IAEA Safety Standards on Occupational Radiation Protection
(GSR Part 3 & GSG-7)
Implementation status through a regional project in Asia and the Pacific Region

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6-8 November 2019
The 5th ARADOS Annual Meeting, Beijing / China
Objectives of this talk...

• IAEA – Occupational Radiation Protection Programme

• Occupational exposure with in the framework of IAEA Safety Standards
  – Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements (GSR Part 3)
  – General Safety Guide on Occupational Radiation Protection (GSG-7)
  – RAS9080: Enhancing National Capabilities on Occupational Radiation Protection in Compliance with Requirements of the New International Basic Safety Standards
  – Occupational Radiation Protection Network (ORPNET)
IAEA - Occupational Radiation Protection Program

Objectives:

• To promote an internationally harmonized approach to ORP through the development and application of standards for optimizing protection and safety, restricting exposures and applying current radiation protection techniques in the workplace

• To ensure an appropriate control of occupational exposure due to external and internal irradiation from both artificial sources and natural sources of radiation
  – This is achieved through provision of operational services for radiation monitoring and protection to the Agency’s own operations; and through assistance to Member States in establishing, maintaining and, where necessary, improving programs for the radiation protection of workers.
  – Activities are targeting regulatory authority(ies), technical service providers (TSPs), employers, registrants / licensees (operators), workers, and radiation protection societies/professionals, ORP Networks (e.g., ALARA networks).
Work environment
About a worker

• Any person who works, whether full time, part time or temporarily, for an employer and who has recognized rights and duties in relation to occupational radiation protection (IAEA glossary, 2018)
  – A self-employed person is regarded as having the duties of both an employer and a worker.

• Protection and safety is an integral part of a general occupational health and safety programme (specific obligations and responsibilities)

• The Board of Governors of the IAEA first approved health and safety measures in March 1960
Occupational Exposure

- All exposure of workers incurred in the course of their work
  - Workers are exposed to ionizing radiation in a wide range of occupational settings (artificial & natural)

- Over 23 million monitored workers worldwide (57% - 13 million, exposure natural sources of radiation workers; 43% - 10 million, man-made source; 860,000-nuclear industry, 870,000 -industry, 3.5 million - medical), *numbers continue to increase*

- Area with multiple actors (global / national level)
  - Requirements for protection of workers (IAEA - ILO)
  - Ministries, Regulators, OHS, etc.

- Safety Standards - To protect occupationally exposed workers against the risks associated with ionizing radiations - **Overall objective**

- Applicable requirements are included in **GSR Part 3** and guidance is provided by **GSG-7**
Hierarchy of the Safety Standards

- Safety Fundamentals (Principles)
- Safety Requirements – GSR and SSR
- Safety Guides – GSG and SSG
- Safety Reports
- TECDOCs

Safety Standards

Supporting publications

Information on the IAEA’s safety standard programme:
http://www-ns.iaea.org/standards/
International Basic Safety Standards, GSR Part 3

• An integrated and consistent set of Safety Requirements that establishes the requirements that must be met to ensure the protection of people and the environment, both now and in the future.

• GSR Part 3 (BSS) follows ICRP 103 recommendations
• Protection and Safety requirements of the BSS apply to all facilities and activities
• Planned, emergency and existing exposure situations
• Occupational, public and medical exposure categories
• 52 overarching requirements – for governments, regulatory bodies, industry, health and safety professionals, workers, public and service providers such as technical support organizations
• 12 requirements for ORP; Control, monitoring and recording
• Regulator(s), TSPs (authorization or approval of service providers for individual monitoring and calibration services) & Operators (End-users)
GSR Part 3 coverage for ORP

**Occupational exposure**
- Req 19: Responsibilities of the regulatory body (*Regulatory Infrastructure for Occupational Radiation Protection*)
- Req 20: Requirements for monitoring and recording of occupational exposure
- Req 21: Responsibilities of employers, registrants and licensees
- Req 22: Compliance by workers (*Responsibilities of workers*)
- Req 23: Cooperation between employers, registrants and licensees
- Req 24: Radiation protection programme
- Req 25: Assessment of occupational exposure and workers’ health surveillance
- Req 26: Information, instruction and training
- Req 27: Conditions of service
- Req 28: Protection and safety for female workers and for persons under 18 years of age

