through State Regulatory Agency for Radiation and Nuclear Safety (SRARNS) on 20 March 2018. Agenda of the Preparatory Meeting and the preliminary composition of the ORPAS Team are attached in Annex 1 and Annex 2 respectively.

2. ORPAS PRE-MISSION DATES

4 – 6 July 2018

3. OBJECTIVES OF THE PRE-ORPAS

- To liaise with the host country regulator (SRARNS) and agree a program of visits to End Users (such as hospitals, NDT companies, etc.) and Technical Services Organizations (TSO) (such as individual monitoring laboratories, SSDL, advisory services, etc.) that will participate in the appraisal process;
- To hold meetings with the identified End Users and TSOs to present the appraisal process, and introduction of the ORPAS self-assessment questionnaires with a SARIS demonstration;
- To visit the facilities of the identified End Users and TSO to form an understanding of these facilities; and
- To agree the program of the full ORPAS appraisal mission in October 2018.

4. ORPAS TEAM COMPOSITION

Team Leader: CARINOU, E. (Greece)
Team Coordinator: OKYAR, H.B. (IAEA)
Team Members: To be included
Team Administrator: To be decided (Vienna based, IAEA)
5. MAIN COUNTERPART

<table>
<thead>
<tr>
<th>Role</th>
<th>Name</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responsible Officer</td>
<td>DIZDAREVIC, E.</td>
<td>Deputy Director State Regulatory Agency for Radiation and Nuclear Safety Hamdije Čemerlića 2 Sarajevo, 71000 Bosnia and Herzegovina</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, and
- To provide a standard recording format for incorporation into the country profile.

As such, official participants of the ORPAS are invited to complete the ORPAS questionnaires for regulator, the End-users (Practices) and the TSO with a deadline which will be agreed during the pre-ORPAS.

Applicable Questionnaires are for Regulator, End-user, External Dosimetry TSO, Internal Dosimetry TSO, Dose Record Keeping Service, Workplace Monitoring TSO and General Technical Services.

6.2. Action plan

Upon completion of a self-assessment (e.g. SARIS) 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, 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.

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 SRARNS 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 SRARNS to save time and gain convenience.
7.6. Arrangements for communication between ORPAS Team members and 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 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 country counterpart.

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 Responsible Officer 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 SRARNS. From the host country side, the Responsible Officer 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 for the initial team meeting.

7.11. Entrance Meeting
Room large enough to accommodate the ORPAS Team and host country representatives has to be identified by the host country. 2 hours are 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.

7.12. Direct observation and site visits
Site visits will be arranged accordingly. The list of ORPAS Team members who will take part in the site visits will be given to the Responsible Officer.

7.13. Exit Meeting (time, venue participants)
A room large enough to accommodate the ORPAS Team and host country representatives has to 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 Responsible Officer 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; and other relevant local customs.

10. REPORT CONFIDENTIALITY

In the interest of openness, countries are encouraged to make their ORPAS mission report public. Unless Bosnia and Herzegovina clearly specify 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

(Signature)

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

Sarajevo, 4 July 2018

For the Counterpart:  

Signed

(Signature)

Mr E. DIZDAREVIC

Deputy Director

State Regulatory Agency for Radiation and Nuclear Safety

Address:

HamdijeČemerlića 2 Sarajevo, 71000 Bosnia and Herzegovina

Sarajevo, 4 July 2018
### ANNEX – IV: FULL MISSION PROGRAMME

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Activity</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>7 October</td>
<td>15:00</td>
<td>Initial Team meeting</td>
<td>International ORPAS Team Members To refresh understanding and discuss on initial impressions and findings based on completed questionnaires</td>
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<tr>
<td>2018</td>
<td>–</td>
<td>Venue: Hotel Holiday Sarajevo</td>
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<tr>
<td>Sunday</td>
<td>18:30</td>
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<tr>
<td>8 October</td>
<td>09:00</td>
<td>Entrance meeting</td>
<td>To be attended by all ORPAS official participants</td>
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<tr>
<td>2018</td>
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<td>Welcoming address</td>
<td>E. Dizdarevic (National Counterpart - State Regulatory Agency for Radiation and Nuclear Safety)</td>
</tr>
<tr>
<td>Monday</td>
<td>17:00</td>
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- **Opening of ORPAS Mission, Bosnia and Herzegovina 2018**
- **Remarks by the ORPAS Team Leader**
- **Remarks by the IAEA**
- **Introduction of the International ORPAS Team**

