2023 ANNUAL REPORT

PAKISTAN NUCLEAR REGULATORY AUTHORITY

THE AUTHORITY

Mr. Faizan Mansoor, SI
Chairman PNRA

FULL TIME MEMBERS

Mr. Muhammad Rahman, PoP
Member (Executive), PNRA

Mr. Naveed Maqbul, SI
Member (Corporate), PNRA

PART TIME MEMBERS

Lt. Gen. Yusuf Jamal, HI (M)

Prof. Dr. Tariq Mahmood

Dr. Rana Muhammad Safdar

Prof. Dr. Hafiz Muhammad Noor ul Huda Khan Asghar

Mr. Mohsin Fayyaz, SI

Ms. Farzana Altaf

Prof. Dr. Anisa Qamar

Our Vision

To become a world class regulatory body with highly trained, competent and dedicated personnel working in unison with a zeal to foster a positive safety culture in their licensees and to regulate nuclear safety to protect the public, the workers and the environment from the harmful effects of radiation in a manner that wins the confidence of all the stakeholders viz. the public, the government and the licensees.

Our Mission

To ensure the safe operation of nuclear facilities and protect the radiation workers, general public and the environment from the harmful effects of radiation by formulating and implementing effective regulations and building a relationship of trust with the licensees and maintaining transparency in actions and decisions taken by the regulatory body.

Core Values

CHAIRMAN's MESSAGE

Faizan Mansoor, SI

I am honored to present the annual report of Pakistan Nuclear Regulatory Authority (PNRA) for the year 2023 highlighting the glimpses of achievements made in ensuring the safe and secure use of ionizing radiation. Over the years, our organization has played a pivotal role in establishing a robust framework for regulating facilities and activities involving nuclear material and ionizing radiation by ensuring nuclear safety, radiation protection and physical protection for achieving the ultimate objective of protecting the workers, the public and the environment from harmful effects of ionizing radiation.

In an age where technological advancements drive progress, it is imperative that we remain steadfast in upholding the highest standards of safety and security. PNRA gives high importance to capacity building of its employees and has established a comprehensive strategy encompassing rigorous training by using in-house training facility as well as at national and international institutes.

Fostering stakeholder's confidence is an integral part of our pledge. We continued our engagements with the public, policymakers and other stakeholders to develop a deeper understanding of the benefits and risks associated with ionizing radiation by nurturing environment of trust. Strategic planning remained a useful tool to achieve our pursuit of excellence for meeting highest standards of safety and security. We successfully implemented five years strategic plan (2019-2023) with significant deliverables. The development of next five years strategic plan (2024-2028) will serve as our roadmap for guiding us through the challenges and opportunities that are envisaged ahead. This plan envisages PNRA ambitions to further enhance its regulatory effectiveness to present itself as role model regulatory authority at national and international canvas.

The concept of safety and security culture is deeply engrained within our organizational fabric. To ensure that our organization is steadfast in its commitment to safety and security, we have conducted second safety culture self-assessment and shared its results throughout the organization to instill awareness regarding continuous learning to further climb to the next levels. We are working on integration of safety and security culture assessment for our organization.

I am pleased to share that PNRA is playing its part in authorizing and regulating all efforts of Government of Pakistan towards indigenization in nuclear field for its peaceful application. Among others, one of the pinnacles is the issuance of site registration of the first radioactive waste disposal facility in the country. This milestone strengthens our commitment of ensuring safe management of radioactive waste in accordance with the highest safety standards. It is also a way forward to accomplish our resolve to protect our future generations from the burden of managing radioactive waste.

Recently, at the occasion of IAEA General Conference, our efforts for enhancing global cooperation were appreciated at international level especially by the delegates of embarking countries. Since past several years we are organizing training of regulatory staff from embarking nations, including Nigeria, Ghana, Iraq, Jordan and Uzbekistan. In addition, we provided experts to support IAEA activities in diverse fields, which is a clear indication of the trust and acknowledgment we have earned globally. Moreover, following the IAEA's recognition of our training institute, NISAS as Collaborating Centre in Nuclear Security last year, we are actively working to broaden its focus to include safety. These accomplishments reflect our incessant commitment towards fostering international cooperation.

At national level, PNRA continued its unwavering support to the Government of Pakistan by fulfilling the obligations of International Conventions and Treaties. We are ready to contribute to actions by Pakistan in achieving UN Sustainable Development Goals (SDGs) set out for 2030. We have assessed ourselves against relevant SDGs and identified areas where we need to further gear up to enhance this contribution. This year, PNRA led national delegation to the Convention on Nuclear Safety (CNS) for its joint eighth and ninth review meeting and presented actions taken to ensure nuclear safety at NPPs.

In the end, I would like to extend my heartfelt appreciation to all the employees of my esteemed organization for their resolute dedication and commitment to our prime mission – safeguarding the safety and security of nuclear and radiation facilities and activities in the country. As we are navigating a dynamic landscape of evolving challenges, ranging from emerging reactor designs to the expanding frontiers in the field of nuclear medicine, our vigilance must remain unwavering. I encourage each member of my organization to continue to exhibit the highest level of professionalism, expertise, and dedication. By staying abreast with the latest developments, embracing continuous learning, and fostering a culture of collaboration, we can effectively address new complexities and ensure that our regulatory infrastructure remains robust and adaptive.

ACHIEVEMENTS 2023

01 Development of Three Regulations

02 Issuance of Two Regulatory Guides (RGs)

03 Issuance of Operating License to K-3

04 Licensing of PINSTECH as Manufacturer of Sealed Radioactive Sources

05 Registration of Site for the Establishment of Near Surface Disposal Facility – NICE

06 Conduct of 1st National Conference on Safety Assessment at DHA Suffa University, Karachi

07 Conduct of Exclusive Drive for Search and Recovery of Radioactive Material out of Regulatory Control

08 Locked and Sealed 18 Radiation Facilities on Violation of Regulatory Requirements

09 Conduct of 2nd Safety Culture Self-Assessment of PNRA

10 Development of PNRA Strategic Plan for 2024-2028

11 Approval of IAEA Technical Cooperation Project (PAK-9043) for further Strengthening the Capabilities of PNRA

12 Hosting of Three Fellowships and Three Scientific Visits for Officials from Jordan, Uzbekistan and Iraq

13 Participation in Joint 8th & 9th Review Meeting of the Parties to the Convention on Nuclear Safety at IAEA for Presenting Pakistan's National Report

14 Conduct of 30 Seminars for Public Awareness

15 Successful Completion of Two Research and Development (R&D) Projects

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1 Introduction

The Government of Pakistan has entrusted PNRA with the responsibility to regulate nuclear safety and radiation protection matters in the country. Since its inception in 2001, PNRA has been actively pursuing its role as an independent regulator to achieve its mission of protection of the public, the workers and the environment from harmful effects of ionizing radiation. For this purpose, PNRA has established an effective and sustainable regulatory framework at par with the international standards to ensure highest levels of nuclear safety, security and radiation protection within the country.

PNRA has also established a meaningful relationship with all its stakeholders based upon confidence and trust. Following the principles of openness and transparency and with the objective of informing the stakeholders about PNRA activities, annual reports are developed and shared with all the stakeholders which provide an overview of the activities performed during a particular year. This report presents the activities performed by PNRA during the year 2023.

1.1 Powers and Functions of PNRA

PNRA Ordinance 2001 mandated PNRA to control, regulate and supervise all matters pertaining to nuclear safety and radiation protection in Pakistan. The Ordinance empowered PNRA to:

- Establish and enforce regulations;
- Grant authorizations and licenses to nuclear installations, radiation facilities and associated activities in the country;
- Conduct regulatory inspections to verify compliance with the regulatory requirements; and
- Take appropriate enforcement measures in case of any non-compliance of regulatory requirements.

Apart from nuclear safety and radiation protection, the domain of PNRA includes:

- Physical protection of nuclear material and nuclear facilities;
- Emergency preparedness & response;
- Environmental monitoring; and
- Civil liability in case of a nuclear incident.

In order to discharge such a multitude of assigned responsibilities effectively, PNRA, over the years, has developed an effective and sustainable regulatory infrastructure. PNRA continuously strengthens the capacity and capability of its human resource through mobilizing in-house resources and participation in related national and international activities. PNRA believes in continuous improvement of

67th Meeting of the Authority held at PNRA HQs

its performance through internal monitoring and evaluation and international peer reviews. PNRA also pursues the commitment of the Government through fulfillment of the obligations of certain international conventions on nuclear safety and security to which Pakistan is a party.

1.2 Organizational Structure

The Authority comprises a Chairman, two full time Members and seven part-time Members who are competent professionals from diverse fields representing various national stakeholders. For effective and smooth execution of assigned responsibilities, the Organogram of PNRA is structured in a way to cover all its legal, regulatory, support and monitoring functions. Figure-1 shows the organizational structure of PNRA.

1.3 Presence Across the Country

PNRA Headquarter is located in Islamabad and three regional directorates are located at Islamabad, Karachi and Mianwali. The regional directorates are mainly responsible for inspection & enforcement of nuclear installations, licensing and inspection of radiation facilities. These regional directorates are further supported by five regional inspectorates located at Peshawar, Gilgit Baltistan, Muzaffarabad, Quetta and Multan. Moreover, establishment of a new inspectorate in Lahore is in progress. Figure-2 shows PNRA presence across the country through its regional directorates and inspectorates.

1.4 Spectrum of Regulated Installations, Facilities and Associated Activities

PNRA regulatory sphere includes wide-ranging spectrum of facilities and activities including nuclear power plants, nuclear research reactors, radio-isotope production facilities, front and back end nuclear fuel cycle facilities (such as fuel fabrication facilities, spent fuel storage facilities and radioactive waste management facilities), Nuclear Safety Class (NSC) equipment manufacturers, designers and service providers. PNRA also regulates radiation facilities using ionizing radiation sources for various applications in medical, industry, agriculture and education & research. PNRA regulatory ambit is continuously increasing with the introduction of new facilities and activities.

At present, PNRA regulates seven Nuclear Power Plants (NPPs) in the country. Four operating units (C-1, C-2, C-3 and C-4) are situated at Chashma, Mianwali whereas site has been registered for another unit (C-5). Two Nuclear Power Plants (K-2 and K-3) situated at Karachi site are in operation phase while one unit (K-1) is under decommissioning phase.

In addition, PNRA also regulates three nuclear research reactors and two molybdenum production facilities situated at Pakistan Institute of Nuclear Science and Technology (PINSTECH) in Nilore, Islamabad. Two research reactors (PARR-1 & PARR-2) are operational while third research reactor (PARR-3) is under construction.

8th Directors' Meeting held at PNRA HQs

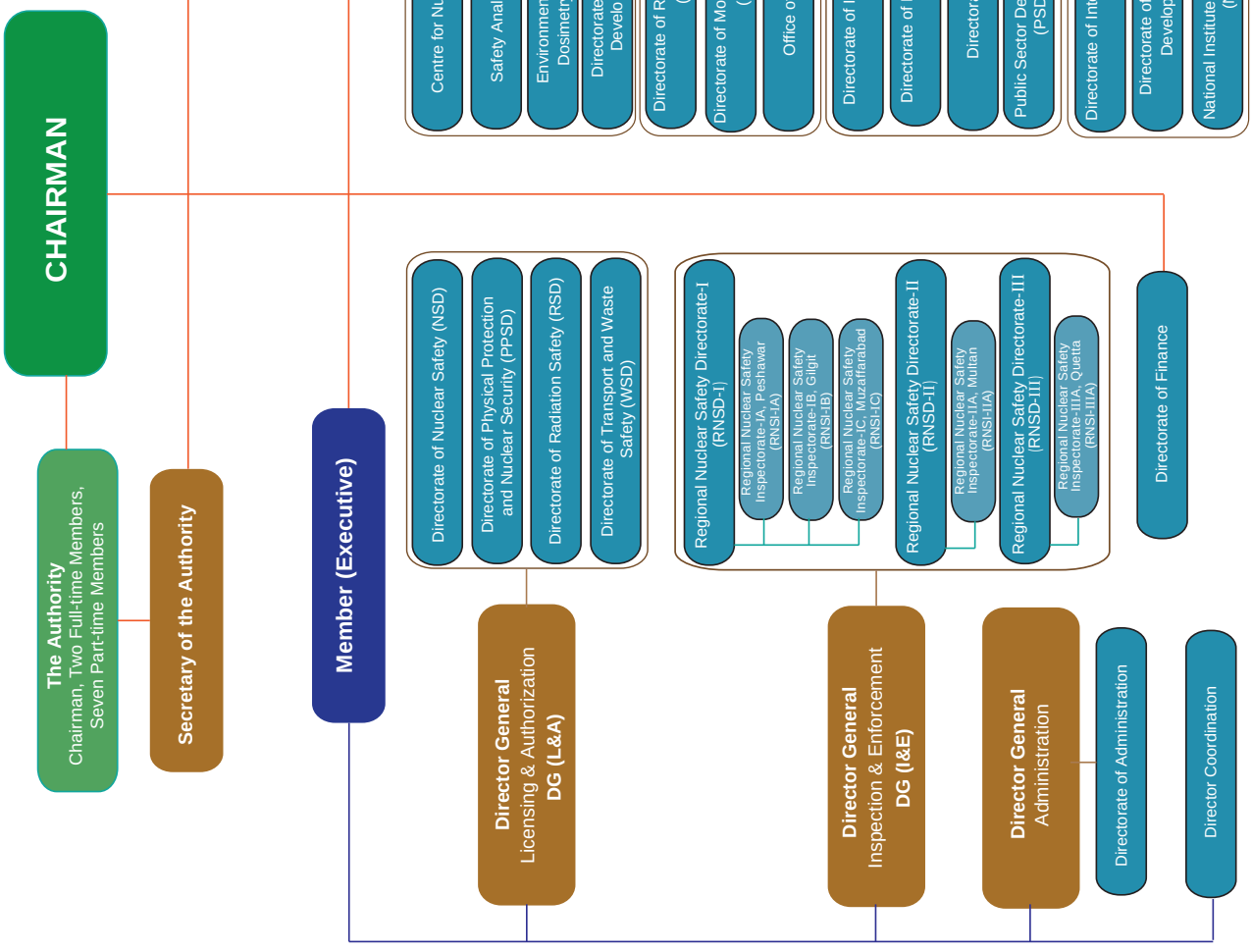
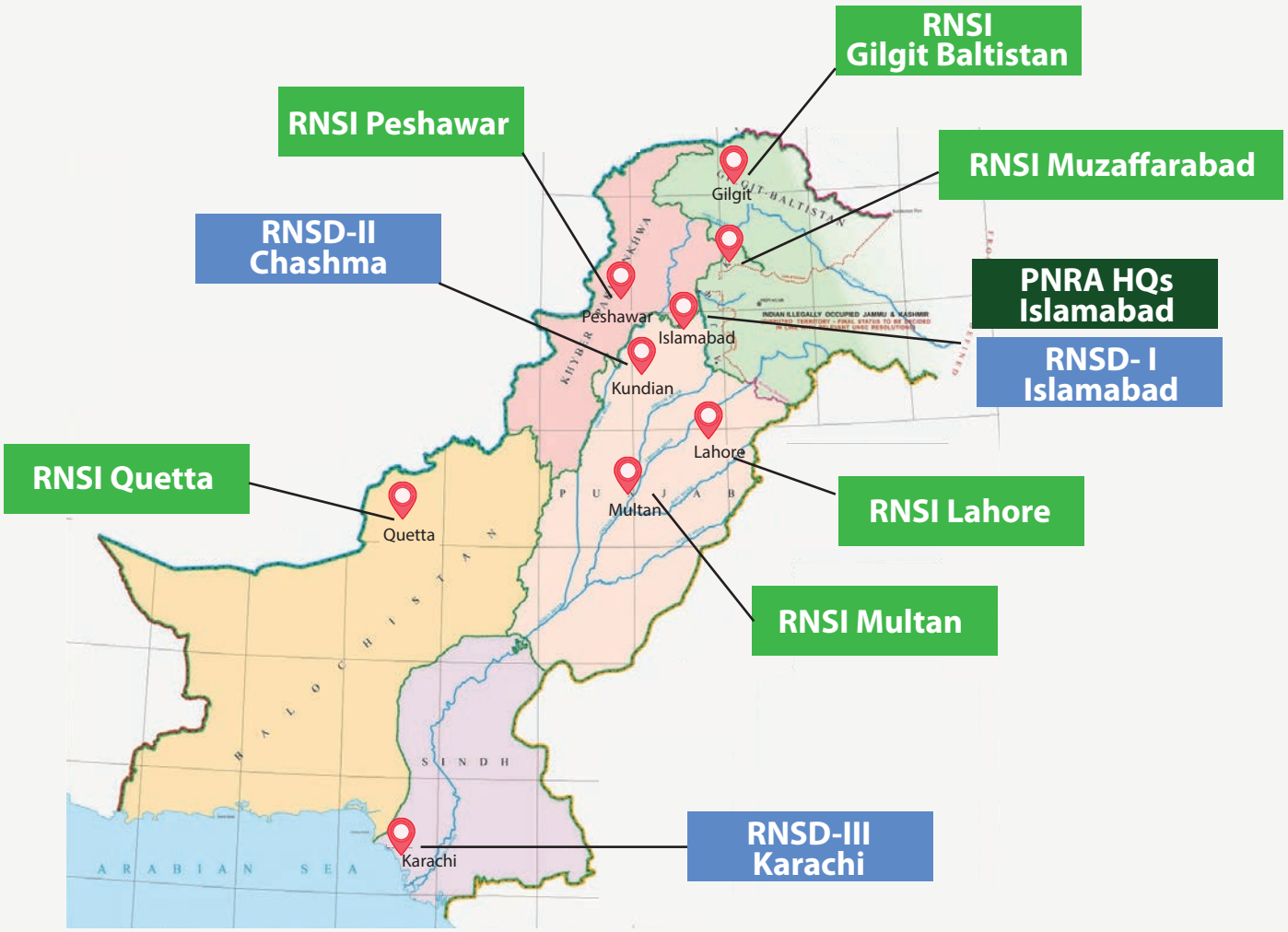


Figure 1: Organizational Structure of PNRA



PNRA Headquarters,
Islamabad

REGIONAL NUCLEAR SAFETY DIRECTORATE-I ISLAMABAD
REGIONAL NUCLEAR SAFETY DIRECTORATE-II CHASHMA
REGIONAL NUCLEAR SAFETY DIRECTORATE-III KARACHI

REGIONAL NUCLEAR SAFETY INSPECTORATE-IA PESHAWAR
REGIONAL NUCLEAR SAFETY INSPECTORATE-IB GILGIT BALTISTAN
REGIONAL NUCLEAR SAFETY INSPECTORATE-IC MUZAFFARABAD
REGIONAL NUCLEAR SAFETY INSPECTORATE-IIA MULTAN
REGIONAL NUCLEAR SAFETY INSPECTORATE-IIIA QUETTA
REGIONAL NUCLEAR SAFETY INSPECTORATE LAHORE (under construction)

HQs
RNSDs
RNSIs

Figure 2: Locations of PNRA Offices

Likewise, one molybdenum production facility is operational while construction activities are in progress at the second molybdenum production facility.

Furthermore, two nuclear spent fuel dry storage facilities are licensed by PNRA. One spent fuel dry storage facility, situated at Karachi site, is operational while the other at Chashma site is under construction. PNRA also regulates two pre-disposal radioactive waste management facilities at PINSTECH and Karachi Nuclear Power Generating Station (KNPGS) sites.

PNRA also regulates designers and manufacturers of nuclear safety class equipment and structures as well as service providers to the nuclear industry.

Three organizations are licensed as nuclear safety class equipment manufacturers. One organization is licensed to design nuclear safety class passive equipment. One organization is licensed for the design of instrumentation and control (I&C) systems of research reactor (analogue type). One organization is licensed for the design of nuclear safety related structures. Further, one organization is authorized to provide Non-Destructive Examination (NDE) services to nuclear industry.

In addition, a license has been awarded to PINSTECH for manufacturing of sealed radioactive sources.

Furthermore, PNRA regulatory domain covers 7100 licensed radiation facilities including 6346 medical centres, 243 industrial facilities, 86 research and educational institutes and 425 other facilities.

Figure 3 represents the current statistics of PNRA regulated installations, facilities and associated activities.

Figure 3: Statistics of Regulated Installations, Facilities and Associated Activities

2 Legislative and Regulatory Framework

Regulations/ Regulatory Guides (RGs) Gazette Notified/ Issued

- **PAK/900** — Regulations on Licensing Fee by Pakistan Nuclear Regulatory Authority
- **PAK/906** — Regulations for Authorization of Service Providers to Nuclear Installations and Radiation Facilities
- **PAK/931** — Regulations on Treatment of Food by Ionizing Radiation
- **PNRA-RG-908.03** — RG on Preparation of License and Authorization Applications for Radiation Facilities & Activities
- **PNRA-RG-926.02** — RG on Management of Nuclear Security Events Involving Radioactive Sources

Under the powers conferred to the Authority by the Ordinance, Regulations and Regulatory Guides are established, necessary orders are issued and policies are formulated by PNRA. The legislative and regulatory framework of PNRA comprises three tiers as depicted in Figure 4.

2.1 PNRA Ordinance

PNRA Ordinance constitutes the top tier of the regulatory pyramid and serves as the primary legislation for establishment of nuclear regulatory authority in Pakistan i.e., PNRA to regulate nuclear safety and radiation protection in the country. It establishes the mandate, composition, powers and functions of PNRA.

2.2 Regulations

Regulations, policies and regulatory orders form the second tier of the regulatory pyramid. The Ordinance empowers PNRA to devise regulations, policies and regulatory orders. These are binding on licensees to comply. PNRA regulations establish administrative and technical regulatory requirements in the areas of nuclear safety, radiation protection, emergency preparedness & response, radioactive waste management, transport safety, physical protection and nuclear security in order to protect the workers, the public and the environment from harmful effects of ionizing radiation. The regulations conform to the latest IAEA safety standards and take into account the national and international experience feedback.