**Exposure of Emergency Workers**
- Req 45: Protection of emergency workers (arrangements for controlling the exposure)

**Existing exposure situation**
- Req 52: Protection of workers in existing exposure situations (remedial actions, Rn in workplaces, exposure of air crew)
GSR Part 1 coverage for ORP
Worker protection

- **Req 7**: Safety of workers (coordination between relevant authorities)
- **Req 9**: Necessary arrangement for worker protection
- **Req 13**: Provisions of Technical Services (services for personal dosimetry, environmental monitoring and the calibration of equipment & authorization)
- **Req 25**: Graded approach for review and assessment of facilities and activities (arrangements for worker protection)
- **Req 35**: Safety related records (records of doses from occupational exposure)
Graded approach to regulation

One of the key principles in the BSS

• Requirement 6 of GSR Part 3
  – application of the requirements “shall be commensurate with characteristics of the practice or source and with the magnitude and likelihood of exposures.”
  – Applies to regulation, control, monitoring and recording

• To determine the optimum regulatory approach
  – Consider, types of operation, process and material in more detail
  – A prior radiological evaluation of possible exposure
  – Consideration of the costs of regulation in relation to the benefits achievable
  – Arrangements to control, monitor and record of occupational exposure

• Other considerations;
  – Other Regulations
  – Non-radiological risks
  – Levels of analysis, documentation and action suitable to the situation
  – Characterization of the current situation
  – The approach should suit the complexity of the industrial operation
  – Ensure worker protection in a cost effective manner
Application of Graded approach
Consider exemption as first option

1. Exemption (decision not to regulate)
   - Dose < 1mSv/y

2. Notification (similar to exemption but regulator stays informed)
   - Dose < 1mSv/y

3. Notification and registration

4. Notification and licencing

This is all about risk assessment and risk management
Where control is proportional to risk
Safety Guide on ORP, GSG-7

- Implementation of the Requirements on ORP in compliance with GSR Part 3
- Jointly developed by the IAEA and the ILO
- Updates of previous safety guides in the field of ORP
  - Occupational Radiation Protection, RS-G-1.1
  - Assessment of Occupational Exposure Due to Intakes of Radionuclides, RS-G-1.2
  - Assessment of Occupational Exposure Due to External Sources of Radiation, RS-G-1.3
  - Occupational Radiation Protection in the Mining and Processing of Raw Materials, RS-G-1.6
  - Management System for Technical Services in Radiation Safety, GS-G-3.2
- It is applicable to all areas concerning occupational exposure, including medicine, nuclear fuel cycle, industries involving NORM, radiation application industries and scientific as well as educational facilities.
Safety Guide on ORP (GSG-7)

• Provides guidance on the control of occupational exposure (technical and operational aspects)

• Based on “exposure situations” and provides information on ORP framework, exposures of workers in different exposure situations, protection of workers in special cases, dose assessment, management system for service providers, control measures as well as health surveillance

• Offers an itemized step-by-step guidance on how to be vigilant in enhancing safety standards for workers across a range of industries

• New approaches for;
  o Itinerant workers
  o Female workers during and after pregnancy
  o Monitoring of lens of the eye exposure
  o Cosmic ray exposure
  o Naturally Occurring Radioactive Material (NORM)
  o Radon at workplaces
Safety Guide on ORP

- **Framework for ORP (Section 2)**
  - Graded approach

- **Planned Exposure Situations (3)**
  - RPP and exposure to natural sources of radiation

- **Emergency Exposure Situations (4)**
  - Emergency workers, management

- **Existing Exposure Situations (5)**

- **Protection of workers in special cases (6)**
  - Female workers during and after pregnancy & itinerant workers

- **Assessment of occupational exposure (7)**
  - External, internal, emergency, skin contamination and records

- **Management of technical service providers (8)**
  - Management, process, additional guidance for providers of calibration and testing

- **Engineered, administrative controls and PPE (9)**
  - Control measures

- **Workers’ health surveillance (10)**
  - Examination, records, overexposure management
Safety Guide on ORP

• Appendices
  – Exposure of workers to naturally occurring radioactive material
  – Methods and systems for individual monitoring for assessment of external exposure
  – Workplace monitoring instruments for assessment of external exposure
  – Biokinetic models for assessment of internal exposure
  – Methods for individual monitoring of internal contamination

• Annex
  – Techniques for retrospective dosimetry

Primarily intended to provide information on the dose rates within the workplace
Photon, Beta & low energy photons, neutron-Ion chambers, proportional counters, GM counters, semiconductor, scintillation