“ORPAS” within the Framework IAEA Review Missions & Mission Process

- **Group photo session**
- **ORPAS official participants**
- **Coffee break**
- **Presentations by official participants of the** Maximum 20 min. per organization ORPAS
- **State Regulatory Agency for Radiation and Nuclear Safety (SRARNS)**
  - E. Dizdarevic (SRARNS)
  - A. Vidic (PHIFB&H)
- **Public Health Institute of Federation Bosnia and Herzegovina, Radiation Protection Center**
  - B. Petrovic (PHIRS)
- **Public Health Institute of Republic of Srpska, Radiation Protection Center**
  - M. Rudan (EKOTEH)
- **Institute of Metrology of Bosnia and Herzegovina, Standard Dosimetry Laboratory**
  - A. Sabela (MIB&H)
- **Lunch break**
- **Faculty of Veterinary Medicine, University of Sarajevo**
  - N. Gradascevic (VFUS)
- **Clinical Centre of Sarajevo University**
  - A. Beganovic (CCUS)
- **Clinical Centre of Republic of Srpska**
  - G. Vuleta (CCRS)
- **International Medical Centre of Affidea**
  - Z. Kuzmanovic (IMC BL)
- **University Clinical Hospital Mostar**
  - S. Galic (UCHM)
- **Jelšingrad**
  - M. Ilic
- **Bosnamontaža Prijedor**
  - D. Vracar
- **Jajce Alloy Wheels D.O.O.**
  - A. Lagumdzija
- **Elektroprivreda BiH Kakanj Coal mine**
  - N. Djokic
- **ElektroprivredaBiH Thermal power plant, Kakanj**
  - S. Velispahic
- **Coffee break**
- **Concluding remarks and introduction of site visits programme**
- **Round table discussion to clarify the scope of the appraisal & agenda of site visits**
- **Adjourn – 1st day**

E. Carinou (ORPAS Team Leader) & H.B. Okyar (IAEA)

E. Carinou (ORPAS Team Leader) & E. Dizdarevic (National Counterpart)
<table>
<thead>
<tr>
<th>Day</th>
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<th>Location</th>
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<td>2</td>
<td>Public Health Institute of Federation Bosnia and Herzegovina, Radiation Protection Center</td>
<td>Sarajevo and Banja Luka A. Lagumdzija</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Travel to Banja Luka</td>
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<td>Clinical Centre of Sarajevo University</td>
<td>Sarajevo and Banja Luka E. Dizdarevic</td>
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<td>Faculty of Veterinary Medicine, University of Sarajevo</td>
<td>Sarajevo and Banja Luka M. Isovic</td>
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<td>10 October 2018</td>
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<td>Sarajevo S Pandzic, I. Coralic</td>
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<td>3&amp; IC (pm)</td>
<td>Clinical Centre of Republic of Srpska</td>
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<td>International Medical Centre of Affidea</td>
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<td>BosnamontažaPrijedor</td>
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<td>Elektroprivreda BiH Kakanj Coal mine</td>
<td>Sarajevo M. Isovic</td>
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*IC: IAEA Coordinator*
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<td>All ORPAS Team meeting</td>
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<td>13-14</td>
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<td>All Preparation of Preliminary Appraisal Report to develop Recommendations,</td>
<td>International ORPAS Team</td>
<td>E. Carinou (ORPAS Team Leader)</td>
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<td>Suggestions and Good Practices</td>
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<td>E. Dizdarevic (Counterpart)</td>
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<td>All Presentation of Preliminary Report to the National Counterpart</td>
<td>E. Carinou (ORPAS Team Leader)</td>
<td>E. Dizdarevic (Counterpart)</td>
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<tr>
<td>Monday</td>
<td>13:00</td>
<td>All Discussions on Preliminary Report</td>
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<td>15:00</td>
<td>All Final ORPAS Team meeting</td>
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<td>16 October</td>
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<td>All Exit meeting</td>
<td>To be attended by all ORPAS official participants</td>
<td>E. Carinou (ORPAS Team Leader)</td>
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<td>2018</td>
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<tr>
<td>Tuesday</td>
<td>12:00</td>
<td>All Introduction of Preliminary Report</td>
<td>E. Carinou (ORPAS Team Leader)</td>
<td>M. Pinak (IAEA, RSM Section Head / NSRW)</td>
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<td>Closing</td>
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<td>M. Zeljko (Director, State Regulatory Agency for Radiation and Nuclear Safety)</td>
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<td>14:00</td>
<td>Wrap-up meeting</td>
<td>E. Carinou (ORPAS Team Leader)</td>
<td>H.B. Okyar (IAEA)</td>
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# ANNEX–V: LIST OF MISSION COUNTERPARTS