During the development process, the draft regulations are shared with relevant stakeholders for review and comments. In addition, draft regulations are also uploaded on PNRA website for information and comments of stakeholders and general public simultaneously. PNRA informs the general public through the national press about uploading the draft regulations on its website for public comments.

During 2023, drafts of the Regulations on Safety of Nuclear Fuel Cycle Facilities - (PAK/917) and Regulations on Safety of Research Reactors -

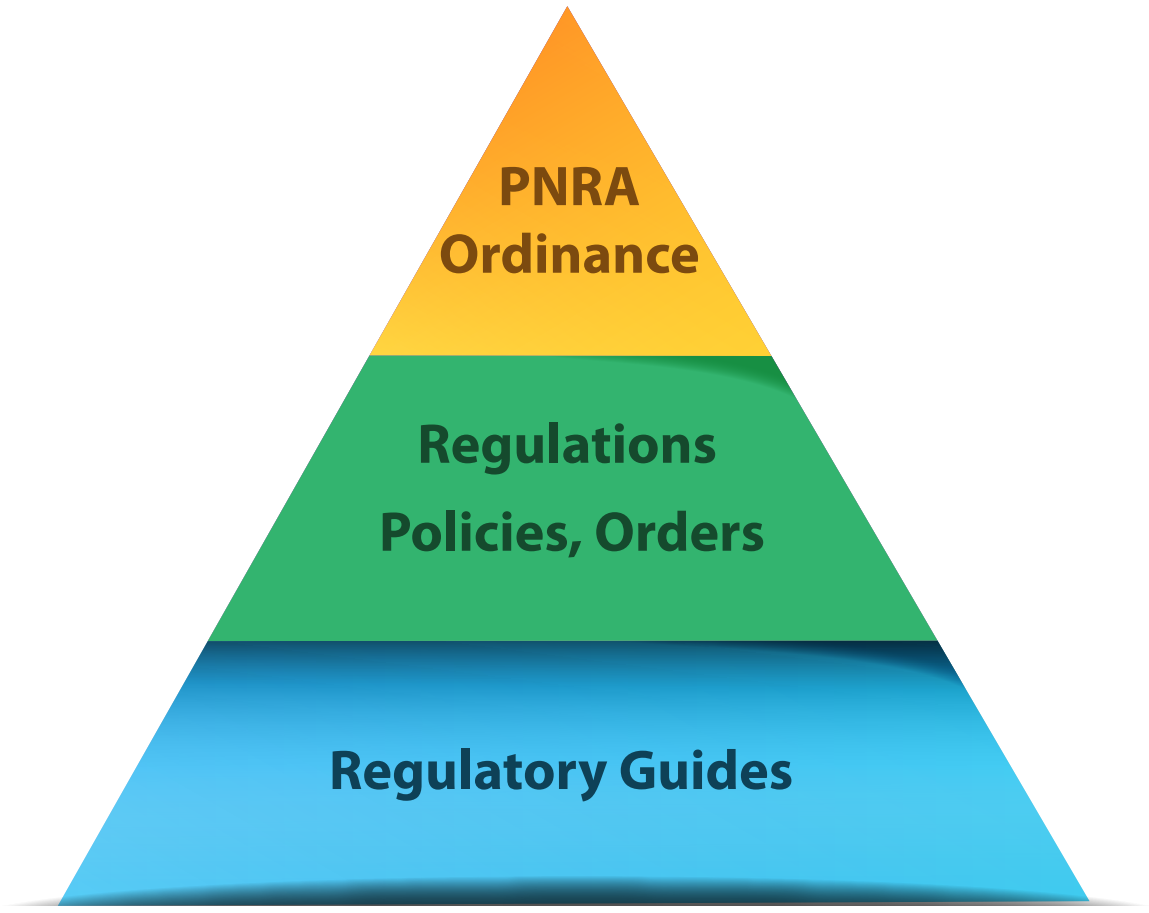


Figure 4: Legislative and Regulatory Framework

(PAK/932) were shared with stakeholders and also uploaded on PNRA website.

The regulations once approved by the Authority are notified in the official gazette of Pakistan and are also placed on PNRA website (www.pnra.org) for information and compliance by all concerned. During 2023, following three regulations were approved by the Authority and gazette notified:

i. Regulations on Licensing Fee by Pakistan Nuclear Regulatory Authority - (PAK/900) (Rev.4);

ii. Regulations for Authorization of Service Providers to Nuclear Installations and Radiation Facilities - (PAK/906); and

iii. Regulations on Treatment of Food by Ionizing Radiation - (PAK/931).

Besides, development of following three new regulations remained in progress:

i. Regulations on Safety of Nuclear Fuel Cycle Facilities - (PAK/917);

ii. Regulations on Licensing of Design Organizations - (PAK/905); and

iii. Regulations on Safety of Research Reactors - (PAK/932).

PNRA Regulations are periodically reviewed and revised after every five years or earlier, if needed. During 2023, following six regulations remained under revision:

i. Regulations on Transaction of Business of Pakistan Nuclear Regulatory Authority - (PAK/901) (Rev.1);

ii. Amendment in Regulations on Radiation Protection - (PAK/904) (Rev.1);

iii. Amendment in Regulations for the Licensing of Radiation Facilities other than Nuclear Installation(s) - (PAK/908) (Rev.1);

iv. Regulations for Licensing of Nuclear Installations in Pakistan - (PAK/909) (Rev.2);

v. Regulations on the Safety of Nuclear Installations Site Evaluation - (PAK/910) (Rev.2); and

vi. Pakistan Nuclear Regulatory Authority Enforcement Regulations - (PAK/950) (Rev.1).

In order to facilitate the general public, translation of Regulations for the Licensing of Radiation Facility(ies) other than Nuclear Installation(s) - (PAK/908) in national language 'Urdu' was completed and uploaded on PNRA website.

2.3 Regulatory Guides

Regulatory Guides (RGs) form the third tier of PNRA's regulatory pyramid. Regulatory guides play a vital role to develop better understanding and to facilitate the licensees in the implementation of the regulatory requirements set forth by PNRA regulations. The RGs are non-mandatory and licensees may choose any alternate methodology by demonstrating that the adopted approach provides similar or higher level of safety and quality as that of the methodology presented in the RGs. During the development process, the draft regulatory guides are shared with relevant stakeholders for review and comments. In addition, draft regulatory guides are also uploaded on PNRA website for information.

During 2023, PNRA issued following two RGs:

i. RG on Preparation of License and Authorization Applications for Radiation Facilities and Activities (PNRA-RG-908.03); and

ii. RG on Management of Nuclear Security Events Involving Radioactive Sources (PNRA-RG-926.02).

The approved RGs are placed on PNRA website (www.pnra.org) for information and guidance of all stakeholders.

During 2023, RG on Format and Contents of Physical Protection Program of Nuclear Installations (PNRA-RG-909.02) was shared with stakeholders and also uploaded on PNRA website.

Moreover, development and revision of following eight regulatory guides remained in progress during 2023:

i. RG on Format and Contents of Radiation Protection Program (PNRA-RG-904.06);

ii. RG on Radiation Safety and Regulatory Requirements in Medical Diagnostic X-ray

facilities (PNRA-RG-904.08);

iii. RG on Radiation Protection and Safety in Nuclear Medicine (PNRA-RG-904.09);

iv. RG on Format and Contents of Physical Protection Program of Nuclear Installations (PNRA-RG-909.02) (Rev.1);

v. RG on Periodic Safety Review (PSR) of Nuclear Installations (PNRA-RG-909.05);

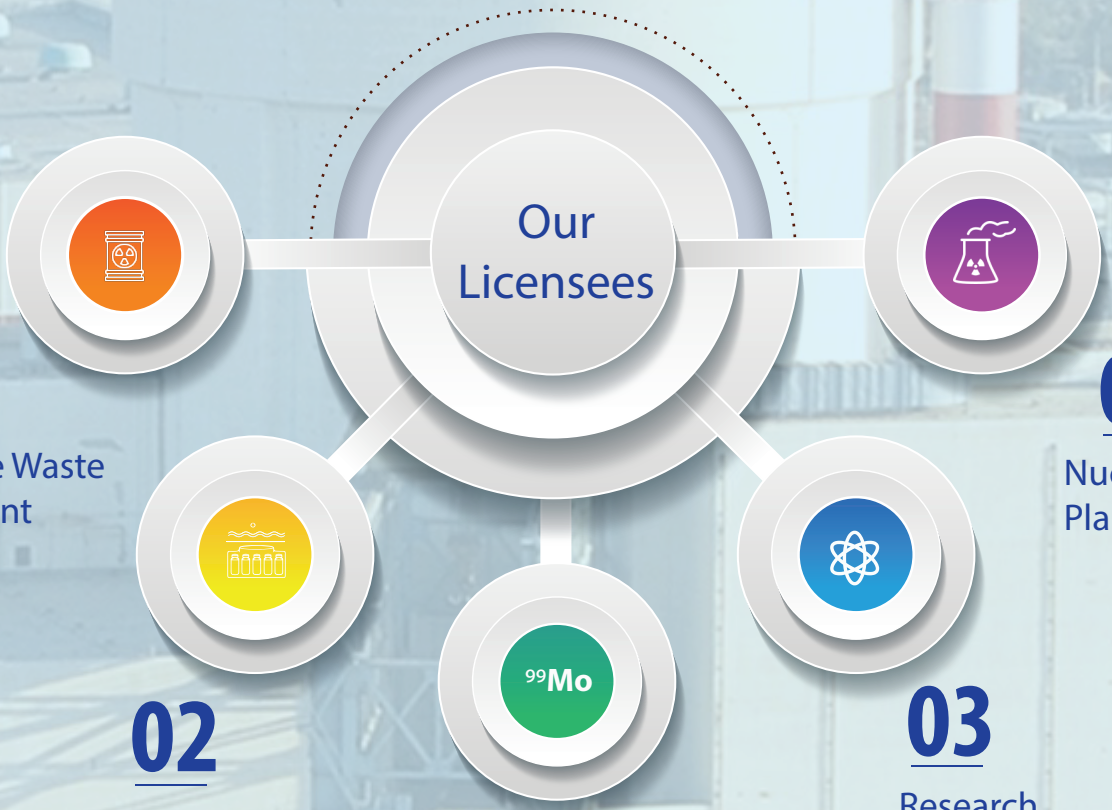
vi. RG on Iodine Prophylaxis during Nuclear or Radiological Emergency (PNRA-RG-914.01) (Rev.1);

vii. RG on Preparation of Radiation Emergency Plan for Radiation Facilities and Activities (PNRA-RG-914.02); and

viii. RG on Operation Interventional Levels and their use during Nuclear and Radiological Emergencies (PNRA-RG-914.04).

Review Meeting of Taskforce on Draft Regulations

3 Regulating Nuclear Installations



02
Radioactive Waste Management Facilities

07
Nuclear Power Plants

02
Spent Fuel Dry Storage Facilities

03
Research Reactors

02
Molybdenum Production Facilities

PNRA grants licenses & authorizations, performs review & assessment, conducts regulatory inspections and takes necessary enforcement actions throughout the life cycle of nuclear installations. The regulatory ambit of PNRA comprises 16 nuclear installations including seven Nuclear Power Plants (NPPs), three Research Reactors (RRs), two Molybdenum Production Facilities (MPFs), two Spent Fuel Dry Storage Facilities (SFDSF), one Pre-Disposal Radioactive Waste Management Facility (PPRWMF) and one Radioactive Waste Storage facility (RAWSA). In addition to that, PNRA also awards licenses to operating personnel of NPPs and RRs.

3.1 K-Series NPPs

K-1, K-2 and K-3 (K-series NPPs) are located at Karachi. K-1, a Pressurized Heavy Water Reactor (PHWR), was permanently shut down in 2021 for decommissioning after 50 years of operation. K-2 and K-3 are each 1100 MWe, three loop pressurized water reactors (PWRs) which started operation in 2021 and 2022 respectively.

During 2023, K-2 was manually shutdown and disconnected from the national grid on account of second Refueling Outage (RFO-2). Upon completion of RFO activities, K-2 submitted application for plant criticality along with the documents required in accordance with PNRA regulations. The same was reviewed at PNRA and a criticality meeting was held at K-2. Based on the discussions held and actions agreed during the meeting and upon fulfilling all the pre-requisites, the criticality permission was granted to K-2 in December, 2023.

Figure 5: Review & Assessment of Licensing Submissions of K-Series NPPs

Application for operating license of K-3 along with the licensing submissions required under the regulations PAK/909 was submitted to PNRA last year. Upon review and assessment of licensing submissions, satisfactory resolution of all safety issues and fulfillment of pertinent regulatory requirements, PNRA granted operating license to K-3 in May, 2023.

During 2023, K-3 underwent its first Refueling Outage (RFO-1) to carry out the planned outage jobs. Upon completion of the RFO jobs and fulfilling all the pre-requisites, the permission for criticality was granted to K-3 by PNRA in June, 2023.

During 2023, PNRA performed review and assessment of a number of submissions of K-series NPPs. These include RFO submissions, Monthly Technical Reports, Quarterly Safety Performance Indicators, Licensee Event Reports, Annual Meteorological Report, Quarterly Ambient Dose Level Records, Occupational Radiation Exposure Reports, Annual Radiological Environmental Operating Reports, Annual Reports on Design Modifications, Effluent Release Reports, Annual Solid Radioactive Waste Reports, etc. In addition, modifications related to design, FSAR, Technical Specifications (TS) and revised licensing programs submitted by K-2/K-3 were reviewed and approved by PNRA in 2023. Figure 5 shows statistics of review & assessment performed against submissions of K-series NPPs.

During the reporting period, PNRA carried out a total of 887 regulatory inspections at K-1, K-2 and K-3 including planned, announced and reactive inspections to verify compliance with regulatory requirements. Furthermore, PNRA also witnessed three emergency exercises at K-series plants. Figure 6 shows statistics of inspections at K-series NPPs.

3.2 C-Series NPPs

Four operational NPPs are located at Chashma site (C-series NPPs), near Mianwali. The C-series NPPs i.e., C-1, C-2, C-3 & C-4 are two-loop Pressurized Water Reactors (PWRs) and have been in operation since 2000, 2011, 2016 and 2017 respectively.

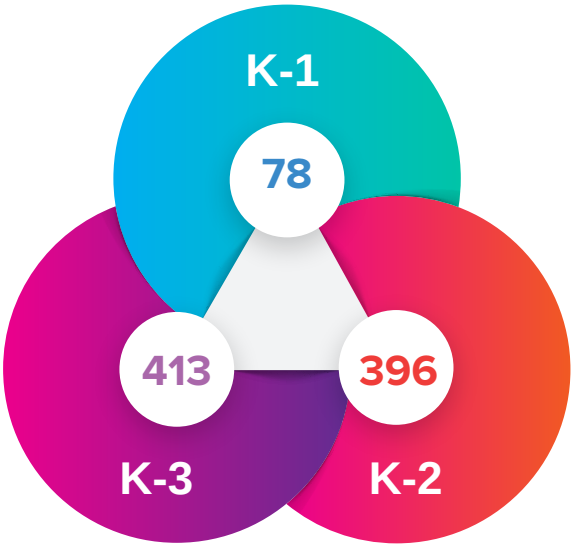


Figure 6: Inspections Performed at K-Series NPPs

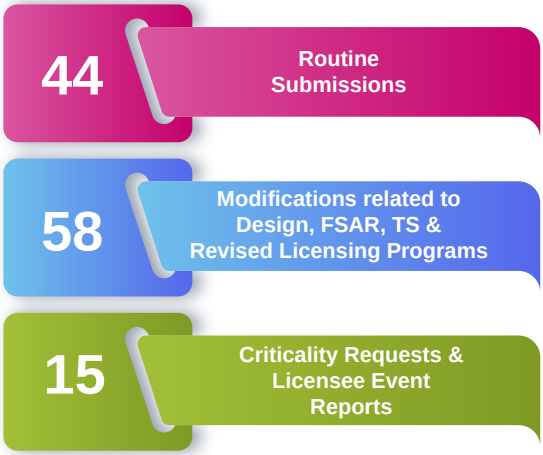


Figure 7: Review & Assessment of Licensing Submissions of C-Series NPPs

During 2023, ninth Refueling Outage (RFO-9) of C-2 was conducted from March to April. After completion of the RFO activities, C-2 submitted to PNRA its application along with required documents for acquiring permission for reactor criticality as per PNRA regulatory requirements. The submitted documents were reviewed and upon fulfillment of regulatory requirements, permission for criticality was granted to C-2 in April, 2023.

C-3 entered into fifth refueling outage (RFO-5) in June, 2023 for executing the planned outage activities. Upon fulfillment of all regulatory requirements and completion of RFO activities, C-3 was allowed by PNRA to make the reactor critical in July, 2023.

Likewise, C-4 underwent its fourth refueling outage (RFO-4) in January, 2023. PNRA granted permission for criticality to C-4 in February, 2023.

During 2023, PAEC submitted an application for construction of fifth NPP (i.e., C-5) at Chashma site. The plant is proposed to be a 1200 MWe three loop pressurized water reactor (PWR). In this regard, finalization of list of codes and standards for review of C-5 PSAR remained in progress.

Throughout 2023, PNRA reviewed a number of regulatory submissions from C-series plants. These included refueling outage submissions, Monthly Technical Reports, Licensee Event Reports, etc. Moreover, the combined Radiological Environmental Monitoring Program of Chashma Nuclear Power Generating Station (CNPGS), Radiation Protection Program and Harmonized Diesel Fuel Oil Testing Program were reviewed and approved during 2023. In addition to that, design, FSAR and technical specifications modifications and revised licensing programs were reviewed and approved by PNRA in 2023. Figure 7 shows statistics of review & assessment performed against submission of C-series NPPs.

PNRA also conducted 568 regulatory inspections during the year 2023 at C-1, C-2, C-3 and C-4. Furthermore, PNRA also witnessed eight emergency exercises at C-series plants. Figure 8 shows statistics of inspections performed at C-series NPPs.

3.3 Nuclear Research Reactors

Two nuclear research reactors i.e., Pakistan Research Reactor-1 (PARR-1) and Pakistan Research Reactor-2 (PARR-2) are currently in operation which are located at Pakistan Institute of Nuclear Sciences and Technology (PINSTECH), near the town of Nilore approximately 25 km from Islamabad city. A third research reactor i.e., PARR-3, located also at PINSTECH, is under construction.

PNRA performed review and assessment of several routine submissions of PARR-1 and PARR-2 (i.e. Monthly Technical Reports, Safety

11th Corporate Level Meeting between PNRA and PAEC

Performance Indicators (SPIs), etc.) in 2023. In addition, PNRA conducted 17 regulatory inspections at PARR-1 and PARR-2.

PARR-3 construction activities remained in progress during the reporting period and PNRA conducted 50 regulatory inspections of the construction activities in order to verify compliance with regulatory requirements by the licensee. Figure 9 shows statistics of inspections performed at research reactors and MPF.

3.4 Molybdenum Production Facilities (MPFs)

One Molybdenum Production Facility (MPF Unit-1), adjacent to PARR-1 is in operation since 2015 to produce Molybdenum radioisotope (Mo-99). Construction of a second unit of Molybdenum Production Facility (MPF Unit-2) adjacent to PARR-3 remained in progress in 2023.

During the reporting period, PNRA performed

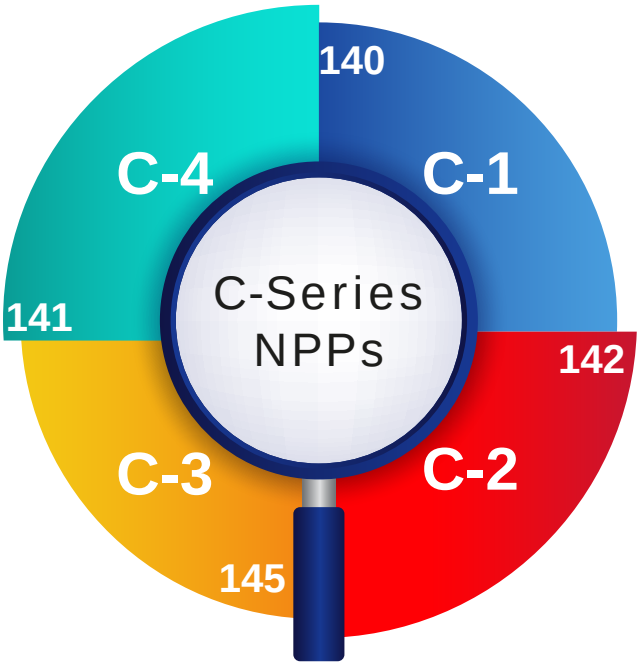


Figure 8: Inspections Performed at C-Series NPPs

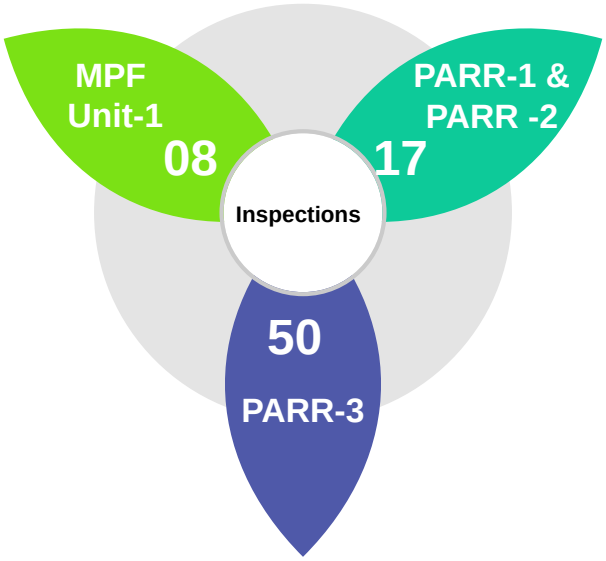


Figure 9: Inspections Performed at Research Reactors and MPF

review and assessment of routine submissions of MPF Unit-1 while eight regulatory inspections were conducted at MPF Unit-1 for verification of regulatory compliance.