Photon & beta radiation
Photographic film dosimetry, TLD, OSL, DIS, active dosimeters
Neutron radiation
Nuclear track emulsions, Solid state track dosimeters, TLD albedo, Bubble detectors, electronic neutron detectors & criticality
**TSP/TSO categories**

**Calibration and testing/assay services**
- Monitoring (individual, workplace and environmental)
- Calibration and verification of monitors and radiation sources

**Consultancy and maintenance**
- Radiation safety consultancy
- Shielding calculations
- Modelling for dose assessment, containment and ventilation
- Maintenance services (in-house & contracted out)
- Decontamination

- Organization or organizational unit designated, or otherwise recognized by a regulatory body and/or a government, to provide expertise and services to support nuclear and radiation safety and all related scientific and technical issues.
- A TSO can also support nuclear security and safeguards.
Occupational Exposure Assessment

- The regulatory body shall establish and enforce requirements for the monitoring and recording of occupational exposures (authorization or approval of service providers for individual monitoring and calibration services).
- Employers shall be responsible for making arrangements with authorized or approved dosimetry service providers that operate under a QMS for assessment of occupational exposures of workers.
- Employers shall maintain records of occupational exposure for every worker for whom assessment of occupational exposure is required until the age of 75 years, and for not less than 30 years after cessation of the work.
GSG 7: the approval process

- **Submission** of a report containing information
  - Dosimetry system (such as type test results, dosimetry procedures, calibration traceability, organizational structure, personnel, equipment, quality control protocols...)
  - **Accreditation** of the management system in accordance with a relevant international standard (ISO 17025!?)
  - **Certification** that the dosimetry system is traceable to the appropriate national standard and based on conversion coefficients for the operational quantities in accordance with international recommendations and standards
GSG 7: the approval process

- An irradiation *performance test* at unknown doses in unknown situations
- *On-site inspection and assessment* of the laboratory by experts who evaluate aspects such as staff (including training), equipment, facilities, calibration and dosimetry procedures
GSG 7: performance testing

- External performance testing should be carried out to demonstrate that the essential performance specifications are routinely maintained.
- The results should verify the type testing data.
- An approval performance testing programme may be subdivided into different irradiation categories to suit different classes of dosimeter.
- Approval performance tests should be carried out at regular intervals organized by the regulatory body or other relevant authority or by international organizations.
Criteria

• set by the RB ... depending on the legislation

Example:
✓ Accreditation (ISO 17025),
✓ Length of the monitoring periods ....

Specific criteria:
✓ Regulation for EU countries
✓ Requirements for data transfer
✓ Requirements for data protection etc...
The authorization or approval may be restricted

- in time;
- to specific sub-domains;
- to specific fields of application.

Example:
- The license is valid till....
- For whole body dosimeters
- In neutron fields!
Effective independence of the service providers

- Independent/Effective independence
  - From the authorized party
  - From the regulatory body
- Need of an operational study where the “conflicts” are identified
  - To ensure personnel are free from any undue commercial, financial or other pressures that might compromise their technical judgement
• Legacy Personal Dosimetry platforms ultimately require a return to a centralized processor for analysis, which delays important dose information to the RPO and wearer (worker).

• DIS detector element
Monitoring & Assessment of Occupational Exposure

- Assessment of external exposure
- Assessment of internal exposure
- Assessment of exposure in emergencies
- Skin contamination
- Records of occupational exposure

Monitoring Programme
Individual monitoring – approval, proper use (inhomogeneous radiation), quantities, extremities, eye dosimetry
Workplace monitoring – routine monitoring (criteria), choice of monitoring system, instruments, specifications, estimation of uncertainties
Type testing (individual & workplace)
Calibration of instruments
Approval of dosimetry services
Interpretation of measurement and dose assessment

Measurement, interpretation and assessment
Monitoring & Assessment of Occupational Exposure

• Assessment of internal exposure

Methods of measurement
- Direct and indirect (with advantages)
- Detection limits & decision thresholds
- Calibration (direct & indirect)
- Performance criteria
- Uncertainties in monitoring measurements
- Interpretation & dose assessment