## Entrance meeting

<table>
<thead>
<tr>
<th>NAME</th>
<th>INSTITUTION/FACILITY</th>
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<tbody>
<tr>
<td>1. NEDŽAD GRADAŠČEVIĆ</td>
<td>VETERINARY FACULTY IN UNIVERSITY IN SARAJEVO</td>
</tr>
<tr>
<td>2. NIJAZ DOKIC</td>
<td>CHAR COAL MINE „KAKANJ“</td>
</tr>
<tr>
<td>3. ZORANA ILIĆ</td>
<td>PUBLIC HEALTH INSTITUTE OF FEDERATION OF BOH</td>
</tr>
<tr>
<td>4. AMRA ŠABETA</td>
<td>INSTITUTE OF METROLOGY IN BOH</td>
</tr>
<tr>
<td>5. GORAN VULETA</td>
<td>UNIVERSITY CLINICAL CENTER OF REPUBLIKA SRPSKA</td>
</tr>
<tr>
<td>6. ADNAN BEGANOVIĆ</td>
<td>CLINICAL CENTER OF UNIVERSITY IN SARAJEVO</td>
</tr>
<tr>
<td>7. DEJAN VRAČAR</td>
<td>BOSNAMONTAŽA“ A.D. PRIJEDOR</td>
</tr>
<tr>
<td>8. ZORAN KUZMANOVIĆ</td>
<td>INTERNATIONAL MEDICAL CENTER BANJA LUKA (AFFIDEA)</td>
</tr>
<tr>
<td>9. JELENA MARINKOVIĆ</td>
<td>PUBLIC HEALTH INSTITUTE OF FEDERATION OF RS</td>
</tr>
<tr>
<td>10. BILJANA PETROVIĆ</td>
<td>PUBLIC HEALTH INSTITUTE OF FEDERATION OF RS</td>
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<tr>
<td>11. JOVICA PRASKALO</td>
<td>PUBLIC HEALTH INSTITUTE OF FEDERATION OF RS</td>
</tr>
<tr>
<td>12. MARINKO ZELJKO</td>
<td>STATE REGULATORY AGENCY FOR RADIATION AND NUCLEAR SAFETY (SRARNS)</td>
</tr>
<tr>
<td>13. EMIR DIZDAREVIĆ</td>
<td>STATE REGULATORY AGENCY FOR RADIATION AND NUCLEAR SAFETY (SRARNS)</td>
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<tr>
<td>14. VELIBOR ČUKOVIĆ</td>
<td>STATE REGULATORY AGENCY FOR RADIATION AND NUCLEAR SAFETY (SRARNS)</td>
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<tr>
<td>15. SANJIN PANDŽIĆ</td>
<td>STATE REGULATORY AGENCY FOR RADIATION AND NUCLEAR SAFETY (SRARNS)</td>
</tr>
<tr>
<td>16. IRMA ĆORALIĆ</td>
<td>STATE REGULATORY AGENCY FOR RADIATION AND NUCLEAR SAFETY (SRARNS)</td>
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<tr>
<td>17. ARMIN LAGUMĐIJA</td>
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<tr>
<td>1. NEDŽAD GRADAŠČEVIĆ</td>
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<td>2. ANTE ĆORIĆ</td>
<td>EKOTEH D.O.O. MOSTAR</td>
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