3.5 Occupational Exposures of Workers at Nuclear Installations

Radiation workers are at risk of getting any undue exposure to ionizing radiation during their involvement in multiple activities at nuclear installations. This necessitates strict control over radiation exposure to the workers. Accordingly, radiation doses received by each worker at nuclear installations are monitored to ensure that the doses remained within the regulatory limits.

During 2023, the radiation doses received by the workers at nuclear installations remained well within the regulatory limit of 20 mSv.

Data of doses received by the workers of C-1, C-2, C-3, C-4, K-1, K-2 and K-3 are presented in Figures 10, 11, 12, 13, 14, 15 and 16 respectively.

Furthermore, dose of workers of research reactors and MPF are shown in Figure 17.

3.6 Radioactive Waste Generation at Nuclear Installations

Nuclear installations are designed and operated in a way to minimize the production of radioactive waste and limit the release of radioactive effluents (liquid and gaseous) to the

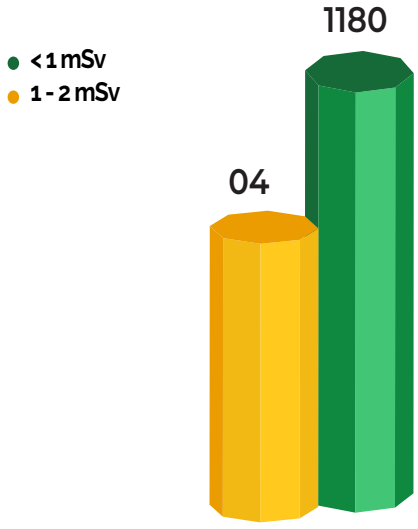


Figure 10: Annual Radiation Doses of C-1 Workers

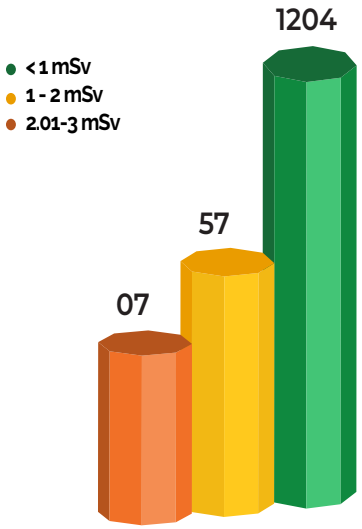


Figure 11: Annual Radiation Doses of C-2 Workers

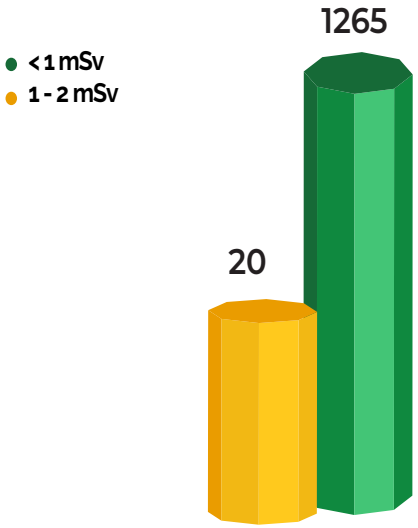


Figure 12: Annual Radiation Doses of C-3 Workers

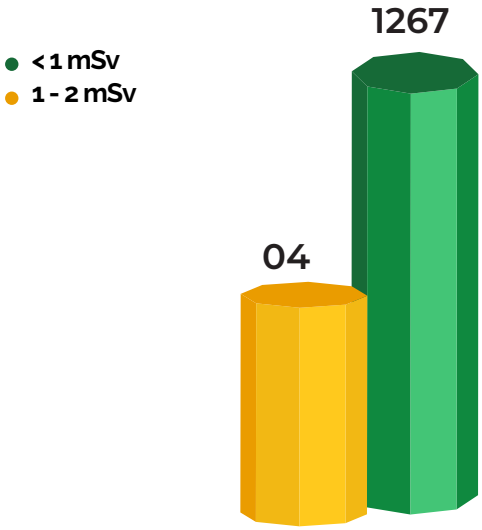


Figure 13: Annual Radiation Doses of C-4 Workers

environment well within the authorized limits so as to ensure safety of the individuals and the environment. Generation of solid radioactive waste and radioactivity released to the environment as effluents are regularly reported to PNRA by the licensee. PNRA ensures that the generation of solid radioactive waste and discharge of effluents from licensed facilities remain within the authorized limits.

During 2023, radioactive effluent releases and generation of solid radioactive waste from all NPPs (C-1, C-2, C-3, C-4, K-1, K-2 and K-3) remained well below the authorized limits. Therefore, the generation of radioactive waste from nuclear installations in the country has no adverse effects on the public, workers and the environment.

The data of radioactive waste and effluents generated is given in Figure 18, 19, 20, 21 and 22.

3.7 Spent Nuclear Fuel Storage Facilities KSFDS and PDS

The fuel removed from nuclear power plants and research reactors following irradiation that may no longer be used in its present form, is termed as Spent Nuclear Fuel (SNF). The spent fuel of nuclear reactors is usually stored in deep pools of water at the reactor site until its heat is sufficiently dissipated and radioactivity decreased to allow for its transfer into storage casks and placed in a dry storage facility. If properly designed and operated, dry storage casks are safe for people and the environment.

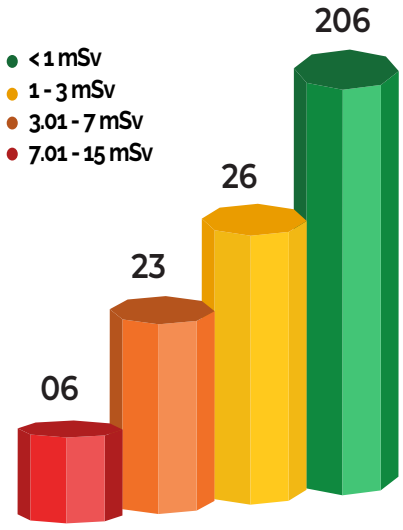


Figure 14: Annual Radiation Doses of K-1 Workers

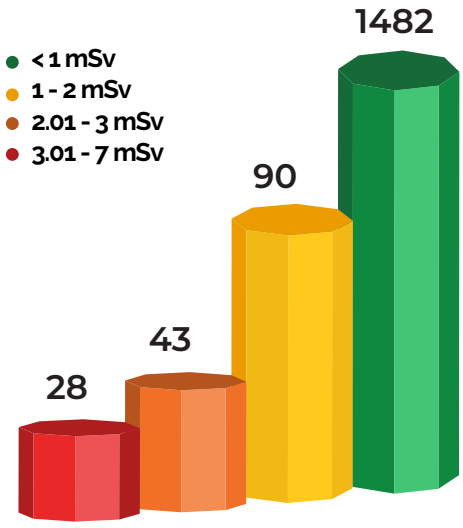


Figure 15: Annual Radiation Doses of K-2 Workers

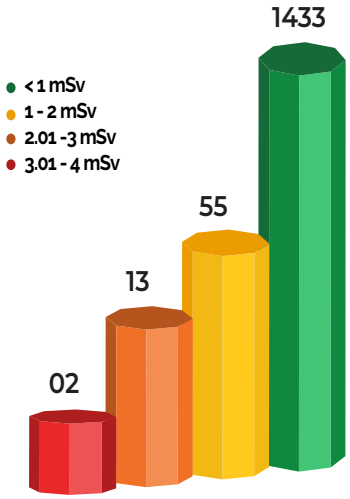


Figure 16: Annual Radiation Doses of K-3 Workers

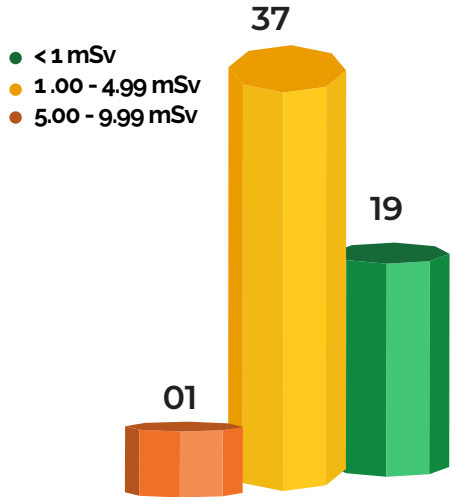


Figure 17: Annual Radiation Doses of Research Reactors and MPF

Currently, there are two spent fuel dry storage facilities for interim storage of spent nuclear fuel from nuclear power plants. One is KANUPP Spent Fuel Dry Storage (KSFDS) facility at KNPGS site and the other is PWR Spent Fuel Dry Storage (PDS) facility situated at CNPGS site. As K-1 is in decommissioning phase, so far total 3672 spent fuel bundles have been loaded in 34 casks and are placed in KSFDS facility. PNRA has granted construction license to PDS facility in 2019 however construction activities were halted and again resumed in 2023.

3.8 Waste Management Facilities

Radioactive waste means radioactive material in gaseous, liquid or solid form for which no further use is foreseen. Radioactive waste is produced from the operation of nuclear and radiation facilities e.g., NPPs, research reactors, MPFs, medical, academic, industrial facilities and other commercial uses of radioactive materials. Radioactive waste is classified into six classes, however, generation of low level radioactive waste is more than 90% of the overall waste generated. Currently, all the radioactive waste generated from nuclear facilities is stored at their respective sites, where as the radioactive waste from other facilities is stored and subsequently disposed off as conventional waste when the radioactivity level reaches well below the regulatory limits/clearance level. PNRA maintains an inventory of radioactive waste generated at nuclear power plants and nuclear research reactors.

3.8.1 Pre-disposal Facilities

Disused radioactive sources (DSRS) of low activity and short half-life from industry, medical

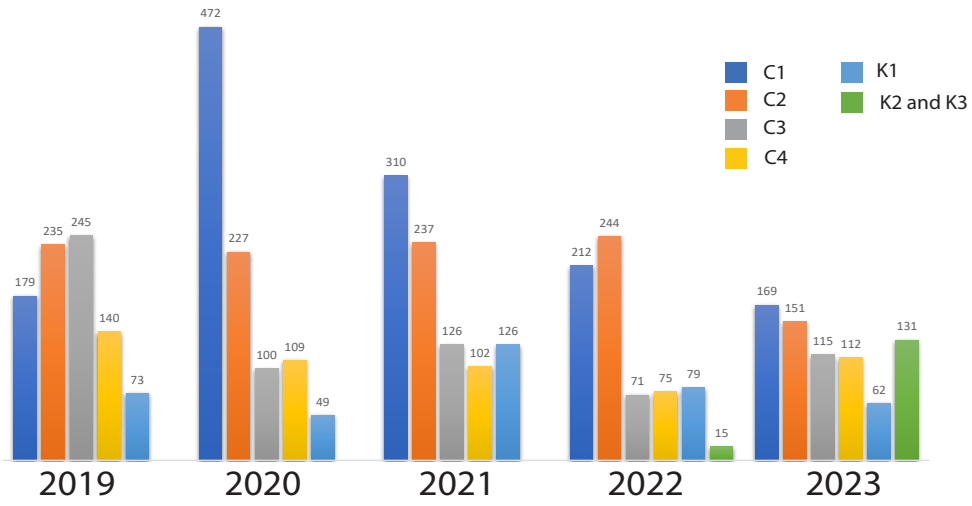


Figure 18: Trends of Generation of Solid Radioactive Waste (Drums) at C-1, C-2, C-3, C-4, K-1, K-2 and K-3

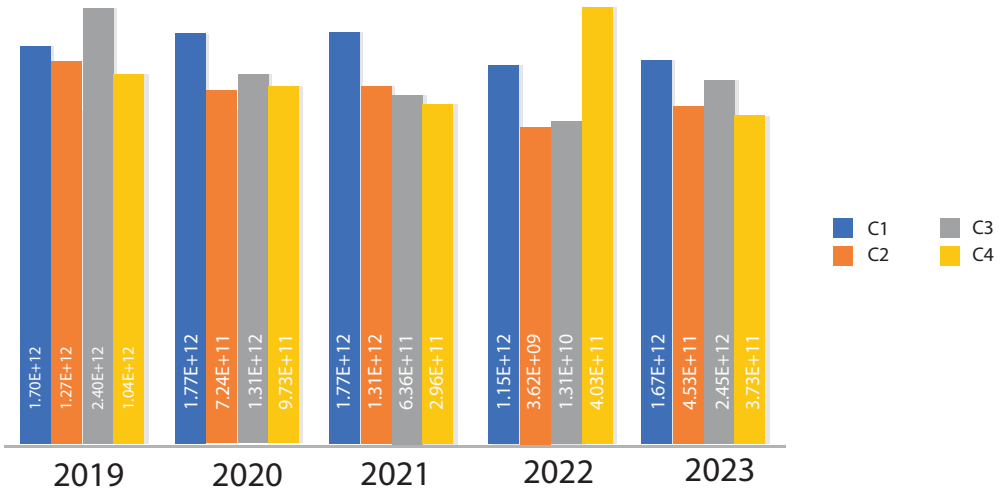


Figure 19: Trends of Liquid Effluent Releases from C-Series NPP (Bq)

sector, research and other facilities are stored in an interim pre-disposal storage facility prior to its final disposal, whereas, DSRS of high activity and long half-life are exported back to the manufacturer. At present, there are two pre-disposal facilities for interim storage of radioactive waste generated from nuclear installations and radiation facilities. One is PINSTECH Pre-disposal Radioactive Waste Management Facility (PPRWMF) located at PINSTECH site, Islamabad and other is Radioactive Waste Storage Area (RAWSA), located at KNPGS site, Karachi.

PPRWMF stores the waste generated from the research reactors, molybdenum production facility (MPF), isotope production facility and DSRS. RAWSA accommodates the solid radioactive waste generated from K-1 as well as DSRS. Radioactive waste is stored in these pre-disposal facilities for an interim period prior to its shipment to a centralized disposal facility.

PNRA, through its regulatory oversight, ensures that pre-treatment, treatment and conditioning of waste are being exercised for the safe pre-disposal management of radioactive waste. During 2023, PNRA performed four regulatory inspections of these facilities in order to verify compliance with the regulatory requirements.

3.8.2 Disposal Facilities

For low level radioactive waste, there is international consensus that this can be safely

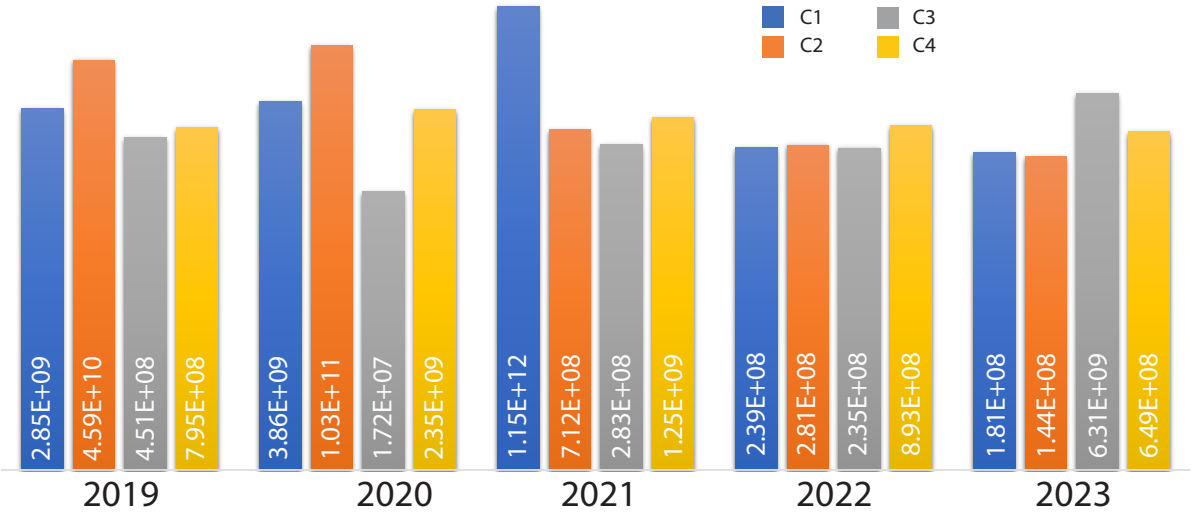


Figure 20: Trends of Gaseous Effluent Releases from C-Series NPPs (Bq)

K-3 Operating License Award Ceremony Held at PNRA HQs

disposed off in near-surface facilities at a depth of no more than 30 m. The underlying assumption is that disposed radioactive waste will decay to background levels before loss of institutional control.

PAEC is planning to establish a near surface disposal facility namely National Institute for Conservation of Environment (NICE) situated at district Chakwal. During 2023, the regulatory review of Site Evaluation Report (SER) of NICE was completed by PNRA and the site has been registered for the development of the facility after conduct of internal hearing session.

Another near surface disposal facility is being planned by PAEC at KNPGS site. For the start of site registration and licensing process, codes and standards have already been agreed between PNRA and the applicant.

3.9 Nuclear Fuel Cycle Facilities

Review of application for site registration of Fuel Fabrication Plant (FFP) located at Wan Bhachran and Indigenous Fuel Fabrication Facility (IFFF) located at Chashma remained in progress at PNRA in 2023.

3.10 Operating Personnel

Considering the vital role played by qualified and trained operating personnel for the safe operation of nuclear power plant and research reactors, PNRA has set forth the criteria for the qualification and competence of the operating personnel. PNRA awards licenses to operating personnel after conducting

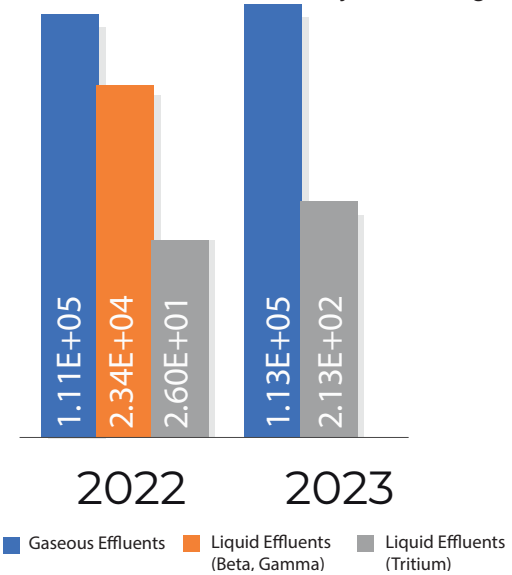


Figure 21: Trends of Liquid & Gaseous Effluent Releases from K-1 (GBq)

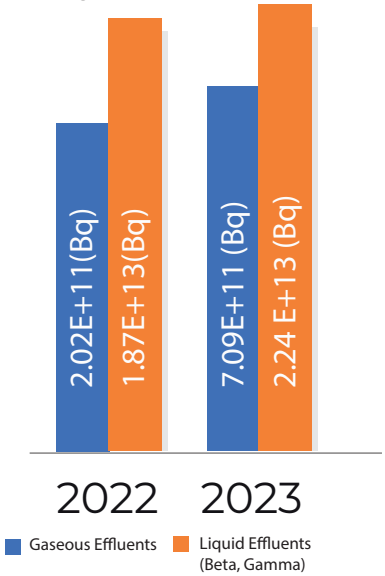


Figure 22: Trends of Liquid & Gaseous Effluent Releases from K-2 & K-3

Internal Hearing Session for the Site Registration of NICE

licensing examination for the positions of Shift Supervisors and Shift Engineers. The operating licenses are renewed annually based on the fulfillment of the requirements as prescribed in PNRA regulations regarding technical and professional competences, completion of minimum shifts duties, re-training and medical fitness.

During the reporting period, licensing examination of operating personnel of nuclear power plants (i.e. both K-series & C-series) and research reactors (i.e. PARR-1 & PARR-2) was conducted by PNRA licensing committee. Statistics of issuance and renewal of licenses of operating personnel for nuclear installations is depicted in Figure 23.

Figure 23: Statistics of Issuance / Renewal of Licenses of Operating Personnel of Nuclear Installations

4 Regulating Radiation Facilities

2887
Inspections Performed

14800
Radiation Workers

303
Enforcement Actions Taken

7100
Radiation Facilities

2276
NOCS and Permits Issued

The benefits of ionizing radiation have been demonstrated through applications in diverse fields that include energy, medical, industry, agriculture, education and research, etc. However, radiation sources emitting ionizing radiation can be harmful to the workers, general public and the environment, if used without proper safety measures.

PNRA regulates radiation facilities and associated activities utilizing radioactive sources or radiation generators through its licensing and authorization processes. During these processes, PNRA performs review and assessment of various licensing submissions of the applicants or licensees to ensure that facilities and activities comply with applicable PNRA regulations before issuing an authorization or a license as needed. In addition, regulatory inspections are conducted at radiation facilities and activities to verify implementation of regulatory requirements.

The regulatory control over radiation facilities and activities is generally exercised according to a graded approach depending upon the safety significance and the hazards associated with the facilities or activities.

4.1 Medical Radiation Facilities

These facilities include diagnostic X-ray machines in radiology (i.e., conventional X-ray units, CT Scanners, Orthopantomogram (OPG) and angiography units); radioisotopes in nuclear medicine and radiation sources in oncology (e.g. linear accelerator (LINAC), Gamma Knife, Cyber Knife, etc.). In order to ensure safety of workers, patients, comforters, volunteers, etc., such facilities or activities require licenses or authorizations from PNRA through demonstration of safe use in compliance with regulatory requirements up to the satisfaction of PNRA.

During 2023, the total number of licensed medical radiation facilities was increased up to 6346 with an addition of 550 new facilities. Figure 24 shows the number of various types of medical radiation facilities licensed by PNRA.

PNRA requires the operators of medical radiation facilities for the submission of documents such as programs / plans on radiation protection, emergency preparedness, physical protection, training and qualification of personnel in order to acquire a particular license or authorization.