Monitoring Programme
- Types of measurement
  - Sequential measurements in the whole body or in specific organs (thyroid or lung)
  - Measurements of radionuclides in biological samples (excretions or breath)
  - Measurement of activity concentrations in air samples
- Choice measurement techniques (such as hints for NORM), design of labs
- Routine monitoring (selected workers)
- Task related monitoring (non-routine, particular operation)
- Special monitoring (suspected exposure, unusual incident)
Monitoring & Assessment of Occupational Exposure

- Assessment of exposure in emergencies

Using data from personal and WM
(sophisticated & highly specialized retrospective dosimetry techniques, chromosomal aberration analysis, electron spin resonance, accident simulation & computer modelling)

Emergency workers (greatly exceed the doses-normal conditions, threshold for severe deterministic effects)

Special attention to the capabilities of dosimeters and to the application of measurements and calculation methods needed for the assessment of RBE weighted organ doses
Monitoring & Assessment of Occupational Exposure

- Records of occupational exposure
- Individual and workplace monitoring

- Demonstrating compliance with the legal requirements
- Information on the general nature of the work in which the worker was subject to occupational exposure
- Information on dose assessments, exposures and intakes

“Records of occupational exposure for each worker shall be maintained during and after the worker’s working life, at least until the former worker attains or would have attained the age of 75 years, and for not less than 30 years after cessation of the work in which the worker was subject to occupational exposure.”
Radiation Protection Programme

What is the objective?

To fulfil the **management’s responsibility for protection and safety**

Effective radiation protection is a combination of
- good design,
- high quality construction, and
- proper operation

A successful radiation protection program relies on having a detailed understanding of the controls and appropriate monitoring to promptly detect and correct problems.
Radiation Protection Programme

- **Systematic arrangements** which are aimed at providing adequate consideration of radiation protection measures.

- Radiation Protection Organisation (manager and personnel)
- Radiation dose and medical surveillance of exposed workers (radiation work categories & surveillance)
- Area and zoning based on radiation exposure conditions
- Radiation work permit
- Radiation protection training
- Radiation protection procedures
- Control
Radiation Protection Programme

- Adoption of management structures, policies, procedures and organizational arrangements that are commensurate with the nature and extent of the risks
- Relates to all phases of a practice or to the lifetime of a facility (i.e. from design through commissioning and operation or process control to decommissioning)
- Only one element in ensuring the overall health and safety of workers (established and managed in close cooperation with those responsible for other areas of health and safety such as industrial hygiene, industrial safety and fire safety)
- To minimize the need to rely on administrative controls and personal protective equipment
Prior radiological evaluation and safety assessment

• The first step towards the definition of a RPP (situation involving occupational exposures)
  • Graded approach
  • Level of effort
  • Formality and detail of the evaluation
  • Links to the magnitude of the exposures in normal operation, and to the magnitude and probability of potential exposures
Prior radiological evaluation and safety assessment

- **Assessment of occupational exposure**
  - Use of workplace monitoring
  - Use of data from the scientific literature and information from comparable facilities
  - Use of simulations
  - Use of confirmatory measurements (with personal dosimeters can help to determine whether individual monitoring is needed)

- **Safety assessment**
  - Conducted at different stages
  - Siting, design, manufacture, construction, assembly, commissioning, operation, maintenance and decommissioning (or closure)
RPP (Scope & Content)

**Documentation**

- **Assignment of responsibilities** (decision making, corresponding organizational arrangements, including itinerant workers, advisory committee)
- **Designation and functions of qualified experts** (RP, internal and external dosimetry, workplace monitoring, ventilation, occupational health, radioactive waste management)
- Integration of ORP with other areas of OHS (industrial hygiene, industrial safety and fire safety)
- System for the accountability for radiation generators and radioactive sources (inventory – location, description of each radiation generator or radioactive source, activity, physical & chemical form)
- Designation of **controlled and supervised areas**
- **Local rules** (to follow and the supervision of work)
- Provision of PPE
- **Arrangements for monitoring** workers and the workplace
- System for **recording and reporting**
- **Education and training** programme
- **Methods for reviewing and auditing**
- **Emergency plan**
- Programme for workers’ **health surveillance**
- Requirements for the **assurance of quality** and process improvement
Monitoring and assessment of exposures

- Making of **measurements** in relation to the assessment or control of exposure (requires **interpretation** and **assessment**)
  
  - Assessing the exposure and demonstrating compliance with regulatory requirements
  - Effectiveness of working practices
  - Radiological conditions in the workplace
  - Operating procedures (individuals & groups)
  - Informing workers
  - Evaluation of doses in the event of accidental exposures

**Types of monitoring based on objectives**

- Routine monitoring
- Special monitoring
- Confirmatory monitoring
- Task related (specific operation)

**Subdivision on the basis of the location of the monitoring**

- Individual monitoring
- Workplace monitoring

**Approved dosimetry services**

- External exposure
- Internal exposure
- Skin contamination
- External radiation
- Air contamination
- Surface contamination
The need for individual monitoring is likely to be greater in the early stages of an operation.