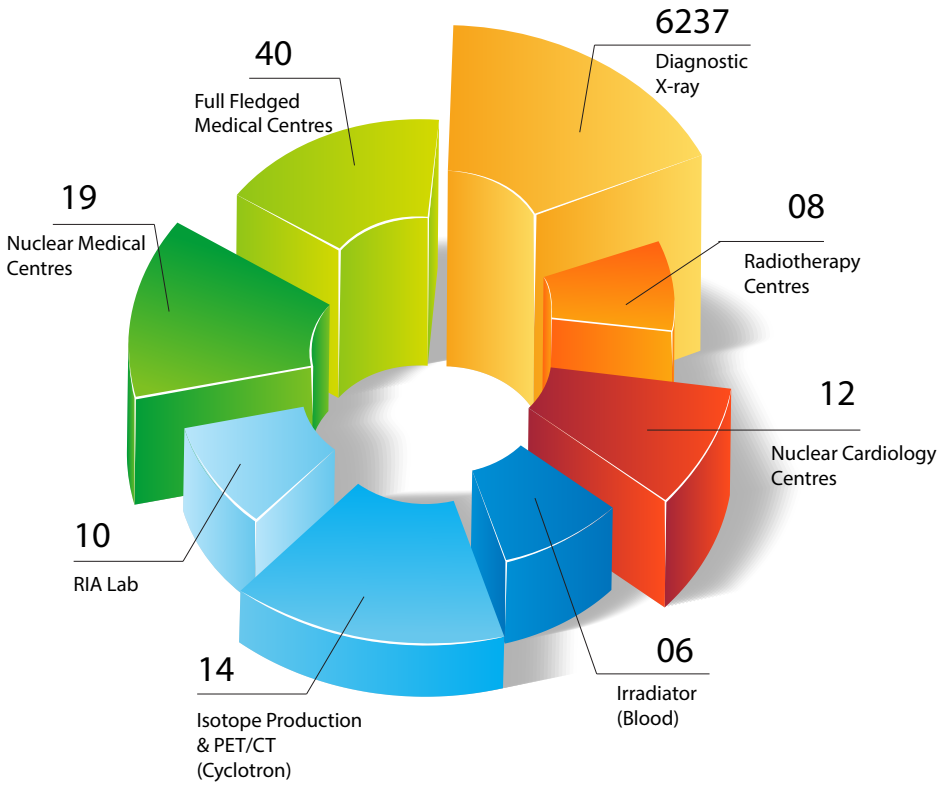


Figure 24: Statistics of Medical Radiation Facilities in Regulatory Net of PNRA

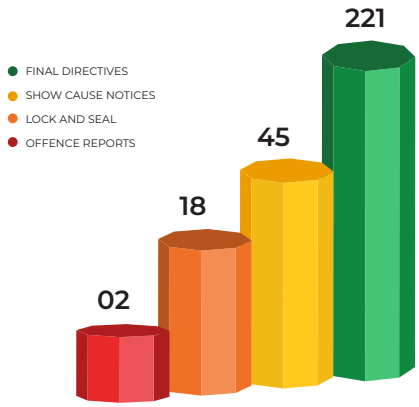


Figure 25: Enforcement Actions against Non-compliances at Medical Radiation Facilities

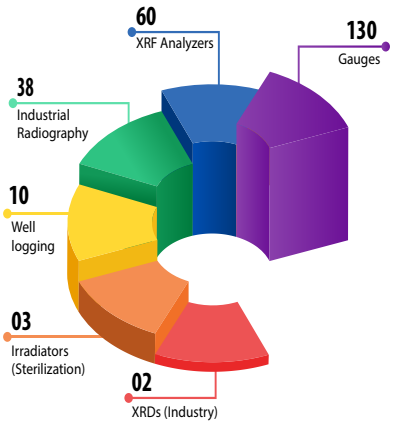


Figure 26: Statistics of Licensed Industrial Radiation Facilities in the Country

These submissions undergo a thorough regulatory review and assessment process by PNRA prior to grant such authorization. In 2023, more than 661 submissions from medical radiation facilities including Safety Analysis Reports (SARs), Radiation Protection Programs (RPPs), Physical Protection Plans (PPPs) and shielding calculations were reviewed.

PNRA performs periodic regulatory inspections of medical radiation facilities to verify the implementation of regulatory requirements such as structural shielding, facility design / layout, inventory of radiation sources, worker credentials, QA system, transportation and storage, etc. Accordingly, a total of 2646 inspections of medical radiation facilities were performed during 2023. In order to verify the effectiveness of radiation emergency plans, PNRA witnessed 21 emergency exercises /drills at radiation facilities.

PNRA takes enforcement actions against facilities which are not complying with the regulatory requirements. The enforcement actions include issuance of final directives, show cause notices, offence reports and conduct of hearings. In severe circumstances, PNRA can also issue work stoppage notice, lock and seal the premises, or suspend / cancel an authorization / license. In 2023, the number of enforcement action taken by PNRA on non-compliance with regulatory requirements are shown in Figure 25.

4.2 Industrial Radiation Facilities

Radiation sources are widely used in industry for different applications such as nuclear gauges for process control / monitoring, well logging for oil exploration, NDT for material inspection, irradiators for preservation of food items, sterilization of medical equipment / items and preservation of blood, etc.

PNRA ensures radiation protection and safety during use, storage and transport of such radiation sources through licensing / authorization, review & assessment of licensing submissions, conduct of inspections and taking enforcement actions against any non-compliance or violation wherever necessary. The total number of licensed industrial facilities reached to 243 by the end of 2023. Figure 26 shows distribution of various types of industrial facilities using radiation sources.

During 2023, a number of submissions were reviewed at PNRA as part of licensing process or as periodic submissions. In addition, PNRA performed 91 inspections for verification of compliance with regulatory requirements and initiated appropriate enforcement actions against the violators. The number of enforcement actions taken against industrial radiation facilities are illustrated in Figure 27.

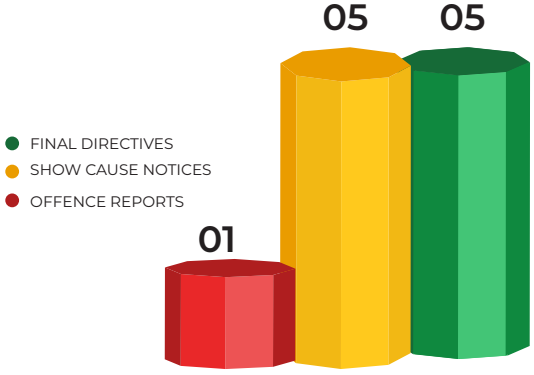


Figure 27: Enforcement Actions against Non-compliances at Industrial Radiation Facilities

Meeting of PNRA Officials with Importers of Radiation Generators

PNRA also witnessed 14 emergency exercises conducted by industrial radiation facilities.

4.3 Research and Educational Institutes

Both sealed and unsealed radiation sources are used in research and development at research and educational institutions e.g. low activity check sources that are sealed sources, used to test operability of radiation detectors, unsealed sources that are used as tracers in field work and in laboratory work, X-ray generators such as diffraction apparatus and accelerators, etc. PNRA issues license to these institutions to ensure the protection of students, researchers and workers. In 2023, PNRA issued 86 licenses to research and educational institutes with an addition of six new facilities. PNRA also reviewed licensing documents as part of licensing submissions or as periodic submissions. In addition, PNRA performed 28 inspections to ensure compliance of regulatory requirements and took enforcement actions against violators by issuing one show cause notice and one final directive.

4.4 Other Applications (Import, Export, Scanners,etc.)

Radiation scanners use Gamma-ray and X-ray radiography techniques to inspect containers, vehicles and baggages for detection of contrabands. PNRA issues licenses and authorizations to the facilities using such scanners. Likewise, PNRA issues the license to importers, exporters and traders of radiation sources. During 2023, PNRA issued 425 licenses with an addition of 38 new facilities in the licensing net of PNRA. Total number of facilities licensed as scanners, importers and exporters is shown in Figure 28.

PNRA reviewed a number of licensing submissions; conducted 122 inspections in order to verify the safety arrangements for compliance with regulatory requirements and took enforcement actions by issuing four final directives against the violators.

4.5 Permits and No objection Certificates (NOCs)

The import / export of radioactive sources and radiation generators is authorized after carrying out necessary verification that only licensed entities are involved in its import and export. Accordingly, PNRA issues authorizations including permits and NOCs as per relevant PNRA regulations. The NOC is issued after verification of the intended end use, the user and the technical specifications of the radiation source or generator being imported / exported. Furthermore, as a pre-requisite for issuance of NOC, it is ensured that a high activity radioactive source can only be acquired / imported upon provision of undertaking by the supplier / manufacturer to accept its return at the end of its useful design life as part of the purchase contract.

Some countries of origin require a special permit from regulatory body of the country of destination for placement of order for procurement of radioactive sources or generators. When such requests are received, PNRA carries out necessary verification and

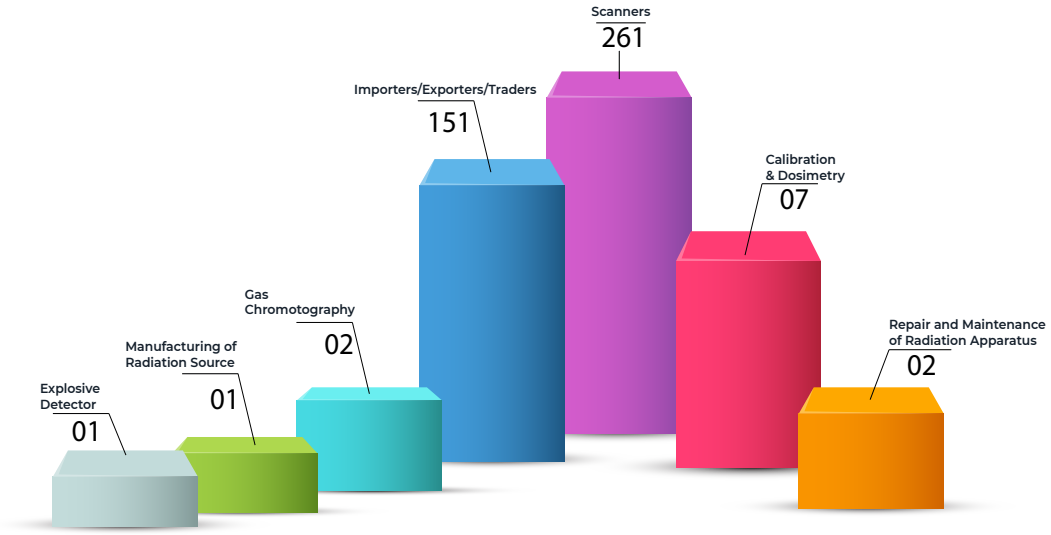


Figure 28: Statistics of Licenses Issued to Scanners, Importers and Exporters of Radiation Sources

issues permits to its licensees to facilitate the process of procurement.

During 2023, PNRA issued 1946 NOCs for the import of new radiation sources, 125 NOCs for the export of empty containers used to carry radiation sources, 62 permits and 110 authorizations for local purchase of radiation sources. Figure 29 reflects number of NOCs and permits issued during 2023.

PNRA has established a close liaison with the Federal Board of Revenue (FBR) through which import / export of radioactive sources is controlled at international entry / exit points throughout the country.

Figure 29: NOCs and Permits Issued by PNRA in 2023

4.6 Disused Sealed Radiation Sources

Sealed radioactive sources upon completing their useful life are termed as Disused Sealed Radioactive Sources (DSRS). Once the radioactive sources become disused, the risk of being used for unintended purposes increases if they are discarded as normal waste and may lead to harm the public and the environment. Therefore, proper management of disused radiation sources is necessary.

As per regulatory requirements, licensee is bound to return the DSRS having half-life of more than one year and initial activity greater than 100 GBq to the supplier. All other DSRS are stored in designated radioactive waste storage facilities located at PINSTECH (Islamabad) and KANUPP (Karachi).

At the end of useful life of a radioactive source/ material, such radiation sources are managed as radioactive waste. PNRA ensures that licensee establishes proper arrangements for waste management through implementation of its regulatory requirements.

During 2023, more than 33 disposal authorizations were issued by PNRA.

4.7 Occupational Exposure

PNRA has developed a database on occupational exposure to maintain dose record of radiation workers at the national level. This database is utilized to evaluate exposure

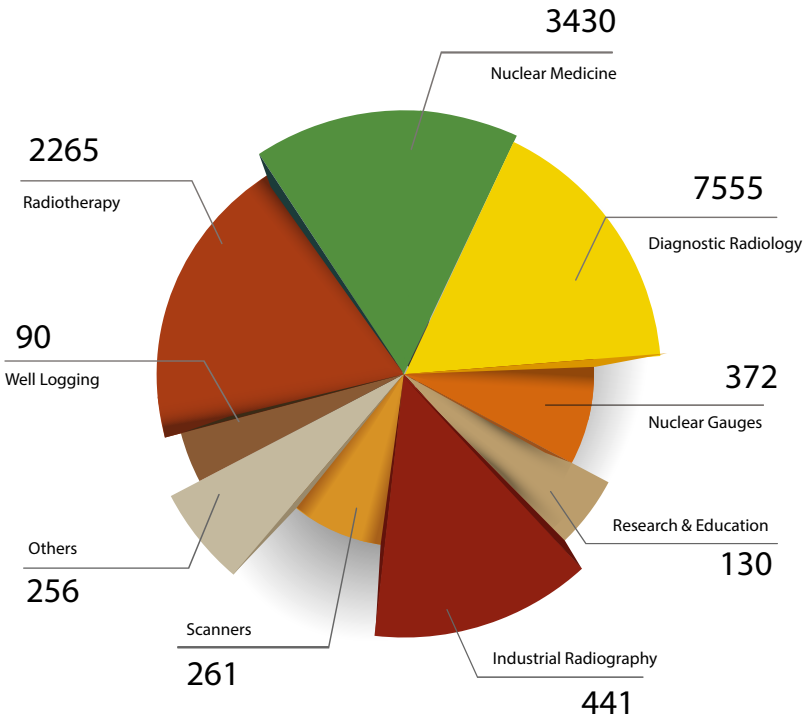


Figure 30: Statistics of Workers in Different Radiation Facilities

trends, assess effectiveness of radiation protection program(s) and as low as reasonably achievable (ALARA) principle implementation. Radiation facilities submit dose records of their radiation workers to PNRA regularly. The dose record is directly linked with Computerized National Identity Cards (CNIC) of the workers which enables PNRA to identify the itinerant workers and smooth retrieval of their dose records, as and when required. Currently, the database has occupational exposure record of 14800 radiation workers working in various radiation facilities.

Statistics of radiation workers in different radiation facilities are shown in Figure 30.

During 2023, more than 97.1% of radiation workers received less than 5 mSv dose, 2.87% of the workers received doses between 5-20 mSv and 0.03% of the workers received more than 20 mSv. Figure 31 reflects overall occupational exposure of radiation workers in different dose ranges.

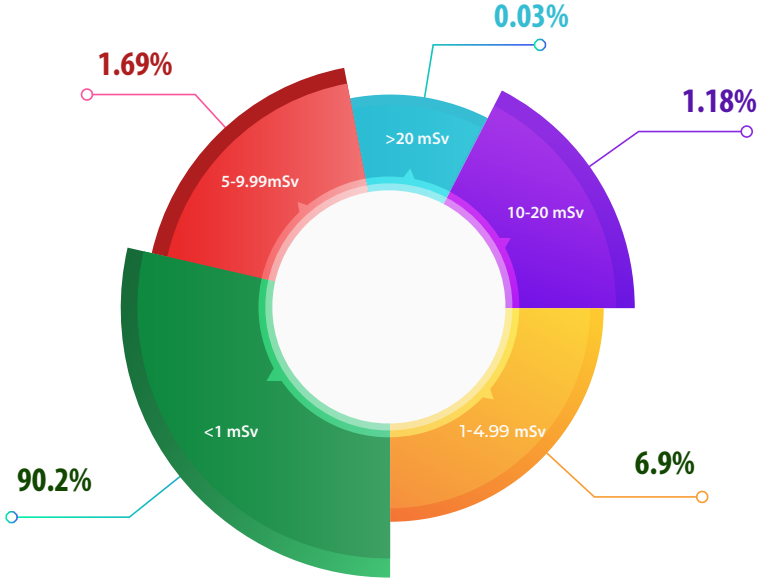


Figure 31: Statistics of Doses Received by Radiation Workers during 2023

5 Regulating Manufacturers, Designers and Service Providers

Our Licensees

03

Nuclear Safety Class Equipment, Components & Safety Related Structure Designers

01

Non Destructive Examination (NDE) Service Provider for Nuclear Safety Class Equipment and Piping

03

Nuclear Safety Class Equipment and Components Manufacturers

Under the Ordinance, activities like design, manufacturing and various other services associated with nuclear installations or radiation facilities require a license from PNRA. As a pre-requisite for obtaining such a license, the organizations involved in design and manufacturing of nuclear safety related structures, systems and components as well as service providers must have the requisite knowledge, technical expertise and associated infrastructure to perform their functions in accordance with the relevant international codes and standards.

Relevant PNRA regulations prescribe the licensing process including requirements for submissions as part of licensing application, demonstration of capabilities, processes and demonstration of the effectiveness of the management system. Accordingly, after completion of the regulatory processes and upon satisfaction that the applicant is fulfilling all the pertaining requirements, PNRA issues license to the manufacturers of Nuclear Safety Class (NSC) equipment and components, designers of nuclear safety class equipment, components and safety related structures, and grants authorization to service providers for performing activities such as Non-Destructive Examination (NDE) of NSC equipment, repair and replacement, maintenance and testing of radiation apparatus, dosimetry services and calibration. PNRA also awards design certification for spent fuel casks and transport packages.

Furthermore, regulatory inspections of licensed equipment manufacturers, nuclear safety class equipment, components & safety related structure designers and service providers are also carried out by PNRA to verify compliance with applicable standards, regulatory requirements and conditions of license or authorization issued by PNRA. Accordingly, the licensees are required to submit relevant design documents for review prior to proceeding for manufacturing.

5.1 Designers of Safety Related Structures and Equipment

Following three design organizations have been licensed by PNRA for the designing of equipment and structures under their respective domains:

i. Heavy Mechanical Complex-3 (HMC-3) to design nuclear safety class 3 equipment;

ii. Instrumentation Control & Computer Complex (ICCC) to design analogue safety instrumentation and control (I&C) systems of research reactors; and

iii. Works and Services Organizations (WASO) to design nuclear safety related structure.

During 2023, PNRA received an application from NOVEL Engineering Works-1 (NEW-1), Islamabd for obtaining license as a designer of safety class 3 equipment and components.

5.2 Manufacturers of Safety Class Equipment

Heavy Mechanical Complex-3 (HMC-3), Taxila and NOVEL Engineering Works-2 (NEW-2), Karachi are licensed by PNRA as manufacturers of Nuclear Safety Class-1 (NSC-1) equipment and components while ICCC is authorized to manufacture analogue safety I&C equipment for research reactors.

ICCC submitted two different applications regarding enhancement of scope of its manufacturing license from manufacturer of “analogue safety I&C equipment for research reactors” to manufacturer of “analogue safety I&C equipment of NPPs” and manufacturer of “In-core Detector Assemblies of KNPGS”. The application regarding analogue safety I&C equipment of NPPs remained in review and assessment phase, while regarding application of in-core detector assemblies, the regulatory inspection for manufacturing demonstration capability (as a third and last step of licensing process) was completed. In addition, the review of application of NEW-1, for acquiring license for manufacturing of safety class-3 equipment was completed.

As per license condition, licensee submits quality plans describing various steps of equipment manufacturing for selection of inspection points by PNRA. During 2023, five quality plans along with the associated documents were submitted by HMC-3 to manufacture safety class components. The same were reviewed by PNRA. In addition to that, one quality plan of ICCC was also reviewed. While, two quality plans of NEW-2 along with other documents for manufacturing of safety class equipment for

PARRs, C-1 and K-1 remained under review at PNRA for the selection of inspection points.

PNRA conducted eight regulatory inspections at HMC-3 and three inspections at NEW-2 regarding manufacturing of safety class equipment and components in 2023. In addition, QA inspection of ICCC (both as a designer and as a manufacturer of safety class analogue I&C equipment) was also conducted for verification of effective implementation of Quality Assurance Program. One Management System (MS) inspection of NEW-1 as a requisite step of both design and manufacturing licensing process was also conducted by PNRA. Statistics of inspections performed at nuclear safety class equipment manufacturers are shown in Figure 32.

5.3 Service Providers

National Centre for Non-Destructive Testing (NCNDT), Islamabad is authorized to provide NDE services to nuclear industry in Pakistan. The authorization issued to NCNDT is valid till December 2025.

During 2023, PNRA reviewed NCNDT application to enhance the scope of its authorization to perform NDE of NPPs components and systems as per RSE-M Code and subsequently issued authorization to NCNDT. PNRA reviewed 67 quality plans of NCNDT for performing NDE at NPPs and also conducted control point inspections. During the reporting period, PNRA has conducted eight regulatory inspections during NDE activities performed by NCNDT at NPPs.

Furthermore, three organizations M/S GHEBA Imaging, Rawalpindi, Blue Star Health Care, Islamabad and AlimMedix, Lahore contacted PNRA to obtain authorization for providing repair and maintenance services of radiation apparatus. In this regard, regulatory requirements were shared with the service providers.

5.4 Design Certification of Casks/Packages

5.4.1 KANUPP Spent Fuel Dry Storage Cask (SC-108)

Dry storage casks are designed and manufactured for storing the spent nuclear fuel that have completed the necessary cooling time of minimum 10 years. The design of KANUPP spent fuel dry storage cask is certified from PNRA and HMC-3 is authorized for manufacturing such casks. The design certification is valid upto June 30, 2024. At present, 34 casks have been manufactured and transferred to KNPGS site. The second batch of 30 casks is being manufactured at HMC-3. PNRA is conducting necessary inspections during manufacturing of these casks.

5.4.2 CNPGS Spent Fuel Dry Storage Cask and Transfer Cask (SC-21 & TC-21)

PNRA has provisionally accepted the design of dry storage and transfer casks and issued authorization to HMC-3 for the manufacturing of prototype casks. During the manufacturing of the prototypes, a total number of 55 inspections were conducted to verify compliance with regulatory requirements. Furthermore, HMC-3 has submitted the updated documents as required by Regulations PAK/918 for the issuance of design approval certificate (DAC).

Figure 32: Inspections Performed at Nuclear Safety Class Equipment Manufacturers

5.4.3 CNPGS Fresh Fuel Type AF Packages

PAEC has applied for design and manufacturing of Type AF Package which is used to transport fresh fuel. PNRA has provisionally accepted the design and granted authorization to HMC-3 for the start of manufacturing of prototype of Type AF package. The manufacturing activities of the prototype are being witnessed by PNRA.

5.4.4 Type B(U) Package with Tungsten Shielding Material

PNRA has granted design certification of Type B(U) package with Depleted Uranium (DU) shielding material to HMC-3. PAEC showed intention for design certification of Type B(U) package with Tungsten shielding material. In this regard, HMC-3 has submitted SAR and management system as per PAK/916. Accordingly, after satisfactory review of submissions, HMC-3 will be authorized to manufacture the prototype of package. Subsequently, after completion of manufacturing of the prototype, design certification will be granted.

5.5 X-ray Baggage Scanner Manufacturer

During the reporting period, application for license renewal of Defense Science and Technology Organization (DESTO) as a manufacturer of X-ray baggage scanners was reviewed and its license was renewed up to June 30, 2024.

5.6 Sealed Radioactive Sources Manufacturer

PAEC submitted application to PNRA for the grant of license for establishing a Sealed Radioactive Sources Manufacturing Facility (SMF) at PINSTECH. PNRA granted the license to SMF in 2023 upon satisfactory compliance with all regulatory requirements. The license is valid till December 2028.

Manufacturing License Awarded to ICCC by Member Executive PNRA in a Ceremony Held at PNRA HQs

PHOTO GALLERY

Pakistan Independence Day Celebrations at PNRA HQs

PNRA Employees Tabl

PNRA Employees Stand for National Anthem on PNRA Annual Day Ceremony 2023

PNRA Employees Performing Skit

PNRA Annual Program on Milad-un-Nabi (S.A.W)

Chairman PNRA Presenting Tro

le Tennis Teams

PNRA Women Tug of War Teams

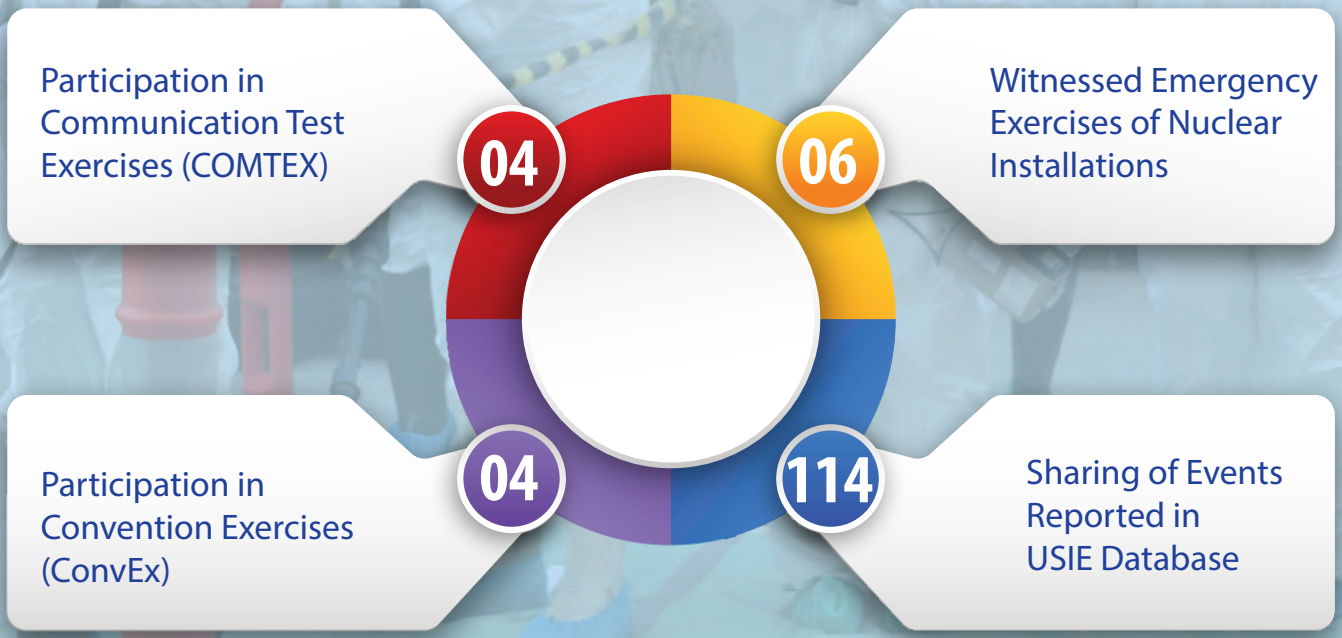
on Pakistan Day at PNRA HQs

PNRA Employees Cricket Team

phy to Winner of Athletics

PNRA Employees Tug of War Teams

6 Emergency Preparedness and Response



The design, construction and operation of nuclear and radiation facilities follow the application of the concept of defense in depth by applying the highest safety standards to ensure that the facility operates within the safe band so as to achieve the goal and objectives of protection of the workers, general public and the environment from harmful effects of ionizing radiation. Despite all safety precautions, it is not practically possible to totally rule out the risk of nuclear or radiation accidents. Accordingly, the applicants and licensees of nuclear installations and radiation facilities are required to develop emergency response plans (on-site and off-site, as appropriate) to ensure their preparedness to cope up with such emergencies and to conduct emergency drills and exercises regularly to demonstrate the effectiveness of these plans. Implementation of on-site emergency plans is the responsibility of the licensees while for off-site plans the licensees have to coordinate with off-site authorities at local, provincial and national levels, as needed. As per regulatory framework of PNRA, the emergency plans are required to be submitted to PNRA for review and approval. PNRA conducts a thorough review of these plans, confirms their adherence to regulatory requirements, and makes recommendations for their improvements. In order to ensure effective implementation of the emergency plans, PNRA conducts regulatory inspections and evaluation of periodic drills and exercises.

PNRA plays a pivotal role in establishing and maintaining emergency preparedness and response arrangements at national level. Under the national emergency response arrangements, defined in National Radiation Emergency Plan (NREP), PNRA is responsible for providing support and advice to the Government and the response organizations working at federal, provincial and local levels.

Based on international standards and experience feedback, PNRA has developed and is implementing its regulations on management of nuclear and radiological emergencies (PAK/914). Facilities that may experience a nuclear or radiation emergency are required to develop on-site and off-site emergency response plans and implementing procedures in accordance with the regulatory requirements and guidelines. Such plans and procedures include measures to cope with emergency situations including communication systems, response procedures and protective actions. Additionally, these include details on handling of contaminated individuals, restrictions to avoid spread of contamination and other long-term safety measures.

Inauguration of NRECC by DG-IAEA

In 2023, PNRA approved 15 Emergency Plans of radiation facilities and activities, including hospitals, industrial units, irradiators, industrial radiography practices, etc., as well as four emergency response plans for nuclear installations. In addition, PNRA also witnessed the six emergency exercises conducted by nuclear installations.

6.1 National Radiation Emergency Coordination Centre (NRECC)

To implement the requirements of PNRA Ordinance and obligations of International Conventions, PNRA maintains a National Radiation Emergency Coordination Centre (NRECC) at its Headquarters in Islamabad which works round the clock. The centre was recently upgraded under the Government's public sector development project with state-of-the-art facilities and is supplemented with two Regional Radiation Emergency Coordination Centres (RECC) each established at PNRA's Regional Nuclear Safety Directorates located at Chashma and Karachi. Dr. Rafael Mariano Grossi, DG IAEA, officially inaugurated the upgraded Centre in February 2023.

In the event of a nuclear or radiological emergency, NRECC is responsible to coordinate with licensees, response organizations and IAEA for notification of an emergency, sharing of related information, assessment of emergency consequences and providing technical advice. In case of unavailability of NRECC, a backup centre has been established at a different locality within another premises of PNRA. NRECC is supported by eight radiation monitoring teams located at PNRA offices across the country with the purpose to monitor radiation level in the field in case of any radiation emergency.

PNRA's responsibility in the event of a nuclear or radiological emergency is detailed in PNRA Emergency Response Plan for Nuclear and Radiological Emergencies. This plan outlines the mandate and responsibilities of PNRA as per its Ordinance, National Response and IAEA's Early Notification and Assistance Conventions. In order to assess the effectiveness of this response plan, different types of drills and exercises are performed, such as those for the Mobile Radiation Monitoring Laboratory (MRML), Communication Test Exercises (COMTEX), IAEA ConvEx Exercise, PNRA-level exercises and the exercises conducted at national level.

PNRA emergency response plan describes provisions to coordinate with licensees, off-site response organizations and international organizations (such as the IAEA) and means for activation of PNRA resources using NRECC at PNRA HQs and RECCs at concerned regional directorate. It also describes the mechanism to offer advice and provide support to the licensees, off-site response organizations and

Briefing to Chinese Delegate & DDG (TC), IAEA at NRECC

government agencies.

As part of its exercise schedule, two MRML exercises were performed in 2023 including a joint exercise involving members from all RMTs of PNRA to test the readiness of RMTs for their deployment and performing field activities. Four Communication Test Exercises (COMTEX) were also conducted to test the availability of dedicated communication channels of PNRA HQ's, regional directorates and inspectorates of PNRA, licensed nuclear installations and other relevant national response organizations.

A PNRA level emergency exercise was conducted in 2023 which provided an opportunity to test PNRA's existing response arrangements and capabilities. The exercise which tested two separate emergency scenarios, also gauged the effectiveness of implementation of PNRA response plan, related procedures and tools; NRECC response team capabilities in performing assigned tasks; and decision-making process of NRECC chain of command. The exercise highlighted the strengths and also identified areas for improvement in EPR arrangements within the organization.

PNRA also participates in international level exercises named Convention Exercises (ConvEx) to test operational readiness of its resources and capabilities identified at national level under both the Conventions. These ConvEx are classified as ConvEx-1, ConvEx-2 and ConvEx-3; based on their scope, scale and objectives. These exercises are organized following a preset schedule which is shared by IAEA with the Member States in advance. During the year 2023, PNRA took part in four ConvEx.

Preventive and corrective maintenance play a vital role for the sustainability of the radiation detection equipment available with RMTs at regional offices and at NRECC. The maintenance activities continued throughout 2023. PNRA also supported other national organizations in strengthening their emergency response capabilities by providing trainings and procurement of equipment, etc.

Under the NREP, one of the tasks of the PNRA is to provide assistance to national organizations through deployment of its radiation monitoring teams in the field, as and when required. Since the response to a nuclear or radiological emergency requires synergistic action from a number of national organizations, a workshop on "NREP" was held from 16-20 Oct, 2023 at PNRA Headquarters, Islamabad for awareness and capacity building of all stakeholders. The basic purpose of the workshop was to sensitize and strengthen the coordination between relevant stakeholders in the area of radiation emergency preparedness and response as defined in NREP. The said workshop

Notification	Assessment	Information	Coordination
Notification and exchange of information with licensees, response organizations, Government and the IAEA	Assessment and prognosis of the situation by using in-house tools, deployment of PNRA Radiation Monitoring Teams (RMTs) & collection and analysis of environmental samples during an emergency	Provision of public information in the form of press releases / press briefings / updates through PNRA Spokesperson	Coordination and provision of advice and assistance to the Government, off-site response organizations through NEMS and to the other Member States under IAEA Response and Assistance Network (RANET)

Figure 33: Main Functions of NRECC

Participants of Workshop on National Radiation Emergency Plan

was inaugurated by the Chairman National Disaster Management Authority (NDMA). The participating organizations were NDMA, Federal Board of Revenue, Ministry of Foreign Affairs, Ministry of Commerce, Ministry of Information & Broadcasting, Ministry of Interior, Ministry of National Health Services, etc.

During the reported year, a number of diplomats from US, Australia, Canada, France, UK, and EU visited the NRECC. Furthermore, delegates from China, IAEA, Uzbekistan as well as from other national organizations also visited NRECC to understand the role and working of the centre. The main functions of NRECC are given in Figure 33.

6.2 Participation in IAEA's Response and Assistance Network

Under the International Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, the IAEA has established a Response and Assistance Network (RANET). The aim of this network is to coordinate international assistance to / from its Member States in case of a nuclear or radiological emergency to help in minimizing the radiological consequences. Being a State Party to the Convention, Pakistan has registered its National Assistance Capabilities (NAC) in seven functional areas in RANET. The NACs registered with RANET were tested during the conduct of IAEA ConvEx-2b which was held from 5-7 September, 2023.

6.3 Sharing of Information about Events Involving Ionizing Radiation

According to the Convention on Early Notification of a Nuclear Accident, IAEA Member States are obligated to notify any nuclear or radiological emergency having transboundary consequences. Under the Convention, the Member States are also encouraged to share information about radiation related incidents to relevant national organizations and the IAEA, even if they do not have transboundary consequences. These incidents are reported through IAEA's platforms, namely the Nuclear Events Web-based System (NEWS) and the Unified System for Information Exchange in Incidents and Emergencies (USIE).

NEWS is a publicly accessible online communication channel for sharing information about events involving ionizing radiation. USIE is a web portal for reporting of radiological events under international conventions. Since PNRA (NRECC) is the national point of contact under the Convention, therefore, it shares any such events which have occurred in the country

Participants of PNRA Level Emergency Exercise for Testing of Emergency Response Arrangements

with IAEA. On the other hand, it receives information from the Member States about nuclear or radiological emergencies occurred in the world through IAEA and disseminates such information to relevant quarters in the country. Such information is analyzed and lessons learnt are shared with the relevant national stakeholders for improvement of their emergency preparedness and response capabilities.

During the reporting period, information about 114 international events including continuous updates about the status of nuclear safety at Ukrainian NPPs were received and shared with relevant stakeholders in the country. These events were related to overexposure of workers or public, theft or loss of radiation sources, spread of radioactive contamination and malfunction of equipment, etc. Similarly, events related to nuclear or radiological emergencies in Pakistan were also reported to IAEA on voluntary basis. Reporting of an event is based on its classification on a scale, known as International Nuclear and Radiological Event Scale (INES) which serves as a tool for communicating the safety significance of nuclear and radiological events. The INES scale is divided into eight levels, ranging from 0 to 7, measuring the events on the basis of their safety significance. During the year 2023, all the three events occurred in Pakistan were rated at level 0 on the INES.

6.4 Reporting of Radioactive Source Movement

Radioactive sources used for industrial radiography and nuclear medicine are often transported from one place to the other are regulated by PNRA. It is imperative to implement stringent safety and security measures during transportation of these sources to prevent any potential incident. Consequently, the regulatory framework requires the licensees to report in advance to NRECC any movement of radioactive sources within the country. PNRA shares this information with relevant authorities and its regional directorates for conducting inspections during movement of such sources. These inspections serve to confirm compliance with safety and security requirements and ensure a timely response in the event of any incident. In the year 2023, PNRA received and appropriately handled more than 2500 notifications of source movement from licensees.

7 Environmental Monitoring and Dosimetry

- 83 Environmental Monitoring Around Nuclear Installations
- 41 Assessment of NORM at OGDCL Sites in the Country
- 381 Analysis of Export Goods
- 475 External Dose Monitoring
- 158 Whole Body Counting
- 2019 Calibration of Radiation Detection Equipment

As per Ordinance 2001, PNRA implements and coordinates national program of environmental monitoring in the country to check any build-up of radioactivity in the environment that might affect the public. Accordingly, PNRA performs environmental monitoring around NPPs and RRs to ensure that radioactivity released from their operation do not pose any threat to health of the general public and the environment. PNRA also performs environmental monitoring and surveillance activities for assessment of Naturally Occurring Radioactive Material (NORM) at different industries.

In addition, PNRA performs external & internal dose assessments of occupational workers to verify the compliance with the regulatory dose limits. Moreover, PNRA provides calibration services of radiation monitoring equipment to the licensees of nuclear installations and radiation facilities for maintaining measurement accuracy of the radiation monitoring equipment. The forthcoming sections describe activities related to environmental monitoring, dosimetry and calibration of radiation monitoring equipment being performed at PNRA.

7.1 Monitoring of Radioactivity in the Environment

All living things are exposed to background radiation present in the environment due to natural and man-made sources. To determine the background radiation levels, PNRA monitors the environmental radioactivity by performing analysis of environmental samples collected from different regions across the country, surroundings of nuclear installations and potential industries. Major activities performed for this purpose are elaborated in the succeeding subsections.

7.1.1 Environmental Monitoring Around Nuclear Installations (NIs)

The operation of nuclear installations generally result in the discharge of radioactivity into the environment. These discharges may result in the build-up of radioactivity in the surrounding environment. The operators of nuclear installations perform environmental monitoring in the vicinity of their installations to ensure that there is no build-up of the radioactivity in the environment due to operation of these installations and submits their monitoring results to PNRA annually in the form of radiological environmental operating report. PNRA also independently monitors the surrounding environment of these nuclear installations periodically and collects and analyzes various environmental and food samples to verify the results submitted by the licensees in their annual environmental operating reports.

During 2023, PNRA collected 83 environmental samples from the vicinity of CNPGS and KNPGS. The results of radiometric analysis of samples were found comparable with the results reported by the licensees in their annual environmental monitoring reports. Hence, it was concluded that operation of these NPPs do not pose any radiological risk to the inhabitants residing in the vicinity of these nuclear installations.

Furthermore, PNRA performed continuous air monitoring at CNPGS and KNPGS sites using High Volume Air Samplers (HVAS) and Low Volume Air Samplers (LVAS) to detect any radiation abnormality in the air due to the operation of nuclear installations. The analysis results showed that there is no risk to the people and the environment from the nuclear installations as no anthropogenic radionuclide was detected in the air filter samples.

7.2 Assessment of NORM at Potential Industrial Sector

Naturally Occurring Radioactive Material (NORM) is found in the earth crust in varying concentrations. NORM levels in the environment may be enhanced due to the waste generated from certain industries as well as from the extraction of natural resources such as coal, oil, natural gas and other mineral ores from the ground. Higher concentrations of NORM may pose risk to the human health and the environment. Therefore, PNRA monitors and assesses NORM in order to protect workers, people and the environment from exposures to NORM.

During 2023, PNRA conducted surveys for the assessment of NORM at oil and gas production fields and analyzed 14 samples of soil, scale, sludge and produced water. In addition, 27 samples of flash, bottom ash, raw coal, phosphate rock and dust samples were collected from coal fired power plant and phosphate fertilizer industry and analyzed. The

results revealed that the activity concentration of natural radionuclides in these samples was well below the exemption levels as specified in national regulations.

7.3 Radiation Analysis of Edible and Non-edible Export Items

Radiation analysis certificates are issued by PNRA for export of edible and non-edible items from Pakistan as per requirement of importing countries. In 2023, PNRA performed analysis of 381 samples of export items that included biscuits, sweeteners, sugar cane, milk, tobacco, mercury, alloy, etc.

7.4 Dosimetry and Calibration of Radiation Detection Equipment

Radiation from planned exposure to human beings must not exceed the dose limits defined in the regulations. To ensure that radiation exposure is within the prescribed regulatory limits, all licensees are required to provide personal dosimeters to their radiation workers for periodic assessment of radiation doses. PNRA also provides limited-scale services to the licensees by providing dosimeters to their workers for periodic personal dose assessment on request basis. The radiation dose received by the workers is shared with the licensees and recommendations are provided where radiation dose is likely to exceed the regulatory dose limits. In addition, enforcement actions are also initiated when radiation exposure exceeds the prescribed limits.

RME being used at nuclear installations and radiation facilities, require periodic calibration to ensure the reliability and accuracy of radiation dose assessment. For this, PNRA calibration laboratories established at Islamabad and Kundian are providing services to the licensees for calibration of their RME along with internal and external dosimetry services.

7.4.1 External Dosimetry Laboratories

PNRA external dosimetry laboratories are located at Islamabad and Karachi. These laboratories provide dosimetry services to PNRA inspectors as well as radiation workers involved in radiation activities at different licensed facilities. During 2023, these laboratories performed dose assessment of 475 radiation workers.

7.4.2 Internal Dosimetry Laboratories

The industrial or medical use of radioactive material has the potential of internal contamination of workers through ingestion and inhalation. The significant likelihood of internal exposure exists at Nuclear Medicine Centres (NMCs). Therefore, bioassay procedures such as urine analysis, organ counting, and Whole-Body Counting (WBC) are required to determine the quantity of internal deposition and the resulting radiation dose.

PNRA has established three internal dosimetry laboratories located at Islamabad, Kundian and Karachi to monitor the internal contamination of radiation workers. These laboratories are equipped with the whole body counters and urine analysis system. During the reported period, PNRA performed internal dosimetry of

PNRA Officials Performing Survey at a Coal Fired Power Plant

radiation workers involved in the handling of unsealed radioisotopes at a nuclear medicine department of a private hospital in Islamabad. The radiation doses received by all workers were found within the regulatory dose limits.

Furthermore, the WBC of contract workers, plant personnel (CNPGS) involved in the maintenance and refueling of NPPs, IAEA Safeguard Inspectors and other foreigners who visited CNPGS and KNPGS sites was performed at Karachi and Kundian. Figure 34 depicts the statistics of personnel monitored through WBC during 2023. The WBC results revealed that no radiation worker was found internally contaminated.