- Type and energy of the radiation and the radionuclides involved
- Amount of radioactive material present and the radionuclides involved
- Physical and chemical form of the radioactive material
- Type of containment used
- Operations
- Expected levels and likely variations in the doses or intakes
- Complexity of the measurement procedures & interpretation procedures of the measurement programme
- General working conditions
IAEA assistances concerning safety

- Workshops
- Expert Missions
- Training Courses/Training Materials
- Peer-Review Services (e.g., ORPAS)
- Fellowships/Scientific Visits

Delivery Mechanisms (TC, EBP, etc.)
RAS9080: Enhancing National Capabilities on Occupational Radiation Protection in Compliance with Requirements of the New International Basic Safety Standards

• 4 years project, starting January 2016
• 36 countries (Asia and the Pacific region)
• Establishment of programmes to increase the coverage of dose control for workers occupationally exposed through technical services with recognized quality systems in place in the countries (individual internal and external monitoring, and monitoring of the workplace) as well as to establish and keep updated national records of occupational dose in countries of the region, require regional efforts.
• Regional workshops, training courses, expert missions, Scientific visit and fellowships and procurements (Passive dosimetry systems, accessories, chips (whole body, extremity), etc.)
Selected activities

• Regional Workshop on Occupational Radiation Protection programmes in line with the IAEA safety requirements (GSR Part 3) and safety culture (22-26 August 2016, IAEA), 36 participants

• Regional Workshop on Occupational Radiation Protection in high exposure operations (10-14 April 2017, Indonesia), 20 participants

• Regional workshop on implementation of GSR Part 3 requirements for technical service providers (21-25 August 2017), 19 participants

• Joint IAEA / ILO Regional Workshop on Occupational Radiation Protection & the Asia regional ALARA network (ARAN) Steering Committee Meeting (2-6 October 2017, Japan), 44 participants

• Regional workshop on establishment and maintenance of national dose registry (24-25 May 2018, Australia), 24 participants

• Regional Training Course on Internal Dose Assessment (5 - 16 November 2018, Korea), 14 participants, practical sessions
Intercomparison Exercise

- Joint IAEA / ARPANSA regional intercomparison exercise on individual monitoring for external exposure (2018)
- To assess the capabilities of the dosimetry services in the region to measure the quantity $Hp(10)$ in photon (gamma and X-ray) fields, thus supporting participating Member States (MSs) to achieve a more accurate dosimetry service.
- An additional objective is to provide MSs with guidelines to improve the performance of the existing dosimetry services in line with the project milestones of RAS/9/080 project.
- Evaluation workshop: To assess the progress, evaluate the findings and results, and finalise the report (19 - 21 February 2019, Vienna)
- 21 Countries
- 30 Individual monitoring services
  - 1 participant withdrew (instrument failure)
  - 29 completed questionnaires
  - 1 participant’s dosimeters damaged in transit
  - 4 participants’ dosimeters delayed by export restrictions
  - 24 sets of results submitted
Irradiation to the $^{137}$Cs Beam

- Direct teletherapy Cs beam (no attenuators added)
- Distance 4 m
- Beam diameter 40 cm
- PMMA slab phantom 30 x 30 x 15 cm
- 2 mm PMMA added over the front of the monitors
- Nominal Hp(10) rate of 35 µSv/s
- Conversion from air kerma:
  - 1.21 Sv/Gy at 0°
  - 1.22 Sv/Gy at 20°
    - ISO 4037 Part 3 Table 33
- Hp(10) delivered:
  - 3.18 mSv at 0°
  - 3.21 mSv at 20°
- Nominal relative uncertainty (k=2): 6%
- Traceability: Via Farmer Chamber calibrated at Co-60 and MEX against ARPANSA primary standard, and interpolated to Cs-137
Measurement of Exposure to the $^{137}$Cs Beam at Normal Incidence