Figure 34: Breakup of Whole Body Counting Performed at PNRA

7.4.3 Calibration of Radiation Detection Equipment

PNRA is operating two Tertiary Standards Dosimetry Laboratories (TSDL) located at Islamabad & Kundian for calibration of protection level radiation detection equipment being used at nuclear installations and radiation facilities. These laboratories are traceable to Primary Standards Dosimetry Lab (PSDL) at IAEA through Secondary Standards Dosimetry Lab (SSDL) at PINSTECH. During 2023, PNRA TSDLs calibrated 2019 radiation detection equipment of PNRA, NPPs and other licensed radiation facilities as highlighted in Figure 35.

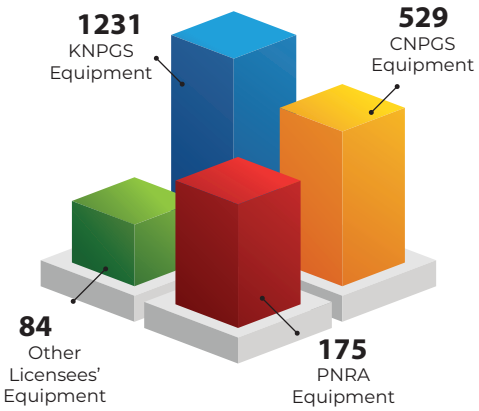


Figure 35: Statistics of RME Calibrated at PNRA

8 Capacity Building

In-house Training Courses	22
Training Courses in National Institutes	63
Higher Education	04
Participation in International Events	50
On-going PSDP Projects	02

Competent professionals are essential for any organization for performing its functions effectively and efficiently. Therefore, PNRA is highly vigilant for capacity building of its employees. PNRA applies a systematic approach to assess competence needs of its employees. This helps in identifying gaps between the existing and desired competencies of the employees. To fill these gaps, PNRA has adopted a three-pronged strategy for competence development which includes in-house trainings within the organization; trainings at national institutes; and capacity building at international institutes/organizations.

Strengthening of necessary infrastructure is an essential element of the capacity building of any organization. PNRA makes continuous efforts for improvement of its technical resources and infrastructure. The projects approved by the Government under its Public Sector Development Program (PSDP) are the main source through which PNRA has so far been able to enhance and strengthen its infrastructure. These projects have effectively contributed to the improvement of the regulatory oversight of nuclear installations, radiation facilities and associated activities in the country.

This chapter describes the organizational efforts for capacity building of PNRA manpower and infrastructure development during the reporting period.

8.1 Competence Development Through In-house Resources

In order to maintain and improve the competence of its workforce, PNRA has established a training institute namely "National Institute of Safety and Security (NISAS)" with the responsibility to plan and execute training programs for PNRA employees and stakeholders.

NISAS is an ISO 9001:2015 certified institute. This institute is equipped with the necessary training aids including laboratories, radiation detection and physical protection equipment, physical models of major components of nuclear power plants, etc. A soft panel nuclear power plant training simulator is also available at PNRA for the training of inspectors on plant systems and study of plant behavior during normal operation, transients and accident conditions. The institute has a well-qualified and professional faculty capable of providing trainings in all regulatory domains like nuclear, radiation, radioactive waste and transport safety; nuclear security; emergency preparedness and response; leadership and management system; and interpersonal skill development.

During 2023, NISAS conducted 22 training courses and a total of 588 professionals attended these courses including 212 from PNRA and 376 from other organizations. Figure 36 presents the number of training courses conducted at NISAS along with the number of participants during the year 2023.

8.2 Competence Development Through National Organizations

PNRA arranges trainings for its manpower from well reputed national universities and training institutes/organizations especially in areas where it is not possible to arrange training internally within the organization. PNRA is collaborating with more than 35 national institutes in this regard. The most prominent among these are Pakistan Institute of Engineering and Applied Sciences (PIEAS), National Centre for Physics (NCP), Pakistan Welding Institute (PWI), National Centre for Non-Destructive Testing (NCNDT), Pakistan Institute of Management (PIM), Secretariat Training Institute (STI), Pakistan Planning and Management Institute (PPMI), Pakistan Manpower Institute (PMI), National University of Science & Technology (NUST) and Pakistan Centre of Excellence in Nuclear Security (PCENS). During 2023, 179 PNRA personnel participated and benefited from 63 training opportunities arranged at various national institutes.

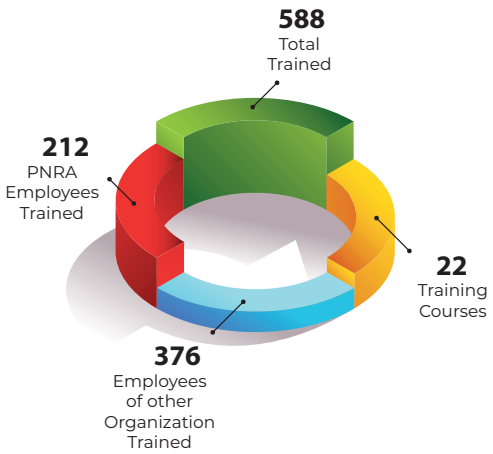


Figure 36: Training Courses and Personnel Trained at NISAS

Specialized management courses are arranged at national reputable institutions that includes Young Officers Orientation Course – YOOC at PCENS, Senior Officers Management Course (SOMC) for middle level managers and Senior Officers Leadership Course (SOLC) for executive cadre at PIEAS. In 2023, five PNRA officials participated in YOOC, eight officials completed SOMC and one officer participated in the SOLC.

As part of the PNRA fellowship program for the induction of technical officers, two fellows joined PNRA after successful completion of MS programs at PIEAS (session 2021-23). Furthermore, four PNRA employees are currently pursuing their PhD programs in various national universities in technical as well as management disciplines.

8.3 Competence Development Through International Organizations

PNRA takes advantage of the capacity building opportunities offered by the IAEA and other international organizations such as National Nuclear Safety Administration (NNSA) and CNPO for capacity building of its employees. PNRA has also signed bilateral agreement with China for capacity building of PNRA employees. PNRA's activities in this area are described below:

8.3.1 Competence Development Through IAEA

IAEA organizes training courses, workshops, fellowships and scientific visits in the fields of nuclear safety, radiation protection, waste safety, transport safety, emergency preparedness & response and physical protection, etc., for capacity building of its Member States under its technical cooperation program. During the reporting period, 50 PNRA officials physically participated in 42 capacity building events internationally while 12 PNRA officials virtually participated in seven such events.

8.3.2 Competence Development Through Bilateral Cooperation with International Organizations

PNRA has signed bilateral agreements of cooperation for competence development of its employees and exchange of information and experience in nuclear safety with NNSA, the nuclear regulatory body of China and its TSO the Nuclear Safety Centre (NSC). In the year 2023, PNRA signed a new MoU to establish a Joint Nuclear Safety Cooperation Centre with National Nuclear Safety Administration of the People's Republic of China (NNSA) under the auspices of the PNRA-NNSA steering committee. Moreover, a long-term cooperation framework agreement between PNRA and CNPO was renewed in October 2023. In addition, the agreement between PNRA and NSC on cooperation in the Field of Nuclear Safety and Radiation Protection was also renewed. In the year 2023, seven PNRA officials were trained in China in areas of regulatory interest.

8.4 Capacity Building and Infrastructure Development Through Public Sector Development Program (PSDP) Projects

PNRA initiated several projects under the Public Sector Development Program (PSDP) of the Government of Pakistan through which the technical infrastructure of PNRA was significantly strengthened. Currently, two PSDP projects are in progress while one project was completed in June 2023.

8.4.1 Strengthening Regional Regulatory Oversight of PNRA

A significant number of licensed radiation facilities are in operation in Lahore and its surrounding areas. Moreover, radioactive sources are frequently transported in the region from the licensed premises to different operating sites for field applications. Similarly, import and export of goods through Wagah border, Lahore and Sialkot dry-ports need to be vigilantly monitored in collaboration with Pakistan Customs to identify and control any ingress of unauthorized nuclear or radioactive material or contaminated goods in Pakistan. PNRA also ensures immediate response and technical assistance in this area, in case of any nuclear or radiological emergency. At present, PNRA is conducting all regulatory, coordination and response activities from its regional office located at Islamabad but managing all these activities from Islamabad is quite challenging. Accordingly, with the approval of the Government, PNRA is establishing a regional inspectorate at Lahore under the PSDP Project "Establishment of Regional Nuclear Safety Inspectorate at Lahore" to strengthen

its regulatory oversight and performing coordination and response activities more effectively and efficiently. The construction work for office building is in progress and is expected to be completed by next year.

8.4.2 Installation of Solar Electric Power System at PNRA

The main objective of the project is to move towards green energy and reducing electricity expenses of the office through installation of Solar Power System. To achieve this target, installation of solar panels, with a total capacity of 386.1 KWe is planned at different PNRA buildings located in various cities of Pakistan. Recently, the Government has approved solarization of PNRA HQs (main building) Islamabad at a cost of Rs. 13.96 million. The project is expected to be completed in 2024.

8.4.3 Reinforcement of PNRA's Capacity and Regulatory Oversight against Vulnerabilities of Digitized Controls and Cyber Threats

Analogue instrumentation and control systems are being replaced by digital equipment in nuclear power plants. Moreover, emerging technologies based on Information and Communications Technology (ICT) or digital technology are also being introduced for safety, security and emergency preparedness at NPPs. Such technologies have their own peculiarity and are also vulnerable to cyber threats. In order to enhance competence of regulatory professionals in this important area, a PSDP funded project titled "Reinforcement of PNRA's Capacity and Regulatory Oversight against Vulnerabilities of Digitized Controls and Cyber Threats" has been completed in June 2023. The main objectives of the project were:

i. Development of a team for effective regulatory oversight of NPPs which utilize digital/ICT based equipment for Safety, Security and Emergency Preparedness functions;

ii. Arrangement of trainings from expert organizations in areas important for safety evaluations and cyber security of NPPs;

iii. Establishment of IT and I&C/OT Labs; and

iv. Strengthening the cyber security of PNRA's digital assets (network and data).

In fulfillment of its objectives, the project has developed a team with expertise in performing regulatory oversight of NPPs which utilize digital or ICT based equipment for safety, security and emergency preparedness. The project team has designed and developed PNRA's Cyber Security and Digital Safety Laboratory. The lab has been designed keeping in view the expertise required by PNRA for the licensing of modern nuclear power plants as well as licensing of manufacturers and designers of ICT based safety class equipment for instrumentation and control. Indigenous design and development of the lab by project team has been pivotal in enhancing the expertise. Moreover, it has allowed PNRA to perform analysis and R&D on various aspects of integration of ICT with Instrumentation and Control of safety systems. Further, the facility is also being used for training of PNRA officials as well as officials of other strategic organizations in safety qualification of digital equipment and cyber security of industrial control systems.

9 Research and Development

PNRA continued working on 10 R&D projects during year 2023.

10
Ongoing R&D Projects

PNRA coordinated with PINSTECH, PIEAS, DHA Suffa University and NCP for conduct of research / conferences in 2023.

07
Research Collaboration

13
R&D Projects for 2023-26

PNRA initiated 13 research projects for the years 2023-26 in the area of safety, security, radiation protection and environmental monitoring.

02
IAEA Coordinated Research Projects

PNRA is contributing in one IAEA CRP since 2020 and initiated one new CRP proposal with IAEA in 2023.

Research and Development (R&D) is an essential function of a nuclear regulatory body to continuously update its knowledge, understanding, framework and processes to improve its effectiveness and efficiency. R&D is also performed to develop new processes and to address new and emerging challenges and technological advancements. PNRA performs R&D activities to execute its tasks effectively, improve regulatory processes, revamp regulatory framework and support regulatory decisions. PNRA also initiates R&D projects in existing as well as new emerging areas to overcome challenges related to licensing and authorization of novel technologies. This chapter describes R&D activities carried out by PNRA during the year 2023.

9.1 Regulatory Research Activities

During 2023, PNRA performed various R&D activities to support its regulatory functions and further enhance its capabilities in emerging fields. The details of research activities are described in subsequent sub-sections.

9.1.1 PNRA Research and Development Projects

PNRA took initiative in 2022 and started 10 research & development projects in the field of nuclear safety and radiation protection and these projects remained in progress during the year 2023. Among these projects, PNRA has completed two projects while eight projects are expected to complete in 2024 & 2025. Some of the projects are described below and overall progress is highlighted in Figure 37.

a) Development of Regulator's PSA Level-II Model

Various fault trees of systems such as Hydrogen Recombining System and Containment Isolation System were developed and integrated with the PSA model. Moreover, Containment Event Trees (CETs) for early and late radioactive releases with the availability of mitigating systems as per Severe Accident Mitigation Guidelines (SAMGs) were developed and preliminary quantification of CETs was performed.

b) Analysis of Operational Events

PNRA performed a study to quantify the safety degradation at nuclear power plants by analyzing different events identified in Licensee Event Reports (LERs). Accident Sequence Precursor Analysis (ASP) approach is used to evaluate and categorize the events. PNRA regional directorates use insight of this study in prioritization of inspections based on precursor events as well as to categorize the inspection findings of NPPs.

c) Determination of Radon Concentration and its Seasonal Variation at Khewra Salt Mines

PNRA conducted research on Radon accumulation and effect of seasonal variation in Khewra Salt mines to evaluate the radiation exposure to visitors and workers. Radon concentration was measured at multiple times during the year using electronic active Radon monitors (RAD-7) and passive Radon monitors (CR-39) and results evaluated. The activity concentration of natural radionuclides with focus on Radium (parent of Radon) in the salt and seepage water in the mine using HPGe detectors was also measured. It was revealed that levels of Radium in salt and Radon concentration in air inside the mine are well below the exemption level of 1000 Bq/kg and 1000 Bq/m^3 respectively. In the visiting area, the average annual effective dose due to Radon was 0.21 mSv which is within the exemption limits.

d) Model Development and Safety Analysis of NPP During Low Power Shut Down Conditions

PNRA conducted this project to estimate available time (time window) for operator until core uncovery during accident progression. PNRA completed two cases. In case-1, analysis is performed for the time calculation of core uncovery during loss of Residual Heat Removal System (RHR) in Plant Operating State - D (POS-D) with RCS full of coolant. Whereas, Case 2 analysis is executed for calculating the required time to align the RFT if loss of RHR system occurs during POS-F state with RCS open (through Pressurizer Manway).

Furthermore, PNRA departments forwarded several research projects during 2023 and 13 of these proposals have been approved for the years 2023 – 2026. Work on these projects have already initiated. These projects are enlisted below:

i. Study of updated requirements related to

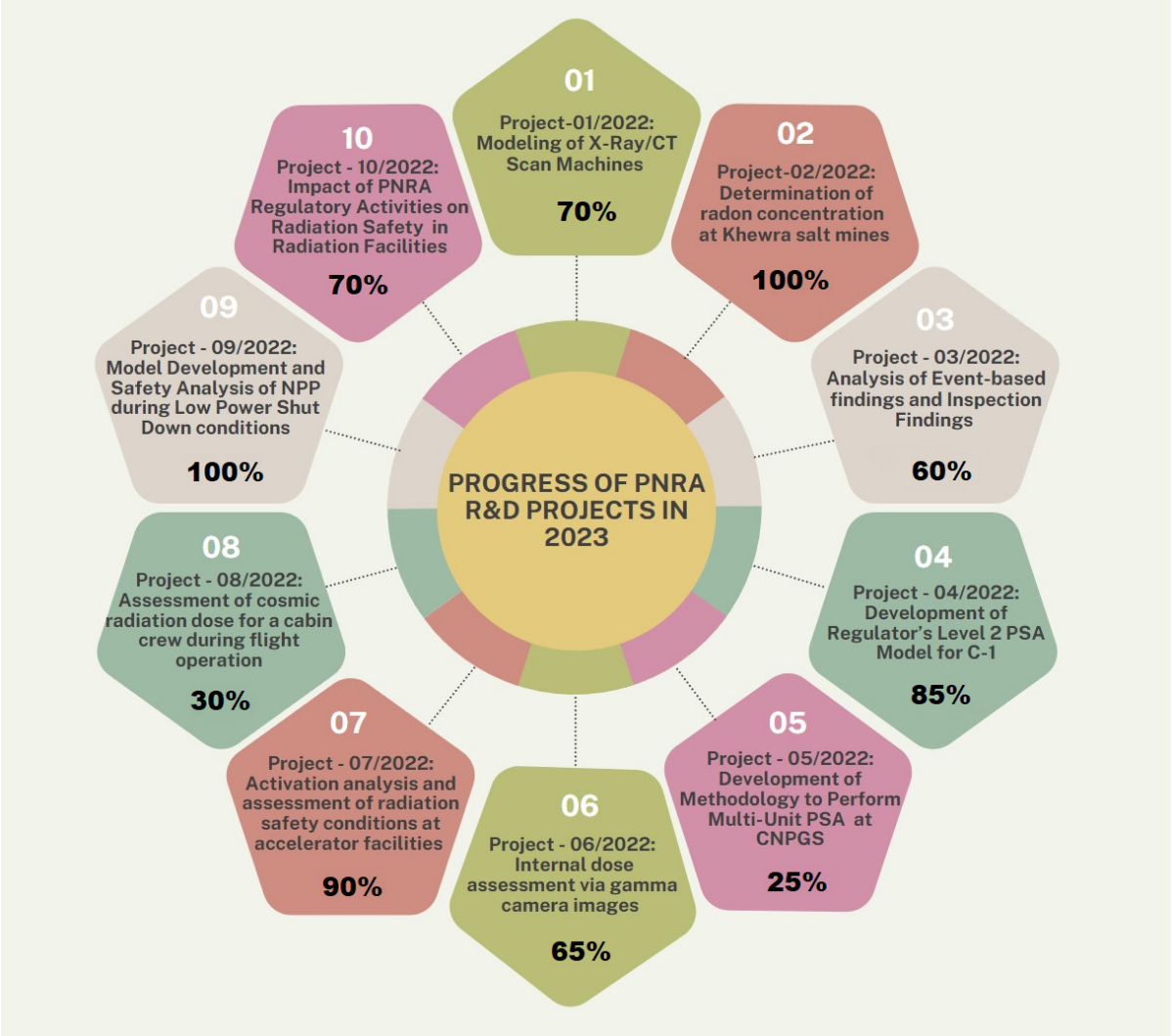


Figure 37: Progress of PNRA R&D Projects in 2023

Stress Corrosion Cracking (SCC) in the light of Operating Experience Feedback (OEF) and its utilization in future reviews of Nuclear Power Plants (NPPs);

ii. Gap Analysis in PNRA Regulatory Framework based on Advancements in Requirements/International Practices for Regulatory Oversight of Motor Operated Valves (MOVs);

iii. Thermal Hydraulic Analyses in Support of Development of Regulator's Level 2 PSA Model of C-1;

iv. Assessment of Differences in Safety Criteria of Updated Industrial Codes and Standards Applicable to Design and Safety Criteria of NPPs for its Effective Utilization in Licensing of Future NPPs;

v. Validation of Severe Accident Analysis MELCOR Model with K-2/K-3 Full Scope Training Simulator (FSTS);

vi. Non-linear Fracture Assessment of Plastic Materials;

vii. Identification of Vital Areas of Nuclear Power Plant to Prevent or Reduce the Likelihood of Sabotage by using PSA Methodology;

viii. Total Harmonic Distortion (THD) Assessment and its Impact on Critical Components;

ix. Analysis of Calibration Factors and Long-Term Stability of Radiation Survey Meters and Electronic Pocket Dosimeters;

x. Assessment of Radionuclides from Coal-Fired Brick Kilns in Rawalpindi and Islamabad Regions and the Consequent Hazards on Human Health and the Environment;

xi. Assessment and Evaluation of Cyber Security Risks of Physical Protection Systems;

xii. Evaluation and Enhancement of National Nuclear Security Detection Architecture; and

xiii. Analytical analysis of Access Control Systems (ACS) for nuclear installations and way forward for the development acceptance criteria for the approval of physical protection program in accordance with regulatory requirements.

9.1.2 Thermal Hydraulic and Safety Analyses

PNRA departments took numerous other activities related to thermal hydraulic and safety analysis during the year 2023. PNRA also performed confirmatory analyses of licensee's submissions pertaining to nuclear installations, structural integrity and regulatory compliance in specific areas considering present and future needs. These research activities provided insight for regulatory oversight and decision making through rigorous and independent assessments. In this context, the following analyses were performed:

i. Analysis of PARR-3 Reactor Core/Pool and Stress Analysis of Core Support Bridge

ii. Fire Propagation Analysis of K-2 MCR

iii. Assessment of Power System Protection Response during Electrical Transients at K-2/K-3

iv. Impact Assessment of Creep Rupture Sizes in RCS Pressure Boundary on High Pressure Accident Sequence

v. Assessment of House Load Operation (HLO) of K-2/K-3

9.1.3 Radiation Protection and Environmental Monitoring

PNRA also performed important research activities in the domains of radiation protection, radiation measurement and environmental monitoring during the year 2023. These activities are described in the following sections:

a) Development of Dose Assessment Module for Calculation of Doses at LPZ

PNRA undertook a task for development of dose assessment software to determine effective and thyroid doses of an adult in case of LOCA at K-2/K-3 NPP. In 2023, PNRA extended this task and incorporated a module for dose calculation at the LPZ within the dose assessment software with an intuitive Graphical User Interface (GUI). Moreover, PNRA performed a benchmark study and conducted rigorous testing with the verification of results with design document of K-2/K-3 to ensure the software reliability and accuracy.

Award of Gold Medal for Best Research Paper

b) Scattering Effect of Aluminum Camera Pillar on Beam Profiles of Gamma Irradiator

PNRA is managing Tertiary Standards Calibration Laboratories with the objective to provide calibration services to licensed nuclear installations and radiation facilities in accordance with international standards. Accurate measurements ensure appropriate radiation protection and necessitates the importance of timely calibration. These laboratories provide calibration services and thus strengthening the radiation protection regime at national level. These labs are equipped with Gamma Beam Irradiator consisting of three radioactive sources installed in a well shielded calibration bunker. The irradiator assembly has a camera on the Aluminum Pillar for remote measurement in control room. Aluminum Pillar Camera has the potential to scatter the radioactivity beam originating from the irradiator assembly thus adding a secondary beam field resulting in erroneous detection of response by radiation detection equipment. Therefore, a study was conducted to quantify the effect of scattering by Aluminum camera pillar on radiation field of Gamma Beam Irradiator and validate appropriate measurement through Radiation Monitoring Equipment (RME) indirectly.

The results of the study can help to improve the quality of calibration services being provided to licensees by minimizing the uncertainty due to scattering. The extent of scattering of the beam was quantified by performing beam profiling in different variations of the Aluminum pillar's positioning. Based on the results, it was concluded that in all the cases, the beam usable area remains stable i.e., the variation in dose rate due to the presence of Aluminum pillar remains within the acceptable limit of 5%.

c) Estimation of Uranium Isotopes in Soil & Water using ASTM Methods

One of the functions of PNRA is to perform environmental monitoring to verify increase in background radiation level. The licensee of nuclear installations and facilities also perform environmental monitoring in and around their sites. There is a need to validate a technique for determination of uranium in environmental samples in case of nuclear or radiological emergency as well as during routine measurements. Accordingly, PNRA adopted and validated a method for determination of Uranium isotopes in soil and water samples by utilizing Alpha Spectrometry System (ASS) with the objective of environmental protection.

In order to validate and verify performance of method, the Standard Reference Materials (SRMs) were analyzed and the results are found in agreement with reference values. PNRA may use this approach to determine the concentration of uranium in environmental samples in case of nuclear or radiological emergency as well as during routine measurements in order to protect general public, workers and environment from the effects of harmful ionizing radiation.

9.2 IAEA Coordinated Research Project (CRP)

IAEA supports member states regarding research and development activities and accordingly implements Coordinated Research projects (CRPs) to bring various countries to collaborate on research topics of common interest. Pakistan has been actively participating in CRPs for last decade and made productive contribution in achieving the deliverables and outcomes of CRPs.

9.2.1 Ongoing CRP

PNRA is participating in an IAEA Coordinated Research Project (CRP) titled "Sustainability of radiation detection equipment used for detection of materials out of regulatory control" since 2020. Under the CRP, trend analysis and baseline assessment of component failure in personal radiation detectors and radionuclide identification devices was carried out through a comprehensive study of failure rate during life-cycle operation. The analysis and assessment identified the approaches for improvement in designs and technical specifications of handheld radiation detection equipment.

9.2.2 New CRP Proposals

PNRA submitted a new CRP proposal on 'Enhancement of the use and sustainability of nuclear detection technologies for detection of nuclear and other radioactive materials along with other contraband items' to IAEA in 2023.

9.3 Research Collaboration with National Institutes

PNRA collaborates with Pakistan Institute of Nuclear Science & Technology (PINSTECH), Pakistan Institute of Engineering & Applied Sciences (PIEAS), National Centre for Physics (NCP), NED University of Engineering & Technology, Sir Syed University of Engineering and Technology, Dawood University of Engineering & Technology and DHA Suffa University for knowledge exchange, expertise development and joint R&D activities. PNRA is collaborating with PINSTECH and PIEAS for a research project to minimize the volume of generated liquid waste and immobilization of incinerator ash. Bench-top experiments related to the incinerator ash immobilization using the real sample were conducted. The samples were tested for physical and chemical properties and these exhibited the acceptable values. It was learnt from the bench top experiments that a volume reduction greater than 70% with a sample composition containing more than 80% of the incinerator ash can be achieved.

9.4 Publications

PNRA promotes R&D activities by encouraging its officials to present and publish the outcome of their research work in national & international conferences/journal papers. The following papers presented in various conferences in 2023 include:

i. "Degradation of Silicon Rubber-based Nuclear Power Plant I & C Cable under Accelerated Thermal Aging" in International Conference on Computing, Mathematics, and Engineering Technologies –iCoMET 2023 Sukkur IBA University;

ii. "Regulatory Oversight and Challenges during Decommissioning of KANUPP", in International Conference on Nuclear Decommissioning: Addressing the Past and Ensuring the Future at IAEA, Vienna, Austria;

iii. "National Regulatory Requirements and Practices for Radioactive Waste Management, Decommissioning and Environmental Protection – Ensuring Safety and Enabling Sustainability" in International Conference on the Safety of Radioactive Waste Management, Decommissioning, Environmental Protection and Remediation: Ensuring Safety and Enabling Sustainability at Vienna, Austria;

iv. "PNRA's Strategy for Regulating Extensively Digitized NPPs: A Case Study" in International Conference "Computer Security in the Nuclear World: Security for Safety", at Vienna, Austria; and

v "Vulnerability Severity Scoring System in Information Technology vs. Operation Technology Environment" in International Conference "Computer Security in the Nuclear World: Security for Safety", at Vienna, Austria.

10 National and International Cooperation

Coordination Meetings 13

Coordination meetings held with licensees

Public Awareness Seminars 20

More than 3000 individuals participated in seminars

National Cooperation Events 86

More than 1000 individuals participated in training courses/visits

International Cooperation (IAEA) Events 70

More than 80 PNRA experts participated in peer review missions, consultancies and technical meetings

PNRA collaborates with national and international organizations to build partnership for continuous improvement of nuclear safety and security.

10.1 Cooperation and Coordination at National Level

PNRA believes in strong collaboration with various national stakeholders which is pivotal for effective regulatory functioning. This coordination supports in meeting governmental requirements, confidence building, improving transparency and regulatory capacity building. Such organizations include government organizations, licensees, public, educational institutions, etc. PNRA also interacts with the public to inform them about the role and responsibilities of PNRA and improving awareness regarding applications of ionizing radiation and associated hazards and necessary protective measures to be taken.

10.1.1 Coordination with Governmental Organizations

PNRA coordinates with governmental departments and ministries for various organizational activities including Strategic Plans Division (SPD), Office of the Accountant General of Pakistan Revenue (AGPR), Ministry of Foreign Affairs (MoFA), Pakistan Customs, Ministry of Planning Division and Special Initiative, Ministry of Finance, Law Enforcement Agencies, National Disaster Management Authority (NDMA) and other relevant governmental organizations etc. PNRA coordinates with law enforcement agencies and district administration for conduct of enforcement activities such as lock and seal of facilities.

PNRA launched an awareness campaign for industries dealing with metal scrap and related finished products regarding potential presence of radioactive or contaminated materials in metal scrap and monitoring mechanism to be employed. PNRA conducted several meetings with provincial health care authorities and health departments to enhance coordination for regulatory oversight of medical facilities utilizing radiation sources or generators.

PNRA maintains an effective coordination with relevant government organizations to sensitize on their role regarding security of radioactive material and integrated response to any nuclear security event. During 2023, PNRA held several senior level meetings with the Provincial Disaster Management Authority (PDMA) and District Disaster Management Authority (DDMA), and conducted awareness seminars. PNRA also held meetings with Federal Civil Defense Training School (FCDTS), Directorate of Civil Defense Baluchistan and National Logistics Cell (NLC) for improving coordination and raising awareness.

PNRA contributes to the inter-agency process for the establishment of National Nuclear Detection Architecture (NNDA) framework at all sea ports, land borders and airports in Pakistan with the aim to monitor and control any illegal import, export or transit of nuclear and other radioactive materials at points of entry/exit of the country. Conceptual framework for the NNDA training facility was developed by PNRA. Handheld Radiation Detection Equipment was also acquired and deployed at Karachi Seaport Container Terminal (KICT) with the aim of strengthening the secondary inspection of the containerized cargo alarmed during passage from Radiation Portal Monitors (RPMs).

PNRA, along with the national stakeholders, assisted self-assessment at CNPGS to identify the national capacity building requirements in radiological forensics and to enhance the technical features of Radiation Portal Monitors (RPMs) during manufacturing.

PNRA assists “Pakistan Centre of Excellence for Nuclear Security” (PCENS) for capacity building of national and international stakeholders. During 2023, PNRA has provided 10 resource persons for four training courses organized by PCENS.

PNRA’s Physical Protection Exterior Laboratory (PPEL), located at PCENS, is being utilized for capacity building of national stakeholders and IAEA Member States in the field of nuclear security. During 2023, following activities were arranged at PPEL:

i. Five training courses for response forces in which more than one hundred officials participated.

ii. 16 technical visits with more than three hundred participants from different organizations.

PNRA has recently initiated efforts to enhance liaison with other regulatory authorities in

Pakistan to learn from each other's experiences and share best practices for effective discharge of regulatory functions.

Collaboration with national academia for competence development is very important for capacity building of PNRA employees. PNRA has an Agreement of Cooperation (AoC) with PIEAS which was renewed in 2023 and extended for the next five years. This cooperation encompasses MS fellowship programs for fresh manpower inducted by PNRA; mandatory management courses; research and development activities and sharing of technical expertise & lab resources, etc. PNRA also held meetings with Centre of Excellence in Physics (CoEP), National Centre for Physics (NCP) to enhance collaboration and cooperation in research and scientific activities.

10.1.2 Interaction with Licensees

PNRA always maintains close liaison with its licensees from nuclear installations and radiation facilities in matters concerning nuclear safety, radiation safety and nuclear security. PNRA holds periodic coordination meetings with the licensees to discuss issues of regulatory concern and find common ground for smooth implementation of safety requirements. This interaction also serves as a feedback mechanism to receive licensees' point of view concerning regulatory performance and receiving suggestions for improvement. During the reporting year, PNRA held 23 coordination meetings with different licensees from nuclear installations and radiation facilities.

PNRA regularly conducts training courses in areas of nuclear safety, radiation protection and nuclear security in which representatives of licensee regularly participate for their capacity building. During 2023, following training courses/workshops/seminars were conducted by PNRA upon request from the licensee(s):

i. Radiation Protection in Industrial Applications of Ionizing Radiation;

ii. Radiation Protection in Medical Use of Ionizing Radiation; and

iii. Radiation Protection in Use of Radioactive Sources for Research and Education.

10.1.3 Interaction with Public

PNRA has established a public awareness program to enhance awareness of general public about the basic radiation protection principles, applications of ionizing radiation in everyday life, associated hazards to human health as a result of overexposure and necessary protective measures. During 2023, PNRA conducted 30 seminars in several institutions which were attended by 4488 participants. These sessions were held at Rawalpindi, Islamabad, Peshawar, Mardan and Quetta.

10.2 Cooperation and Coordination at International Level

PNRA maintains close liaison and effective coordination with International Atomic Energy Agency (IAEA). PNRA has also established bilateral cooperation with regulatory bodies of China, Nigeria and Ghana to exchange technical support, knowledge and experience in areas of regulatory interest.

10.2.1 Collaboration with the IAEA

PNRA works closely with IAEA for capacity building of its staff and fulfillment of Pakistan's obligations under various international conventions on nuclear and radiation safety. PNRA provides technical experts for various IAEA activities and provides technical assistance to other Member States under auspices of IAEA. PNRA also benefits from IAEA programs on Technical Cooperation (TC) for its capacity building. The following sections give an overview of the collaboration activities with IAEA during 2023:

a) DG IAEA Visit to PNRA

Dr. Rafael Mariano Grossi, Director General IAEA visited PNRA on February 16, 2023. Chairman PNRA briefed him about the technical prowess and responsibilities of PNRA. Dr. Grossi stressed that the role of regulator is indispensable in ensuring the safe use of nuclear energy in the country. He stated that IAEA is standing shoulder to shoulder with PNRA for the safety of nuclear installations and radiation facilities in the country. Dr. Grossi encouraged PNRA to maintain a strong presence in IAEA activities including peer review missions. He also appreciated PNRA's support to Nuclear Harmonization and Standardization Initiative (NHSI) for SMRs.

Dr. Grossi visited National Institute of Safety and Security (NISAS) and also inaugurated National

Radiological Emergency Coordination Centre (NRECC) established by PNRA. Dr. Grossi expressed satisfaction on the designation of NISAS as Collaborating Centre of IAEA for Nuclear Security and acknowledged the role of NRECC in fulfilling the requirements of the Convention on Early Notification of a Nuclear Accident (CENA) and Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (CANARE). DG IAEA urged PNRA to be vigilant and ensure its readiness for upcoming challenges evolving from introduction of new technologies.

b) NISAS as IAEA Collaborating Centre on Nuclear Security

NISAS, since being declared IAEA Collaborating Centre for Nuclear Security Education, training and technical support has contributed to various nuclear security activities within its scope. The scope of Collaborating Centre includes conduct of nuclear security training courses; IAEA peer review and advisory missions; development of IAEA guidance documents; training/educational material; hosting fellowships and participation in IAEA Coordinated Research Projects (CRPs). Following are the details of activities performed by NISAS during 2023:

i. Five (05) National Training Courses (NTCs) were conducted since designation of NISAS as IAEA-CC for "Nuclear Security and Technical Support";

ii. A case study on "Nuclear Security Training" was shared with INSEN/IAEA;

iii. Marie Sklodowska-Curie Fellowship Program (MSCFP) was designed.

c) IAEA Committees, Forums and Working Groups

PNRA is a member of the Commission on Safety Standards (CSS) for finalization and approval of safety standards, guides and other regulatory documents relevant to nuclear, radiation, transport & waste safety, security and emergency preparedness & response.

PNRA is also a member of IAEA Safety Standard Committees established for development of safety standards in the areas of nuclear safety (NUSSC), emergency preparedness & response (EPReSC), radiation safety (RASSC), transport safety (TRANSSC) and waste safety (WASSC). Points of Contact (PoCs) in all five SSCs regularly participate and contribute in the proceedings of these committees and forums.

Moreover, PNRA is a member of a number of IAEA scientific and technical fora and networks. These include Global Nuclear Safety and Security Network (GNSSN), Technical Support Organization Forum (TSOF), Regulatory Cooperation Forum (RCF), National Nuclear Security Support Centre (NSSC), International Nuclear Security Education Network (INSEN), etc.

Relevant information is reported to the IAEA through fora such as Incident and Trafficking Database (ITDB), Incident Reporting System for Research Reactors (IRSRR), International Reporting System for Operating Experience (IRS), International Nuclear and Radiological Event Scale (INES), IAEA International Physical Protection Advisory Services (IPPAS) Good Practices Database, Denials Shipment of Radioactive Material etc. PNRA also contribute regularly to the CANDU Probabilistic Safety Assessment (PSA) Working Group and the International Generic Ageing Lessons Learned (IGALL) Working Groups, etc. During 2023, 34 PNRA officials participated in 34 events.

d) IAEA Missions, Consultancies and Technical Meetings

IAEA invites experts from Member States to provide support in different activities like IAEA peer review missions, development & review of technical documents and support of

41st Meeting of the Advisory Group on Nuclear Security (AdSec)

Director NSNS, IAEA Visit to PNRA for Discussing the Nuclear Security Capabilities of PNRA

Member States in their efforts for enhancing nuclear safety and security worldwide. PNRA contributes in these activities by providing its experts. During 2023, 65 PNRA officials participated in 52 such events.

e) Technical Cooperation Program and Projects

During 2023, PNRA hosted an IAEA delegation from the Technical Cooperation (TC) department to discuss the current and future TC activities related to Pakistan. The delegation comprised IAEA Project Management Officer (PMO) and technical officers. Matters related to IAEA review queries of PNRA TC project "Strengthening National Nuclear Regulatory Infrastructure and its Sustainability by Enhancing Competency of Regulatory Staff in using Emerging Knowledge and Advanced Tools/Technologies" for cycle 2024-25 were discussed in detail. The TC project "PAK9043" was approved in the IAEA Board of Governors (BoG) meeting held in November 2023.

PNRA has also benefited from IAEA projects at regional and interregional levels. In 2023, PNRA contributed to IAEA Asia and Pacific Region (RAS) projects including RAS 9096 on "Strengthening Radiation Safety Infrastructure" and RAS 0090 on "Establishing and Enhancing National Legal Frameworks" as a counterpart. During 2023, six PNRA officials participated in different workshops, training courses, etc. arranged under the TC program.

PNRA also helps other regulatory bodies of Member States with technical and scientific support under IAEA TC projects. During 2023, PNRA has hosted scientific visits (SVs) and fellowship/training program of foreign officials nominated by IAEA from various countries. During 2023, following SVs and fellowship / training of foreign officials were conducted at PNRA as per detail given below:

1) Scientific Visits

PNRA hosted a scientific visit of two Officials from Uzbekistan and two scientific visits for three officials from Iraq in the field of Governmental Regulatory Infrastructure for Nuclear Installation safety

2) Fellowship/Training

PNRA hosted a month-long fellowship of two officials from the Jordanian Energy and Minerals Regulatory Commission (EMRC), for their capacity building in 'Emergency Preparedness and Response'. Three-month fellowships of two Uzbek officials in the field of 'Governmental Regulatory Infrastructure for Nuclear Installations Safety' was also conducted at PNRA. One Iraqi official visited PNRA for one month fellowship in the field of licensing and inspection of research and other facilities.

f) Pakistan-IAEA Nuclear Security Cooperation Program

PNRA is the national focal point for coordinating with all national stakeholders and IAEA for effective implementation of the Pakistan-IAEA Nuclear Security Cooperation Program. During the reported period, PNRA coordinated with IAEA, contractors and relevant national stakeholders for execution of several projects under this cooperation program such as enhancement of Central Alarm Station (CAS) and provision of maintenance and training for Physical Protection Exterior Laboratory (PPEL); procurement of radiation detection equipment and their cyber-security evaluation as well as physical protection upgrades at KANUPP and radiation facilities of PAEC. During 2023, PNRA coordinated visit of Director, Division of Nuclear Security, IAEA to Pakistan. The objective of the visit was to discuss the implementation status of IAEA-Pakistan Nuclear Security Cooperation Program and areas of future collaboration. During the visit, the IAEA Director inaugurated the enhancement of Central Alarm Station (CAS) at PPEL.

g) International Conventions

PNRA is the national contact point for fulfilling the national obligations under the following four conventions related to nuclear safety, physical protection, and nuclear & radiological emergencies:

i. Convention on Nuclear Safety (CNS);

ii. Convention on Physical Protection of Nuclear Materials & its Amendment;

iii. Convention on Early Notification of a Nuclear Accident; and

iv. Convention on Assistance in the case of a Nuclear Accident or Radiological Emergency.

PNRA also helps the Government of Pakistan to implement the Codes of Conduct on Safety and

Security of Radioactive Sources and Safety of Research Reactors.

During 2023, Pakistan participated in the combined 8th and 9th review meeting of the Convention on Nuclear Safety at Vienna. Pakistan also participated in Technical Meeting of the Representatives of Parties to the Convention on the Physical Protection of Nuclear Material (CPPNM) and the CPPNM Amendment at IAEA, Vienna.

10.2.2 United Nations Scientific Committee on Effects of Atomic Radiation (UNSCEAR)

The UNSCEAR undertakes scientific evaluations of sources of ionizing radiation and of the associated exposures, effects and risks to human health and to the environment. Pakistan is a member of this UN forum. PNRA, as national PoC, participated in the 70th annual session of UNSCEAR held during June 2023 and contributed in the development and review of its ongoing technical evaluations.

10.2.3 Bilateral Cooperation

PNRA believes in international cooperation amongst regulatory bodies of IAEA Member States to enhance nuclear safety through exchange of technical knowledge and regulatory experiences; human resource development; etc. PNRA has instruments of bilateral cooperation agreements with regulatory bodies of China, Nigeria and Ghana.

a) China

PNRA has established bilateral cooperation agreements for capacity building of its staff with the Chinese nuclear regulatory body 'National Nuclear Safety Administration' (NNSA), its TSO 'Nuclear Safety Centre' (NSC) and 'China Nuclear Power Operations Technology Cooperation Ltd' (CNPO).

In 2004, PNRA and NNSA had established a Steering Committee for cooperation in Nuclear Safety. The Committee makes annual work plans and arrangements for the following:

- Exchange of nuclear and radiation safety information and personnel;
- Review of cooperation activities that have been conducted under the work plan in past calendar year; and

Signing of MoU between PNRA and NNSA

- Discussion on any other matter of mutual interest.

A high-level delegation led by Mr. Dong Baotong, Administrator NNSA, visited Pakistan in August 2023 to attend the 11th Steering Committee meeting which was held at PNRA HQ. During this meeting, an MoU for establishment of a joint nuclear safety cooperation centre was signed. In addition, MoUs/agreements with NSC and CNPO were revalidated for another five and ten years respectively.