Exposure: 3.18 mSv
Lower Limit: 2.01 mSv
Upper Limit: 4.89 mSv

Only 54% of results within confidence interval
Measurement of Exposure to the $^{137}$Cs Beam at 20° Incidence

Exposure: 3.21 mSv
Lower Limit: 2.03 mSv
Upper Limit: 4.93 mSv

Only 50% of results within confidence interval
Irradiation to the X-ray Beam

- Constant potential, tungsten target X-ray tube
- Beam quality 70 kVp, 15 mA
- Additional filtration: 4 mm Al, HVL = 3.19 mm Al (approx. 0.11 mm Cu)
- Effective energy ~34 keV for Cu
- Similar to PTB therapy beam, code TH 70
- Distance 3 m
- Beam diameter 45 cm
- Water slab phantom 30 x 30 x 15 cm of water
  - outer 32 x 32 x 16.3 cm including PMMA walls
- No PMMA added over the front of the monitors
- Conversion from air kerma:
  - 1.47 Sv/Gy at 0°
  - 1.44 Sv/Gy at 20°
    - ISO 4037 Part 3 Table 27
- Hp(10) delivered:
  - 5.44 mSv at 0°
  - 5.34 mSv at 20°
- Nominal relative uncertainty (k=2): 6%
- Traceability: Via large area transmission chamber calibrated directly against the primary standard of MEX air kerma
Measurement of Exposure to the X-ray Beam at Normal Incidence

Exposure: 5.44 mSv
Lower Limit: 3.52 mSv
Upper Limit: 8.28 mSv

Only 25% of results within confidence interval
Measurement of Exposure to the X-ray Beam at 20° Incidence

Exposure: 5.34 mSv
Lower Limit: 3.45 mSv
Upper Limit: 8.13 mSv

Only 25% of results within confidence interval
Assessment of Uncertainty

Cs-137 @ 0°

Relative Standard Uncertainty
Relative Standard Deviation
Evaluation Workshop

Workshop on Evaluation and Finalization of the Joint IAEA / ARPANSA Regional Intercomparison Exercise on Individual Monitoring for External Exposure

PROVISIONAL PROGRAMME

19 - 21 February 2019
Vienna / Austria
Room: C5

Organizer:
The International Atomic Energy Agency (IAEA) in collaboration with the Government of Australia through Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)

The Joint IAEA/ARPANSA Regional Intercomparison Exercise on Individual Monitoring for External Exposure was organized under the Asia and the Pacific Regional Cooperation Project (RAS/D/000). The aim of this exercise was to assess the capabilities of the dosimetry services in the region to measure the quantity Hpt(10) in photon (gamma and X ray) fields, thus supporting participating Member States to achieve a more accurate dosimetry service.

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) collaborated with the IAEA to provide this Intercomparison Exercise.

ARPANSA maintains the primary standards for the dosimetry of ionisation radiation for Australia. ARPANSA’s Calibration and Measurement Capabilities (CMC) and comparison results are listed in the BIPM Key Comparison Database.

Results

RESULTS OF THE JOINT IAEA/ARPANSA INTERCOMPARISON EXERCISE ON WHOLE BODY DOSEMETERS FOR PHOTONS IN ASIA AND THE PACIFIC REGION

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Received 1 May 2019; revised 25 July 2019; editorial decision 24 July 2019; accepted 24 July 2019

An Intercomparison exercise (IC) on whole body dosimeters to determine the quantity personal dose equivalent Hpt(10) in photon radiation fields was jointly organised and conducted by the International Atomic Energy Agency (IAEA) and the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) for individual monitoring services (IMS) in Asia and the Pacific region. This was arranged to help the IMS in the region to achieve a more accurate dosimetry service and to improve their performance. Twenty-four IMS participated in this IC. Four sets of dosimeters were measured once from a wide range of radiation qualities of 0° and 20° angle of incidence, respectively. All the IMS provided results that were within the acceptable limits defined by the IAEA. However, only a minority of participants reported confidence intervals that included the reference dose, for each exposure scenario. For low systems, the overall performance could be significantly improved by retesting qualification procedures.

INTRODUCTION

Participation in regular intercomparison exercises (ICs) is an essential criterion for authorization or approval of individual monitoring services (IMS) by some regulatory bodies1,2. Also, it is an essential criterion for an IMS working towards, or having already achieved, formal ISO/IEC (International Electrotechnical Commission) 170253 accreditation. This type of performance can be carried out as an independent assessment to verify that an IMS fulfills stipulated national or international performance requirements under exposure conditions that are representative of workplace fields from the radiological activities being monitored4.

The International Atomic Energy Agency (IAEA) has a programme focusing specifically on occupational radiation protection, which promotes an internationally harmonised approach to the issue and develops safety standards and guidelines to reduce radiation exposure at the workplace. It also helps Member States (MSs) in applying these standards and guidelines in practice. Within this framework, the IAEA has organised ICs focusing on the performance of IMS for photon fields.

In the framework of the IAEA Regional Technical Cooperation Project RAS/D/000: “Enhancing National Capability on Occupational Radiation Protection in Complementing the New International Basic Safety Standards”, an IC on measurements with parallel plate ionisation chambers was conducted in 20184. The parallel plate ionisation chambers were placed in a single-photoneutron field. The objectives of this IC were to (a) assess the capabilities of the IMS in the region to measure the quantity Hpt(10) in photon (X-rays and gamma rays) fields, (b) support participating IMSs to achieve more accurate dosimetry service, (b) provide MSs with guidelines to improve the performance of the existing IMS in line with the project milestones and (c) support the improvement of the quality management system of the laboratories in the region. The overarching purpose of the planned IC was to assist in the harmonisation of IMS in the region in line with the project objectives.

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Uncertainty Course

• Regional training course on evaluation and expression of measurement uncertainty for external dosimetry (22-24 October 2019, Kuwait), 35 participants
• To train participants on investigation of measurement results including defining measurement of uncertainties (uncertainty budgets and uncertainty contributions) in external dosimetry based on GSR Part 3 and GSG-7.
• Irradiation tests; to be performed by each participant prior to the training course;
  – Linearity,
  – Energy and angular dependence,
  – Fading,
  – Inhomogeneity of detector sensitivity (ECC),
  – Variability of detector readings due to limited sensitivity and background,
  – Variability of detector readings at zero dose (blanco value), and
  – Reader stability.
ARADOS: Asian Radiation Dosimetry Group

- Goal is to establish a similar framework to EURADOS among Asian countries in radiation dosimetry fields (young organization -2015)
- Support from the IAEA (future direction for high-quality services in A&P region)
- The 5th ARADOS annual meeting - Oct.16-18, 2019

Main missions of ARADOS

- Enhancement and harmonization of radiation dosimetry capabilities in Asian countries
- Exchange of the technology and activities on radiation dosimetry of each participating institute
- Preparation of the joint response of radiation dosimetry services in RN accidents
Potential items for collaborative studies

Internal dosimetry

- Direct thyroid measurements Ver. 2 (physical or voxel phantoms)
- Bioassay (spiked urine samples or ash, actinides, FP)
- Scenario based internal dose assessment
- Biokinetic model calculations (new OIR series by ICRP)

External dosimetry

- ESR intercomparison exercise
- Exchanging information on medical/occupational exposure and response to change of the dose limit on eye lens at each country
- Scenario based external dose assessment (simulations)

Biososimetry

- Intercomparison of chromosome analysis Ver. 2 (using blood samples)
- Comparison of calibration curve
- Other methods (MN assay, FISH, ...
ARADOS: Next?

- More promoting collaborative research activities (scientific papers)
- Inviting new collaborating institutes in Asian countries
- Exploring new research areas
- Developing a strong relationship between member institutes

- Needs to cover the region (currently limited participation)
- All RAS9080 participants are invited to consider ARADOS membership (corresponding)
- IAEA is in a position to bring the expertise and experience for ARADOS’s use
- Support of the ARADOS activities is a priority
- Joint activities with ARADOS
New ORPNET & Newsletter

- Web-based network with an ultimate goal to promote optimization of the ORP since 2010
- Worldwide comprehensive knowledge / information exchange,
- Global, regional and national networks (targeted to systems for radiation protection of workers)

https://nucleus.iaea.org/sites/orpnet/home/SitePages/Home.aspx

Registration: https://mailchi.mp/8dc89d5e14d3/orpnet
Thank you!

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IAEA ORPNET: https://nucleus.iaea.org/sites/orpnet/home/SitePages/Home.aspx
IAEA ORPAS: https://gnssn.iaea.org/main/ORPAS/SitePages/Home.aspx