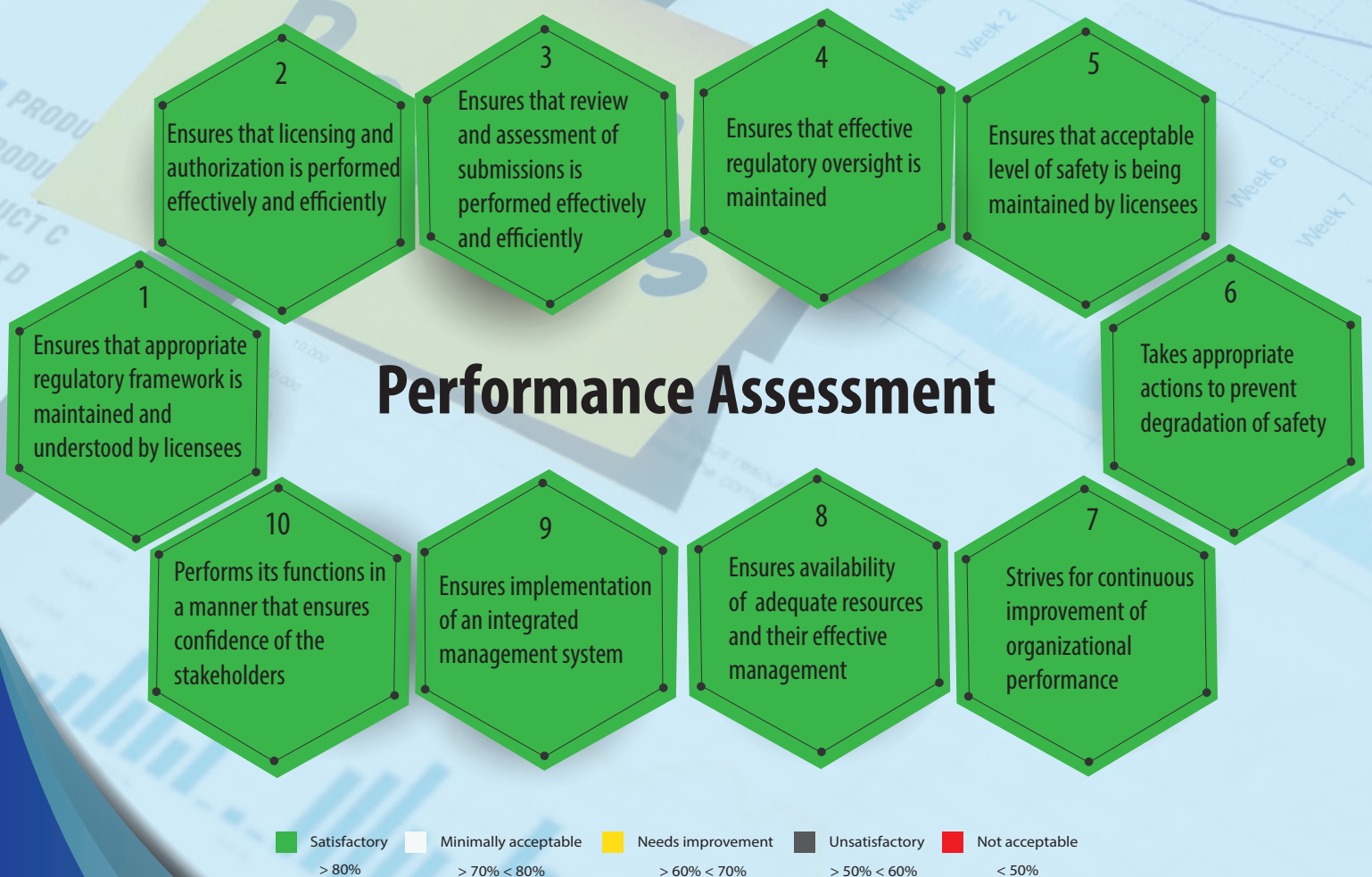
b) Nigeria

PNRA and Nigerian Nuclear Regulatory Authority (NNRA) signed an MoU for capacity building of the regulatory staff of NNRA, provision of support in the development of regulatory framework and experience sharing etc., in 2019 for a period of three years. Currently, this MoU is in the process of revalidation through IAEA TC Department as the current MOU expired in 2022.

10.2.5 Visit of Foreign Diplomats to PNRA

Diplomats from a number of countries visited PNRA in 2023 to obtain an insight on mechanisms in place for regulation of nuclear safety and security in Pakistan. During the visit, the diplomats were briefed about PNRA and its functions. The dignitaries visited the National Radiation Emergency Coordination Centre (NRECC) of PNRA and they commended the state of the art emergency centre and praised PNRA on its capability of preparedness, coordination and response arrangements in emergency situations. The delegation of foreign diplomats also visited the National Institute of Safety and Security (NISAS), an IAEA collaborating centre for nuclear security. The delegation admired the training facilities maintained at NISAS. The delegation also praised the effective nuclear regulatory mechanism and infrastructure for nuclear safety and security in Pakistan.

11 Performance Monitoring and Assessment



PNRA is committed to implement a robust monitoring and assessment process for measuring its regulatory efficacy. The monitoring and assessment process developed by PNRA comprises a diverse set of mechanisms e.g. progress monitoring, self-assessment, independent assessment, assessment based on strategic performance indicators, etc.

The detail of various monitoring and assessment activities performed during 2023 is described in the subsequent sections of this chapter.

11.1 Monitoring and Assessment

11.1.1 Progress Monitoring

PNRA develops and implements strategic plan at organizational level. The strategic plan outlines goals, strategies and downstream activities to be focused during a particular duration to meet the goals. It also assigns responsibilities to relevant departments to execute various tasks for achieving the overall organizational goals. The progress on PNRA strategic plan is monitored on bi-annual basis and progress monitoring reports are issued accordingly.

In addition, each department develops its own annual work plan and reports its progress in monthly progress reports. Further, the progress of annual work plans is also assessed independently on quarterly basis and accordingly Quarterly Performance Evaluation Reports (QPERs) are issued.

During the reported period, PNRA issued two progress monitoring reports on PNRA Strategic Plan 2019-2023 and four QPERs. These reports highlighted progress on implementation of plans and areas for further improvement for taking necessary actions as deemed necessary.

11.1.2 Self-Assessments

PNRA conducts different types of self-assessments across the organization in accordance with the frequency defined in PNRA Management System Manual (MSM). These include self-assessments conducted at departmental level and at organizational level such as self-assessment using IAEA tool “Self-Assessment of Regulatory Infrastructure for Safety (SARIS)”, performance assessment against Strategic Performance Indicators (SPIs) and Safety Culture Self-Assessment (SCSA), etc.

During 2023, a number of PNRA departments performed their self-assessment and identified areas for further improvement in their processes and practices. Accordingly, corrective action plans were developed that aimed continuous improvement of their performances, efficiency, and overall effectiveness.

At organizational level, PNRA completed its self-assessment using IAEA SARIS tool. During the reported period, analysis phase of the self-assessment was performed and SWOT (Strength, Weakness, Opportunity and Threat) analysis was conducted. Subsequently, a detailed report highlighting the outcome of self-assessment was issued. Furthermore, PNRA also completed its second Safety Culture Self-Assessment during this year. The descriptive and the normative analyses were performed in line with the IAEA methodology and the areas requiring cultural improvements were identified. A detailed report highlighting the results of second SCSA was issued and shared within the organization.

PNRA also conducted its annual performance assessment based on SPIs for the year 2023. The details of this assessment are presented in the forthcoming sections.

11.1.3 Independent-Assessments

PNRA engages in independent assessments by hosting international peer review missions such as IAEA’s International Regulatory Review Service (IRRS) Mission and by undergoing a regulatory audit conducted by independent teams.

During 2023, PNRA conducted 5th regulatory audit of its corporate wing’s departments to assess and monitor the implementation of PNRA Management System, processes/ procedures and plans that were developed against the assigned "Tasks and Functions". The audit recommendations highlighting areas of improvement were shared with each department in the form of audit reports. Accordingly, the departments prepared corrective action plans in the light of audit recommendations and initiated implementation for further improvements. In addition, the overarching organizational level issues were identified and shared with the Top Management in the form of integrated audit report for their consideration.

11.2 Annual Performance Evaluation

PNRA has established its Strategic Performance Indicators (SPIs) comprising 10 SPIs supported by 23 downstream Performance Elements (PEs). Each year, PNRA assesses its performance using these SPIs and PEs. The evaluation is done using a five-level rating scale: satisfactory, minimally acceptable, needs improvement, unsatisfactory and not acceptable. The assessment for the current year against each indicator is detailed below:

Performance Indicator 1 - "Ensures that appropriate regulatory framework is maintained and understood by licensees"

This performance indicator is assessed by evaluating the availability, accessibility and understanding of relevant regulations and Regulatory Guides (RGs) by licensees.

PNRA's current regulatory framework comprehensively covers all regulated areas. The development of new regulations, RGs and updating the existing ones is a necessity, owing to experience feedback, continuous advancement of technologies, emergence of new applications and improvements in international standards. Accordingly, PNRA identifies and plans development and revision of regulations and RGs in strategic plans and departmental level annual work plans. During 2023, PNRA developed three regulations (two new and one revised). Also the development of three new regulations remained in progress. Further revision of eight existing regulations remained in progress. In addition, two new RGs were issued, and revision of existing eight RGs remained in progress. Moreover, PNRA Strategic Plan for 2024-2028 included the development of some more regulatory guides to facilitate the licensees in various activities.

PNRA is also committed to enhance its licensees' comprehension and perception about the regulatory framework through various means. This includes conducting targeted training courses on regulations and regulatory guides (RGs), as well as responding to licensees' queries through formal correspondence and during scheduled meetings. During the reported period, PNRA conducted four training courses on various regulations/RGs for its licensees to enhance their understanding about the regulatory framework of PNRA. A total of 120 participants benefitted from these training courses. In addition, a number of queries raised by different licensees during formal meeting, inspections and through formal correspondences were effectively addressed throughout the year.

During the assessment, it was also noted that the review/revision of two regulations and three RGs was overdue. In addition, it was noted that progress on development/revision of few regulations and RGs were behind the schedule.

Presenting the Results of 2nd Safety Culture Self Assessment to PNRA Management

Foregoing in view, the performance of PNRA against this indicator is rated as "Satisfactory" for the year 2023.

Performance Indicator 2 - "Ensures that licensing and authorization is performed effectively and efficiently"

This indicator is evaluated on the basis of availability of well-documented processes to execute licensing and authorization activities for all existing practices according to plans, identification and proactive planning for development of new processes in emerging areas, ensuring internal stakeholders have access and have clear understanding of relevant processes.

A number of processes are in place which are adequate to perform licensing and authorization of all existing practices. However, the need to further improve these processes or to develop new ones may arise on the basis of experience feedback and initiation of new activities in the country.

PNRA maintains all these processes/procedures in the central registry that is accessible to all internal stakeholders. PNRA periodically gauges the understanding of relevant internal stakeholders about these processes during regulatory audits. Furthermore, PNRA develops specific work plans to carry out all the licensing and authorization activities.

During the year 2023, PNRA granted operating license to K-3, registered site for the construction of NICE as disposal facility and granted permission for criticality to K-3, C-2, C-3 and C-4 following successful completion of RFOs. PNRA also conducted licensing examination of operating personnel of nuclear power plants and research reactors and issued nine new licenses and renewed 194 licenses of operating personnel.

Furthermore, PNRA granted operating license to PINSTECH for manufacturing of SRS of category–IV and below, enhancement in scope of authorization of NCNDT to Perform PSI/ISI as per RSEM-2010 and renewed license of DESTO as a manufacturer of X-ray baggage scanners.

In addition, PNRA registered 603 new radiation facilities this year. PNRA also issued 2071 NOCs for the import/export, 62 permits for procurement and 33 disposal authorizations during the reported period.

During the assessment of the progress for the year 2023, it was noted that most of the licensing and authorization activities performed by PNRA were executed according to plans. However, some of licensing/authorization activities such as permission for commissioning of PARR-3, design approval certification of SC-21 & TC-21 fuel casks and type AF package and site registration of FFP could not be completed as per plan due to delays on part of the licensees.

Keeping in view the above efforts, PNRA performance against this indicator is rated as “Satisfactory” for the year 2023.

Performance Indicator 3 - "Ensures that review and assessment of submissions is performed effectively and efficiently"

PNRA evaluates this indicator on the basis of availability of established processes to execute review and assessment activities for all existing practices according to plans, identification and proactive planning for development of new processes/procedures in emerging areas and ensuring that internal stakeholders have clear understanding of relevant processes/ procedures.

PNRA has already developed processes to perform review and assessment of licensing submissions related to all existing practices. These processes are periodically reviewed on the basis of feedback and maintained in the central registry which is accessible to all internal stakeholders. Understanding of relevant internal stakeholders about these processes is gauged periodically during regulatory audits.

During 2023, PNRA completed review of site evaluation report of near surface disposal facility (NICE). The review of applications for site registration of Fuel Fabrication Plants (FFP) and Indigenous Fuel Fabrication Facility (IFFF) remained in progress. Furthermore, PNRA performed review and assessment of more than 250 submissions from licensees of nuclear installations.

Additionally, submissions from ICCC and NCNDT regarding scope enhancement, renewal of DESTO's license as manufacturer of X-ray scanner and NEW-1 for acquiring license

for manufacturing of safety class-3 equipment were reviewed. Numerous quality plans from different licensees were also examined during the reporting period.

PNRA also performed review and assessment of a number of submissions related to various radiation facilities. These include Safety Analysis Reports (SARs), Radiation Protection Programs (RPPs), Physical Protection Plans (PPPs) and shielding calculations, etc. During the assessment, it was noted that review and assessment activities were executed as per plans.

Keeping in view the above activities, PNRA performance against this indicator is rated as “Satisfactory” for the year 2023.

Performance Indicator 4 - "Ensures that effective regulatory oversight is being maintained"

This performance indicator is assessed on the basis of development and execution of inspection plans and initiating enforcement and legal actions against violators in accordance with PNRA enforcement regulations.

PNRA has developed an inspection program that employs a graded approach for the regulatory oversight of nuclear installations, radiation facilities, and associated activities. Under this program, distinct inspection plans covering all jurisdictions are prepared and inspections are conducted accordingly.

During 2023, PNRA carried out a total of 4488 regulatory inspections of nuclear installations, radiation facilities, equipment manufacturers, designers and service providers, etc. as planned to verify compliance with regulatory requirements. In addition, PNRA also witnessed 49 emergency exercises/drills at nuclear installations and radiation facilities to ensure the effectiveness of radiation emergency plans. The findings/directives were shared with the licensees for compliance.

PNRA has established an internal process outlining various enforcement actions, including the issuance of directives, show cause notices, work stoppage, offense reports, lock and seal of the facility, conduct of hearings and initiation of legal proceedings in the court of law. Accordingly, PNRA undertakes necessary enforcement actions against violators in case of non-compliance with regulatory requirements.

During 2023, PNRA identified various non-compliances of regulatory requirements made by licensees. Accordingly, PNRA issued 51 show cause notices, three offense reports and 231 final directives to the violators. In addition, PNRA conducted 18 hearings. PNRA also locked and sealed 18 facilities which were de-sealed after necessary hearing process and compliance of regulatory requirements during the reported year. Furthermore PNRA took five enforcement actions on non-compliances of nuclear installations.

During the assessment, it was noted that PNRA carried out inspections in all areas however, the inspection program for the regulatory oversight of nuclear installations, radiation facilities, and associated activities should also include regulatory oversight for designers and service providers.

Keeping in view the above activities, PNRA performance against this indicator is rated as “Satisfactory” for the year 2023.

Performance Indicator 5 - "Ensures that acceptable level of safety is being maintained by licensees"

Performance assessment for this indicator is made against evaluation and trends of occupational exposures and radiation dose levels of radiation workers, ambient radiation levels around NPPs, environmental monitoring results, non-conformances made by licensees, events at nuclear installations and radiation facilities and their reporting. Furthermore, issues highlighted during licensee peer reviews/self-assessments are also considered.

During 2023, PNRA performed trend analysis of occupational exposure and ambient radiation level around C-series NPPs. The trend analysis reveals that occupational exposure at C-series plants is well within regulatory limits. The trends of ambient radiation level remained in the same range for the last five years. Further, the trends of environmental monitoring results around NPPs and RRs showed no significant deviation over the period 2018-2022.

In addition, no critical non-conformance was issued by licensee during the reported period.

Further, PNRA ensures that the issues identified by QA departments of licensees during normal operation and RFOs are adequately resolved by their management. All the reportable events were timely submitted by licensees during 2023. PNRA also issued a report highlighting the trend of safety system failures, trips, over exposures, releases higher than regulatory limits, etc., for NPPs for the duration 2018-2022.

Considering the above evaluation, PNRA performance against this indicator is rated as " Satisfactory" for the year 2023.

Performance Indicator 6 - "Takes appropriate actions to prevent degradation of safety"

The assessment against this indicator is made on the basis of identification of signs of degradation in safety by considering the trending of integrated safety assessment of NIs, assessment of radiation facilities against PO&Cs and evaluation of inspection reports. In addition, timely implementation of modifications to maintain and enhance safety in these facilities is also considered to evaluate this indicator.

PNRA has established processes for determining safety performance of operating nuclear power plants to verify compliance with the regulatory requirements and to assess the trend of operational safety and integrated safety assessment. Accordingly, PNRA issued an integrated safety assessment (ISA) report that highlighted performance of NPPs as satisfactory. PNRA also issued a report on operational safety trend assessment for C-series NPPs that showed an overall improving trend in their performance. Moreover, PNRA approved 99 modifications related to design, FSAR and Technical Specifications (TS) to enhance the plant safety and performance.

PNRA also performs periodic safety assessment of radiation facilities against pre-defined PO&Cs. During the reporting period, decreasing trend was observed in issues identified in assessment of radiation facilities. In addition, PNRA evaluated a number of inspection reports of nuclear installations and radiation facilities at Headquarters level and provided feedback to its regional departments for further improvement in inspection methodology. Accordingly, feedback was provided to regional departments and inspectorates for further improvement in the inspection process.

Considering the above evaluation, PNRA performance against this indicator is rated as "Satisfactory" for the year 2023.

Performance Indicator 7 - "Strives for continuous improvement of organizational performance"

The performance assessment against this indicator is based on performance monitoring, conduct of self-assessment, utilization of international operating experience feedback and conduct of internal audits and peer reviews.

PNRA develops Strategic Plan for defining its organizational goals to meet the vision, mission and objectives of the organization. Under PNRA management system, each department defines its annual work plan along with target dates. These work plans also include relevant tasks from the strategic plan, task and functions and other routine activities. PNRA employs diverse mechanisms to monitor and assess these activities.

PNRA conducted periodic monitoring of PNRA strategic plan for 2019-23 and issued two progress reports in 2023. Further, quarterly performance evaluations were conducted for all departments, resulting in the issuance of four reports. These reports highlighted the implementation progress of annual work plans. Additionally, PNRA also monitored the progress of implementation of recommendations and suggestions of IRRS follow-up mission and accordingly issued the report to reflect the progress against IRRS follow-up action plan.

PNRA also conducts various self-assessments to assess and evaluate its performance. This includes assessment conducted using IAEA SARIS tool, department level self-assessment and safety culture self-assessment. During 2023, PNRA completed the organization level self-assessment utilizing IAEA SARIS tool and second Safety Culture Self-Assessment (SCSA-2). The outcomes of both activities highlighted potential areas for further improvement in the organization. These outcomes were documented and shared with the Top and Senior management for consideration. PNRA also conducted 5th regulatory audit of its corporate wing directorates and highlighted

the recommendations for improvement of respective directorates. In addition, a number of PNRA departments carried out self-assessment as per defined frequency.

Furthermore, PNRA utilizes international operating experience feedback by identifying improvement in practices of nuclear installation, radiation facilities and associated activities. During 2023, PNRA evaluated several international events and accordingly issued two reports that highlighted recommendations for further improvement in practice.

All these above activities served as a drive for continuous improvement of organizational performance. Based on the evaluation of this indicator, PNRA performance in this area is rated as "Satisfactory" for the year 2023.

Performance Indicator 8 - "Ensure availability of adequate resources and their effective management"

This performance indicator is assessed on the basis of availability of adequate resources such as competent human resources, technical & knowledge resources, financial resources and their effective and efficient utilization in the organization.

PNRA ensures that adequate manpower is available to perform its activities. Accordingly, PNRA has determined the estimates of required staff for various PNRA departments till 2030. During 2023, two fellows joined PNRA after successful completion of MS programs at PIEAS. To ensure sustainability of knowledge resources, re-skilling of the existing workforce continued in 2023 with around 35 rotations of technical officers for assignment of new job responsibilities and new technical domains.

To develop capacity of PNRA officials in desired areas, PNRA has developed a competence development program comprising various mechanisms such as in-house training and trainings & attachments at national and international level. During the reporting year, PNRA conducted 22 in-house training courses in which a total of 588 professionals participated. Furthermore, 179 PNRA personnel participated and benefited from 63 training opportunities arranged at various national institutes. Also, 50 PNRA officials in-person participated in 42 capacity building events internationally while 12 PNRA officials virtually participated in seven such events.

PNRA continued its efforts to acquire adequate financial resources. The annual budget provided by the Federal Government was effectively utilized to achieve the set targets. Throughout the year, all regulatory functions and planned activities received sufficient resources and were executed effectively. PNRA also continued execution of planned activities of two PSDP projects for further strengthening the infrastructure of PNRA. In addition, one PSDP project i.e., upgradation of NRECC was successfully completed during the reporting period.

Based on the evaluation of this indicator, PNRA performance in this area is rated as "Satisfactory" for the year 2023.

Performance Indicator 9 – "Ensures implementation of an Integrated Management System"

PNRA assesses this performance indicator on the basis of availability of updated Management System, monitoring and implementation of requirements of Management System; identification and development of policies/ programs/processes/procedures as per plan; and availability of periodic review of management system documentation.

During 2023, the process for revision of PNRA Management System Manual was completed and the revised draft of MSM (Rev. 2) was submitted to Top Management for approval. PNRA identified, planned and developed two new organizational policies and four new procedures. In addition, two existing policies and two procedures were revised to align with organizational best practices.

Foregoing in view, the performance of PNRA against this indicator is rated as "Satisfactory" for the year 2023.

Performance Indicator 10 – "Performs its functions in a manner that ensures confidence of the stakeholders"

This performance indicator is assessed on the basis of confidence-building measures taken by PNRA for its stakeholders. These include engagement of licensees in the development process of regulatory framework and acquiring

feedback for improvement; building public trust through information sharing, executing public awareness programs and involvement in regulatory framework development; and building Government trust by providing necessary support for fulfillment of national and international obligations.

During 2023, PNRA shared two regulations with stakeholders by uploading them on PNRA website for seeking input from licensees, public and the interested parties. To facilitate the public, Regulations for the Licensing of Radiation Facility(ies) other than Nuclear Installation(s) - (PAK/908) was translated in Urdu and uploaded on PNRA website. Further, PNRA held twenty-three coordination meetings with different licensees from nuclear installations and radiation facilities. PNRA also organized 30 public awareness seminars across the country. More than 4400 participants attended these seminars.

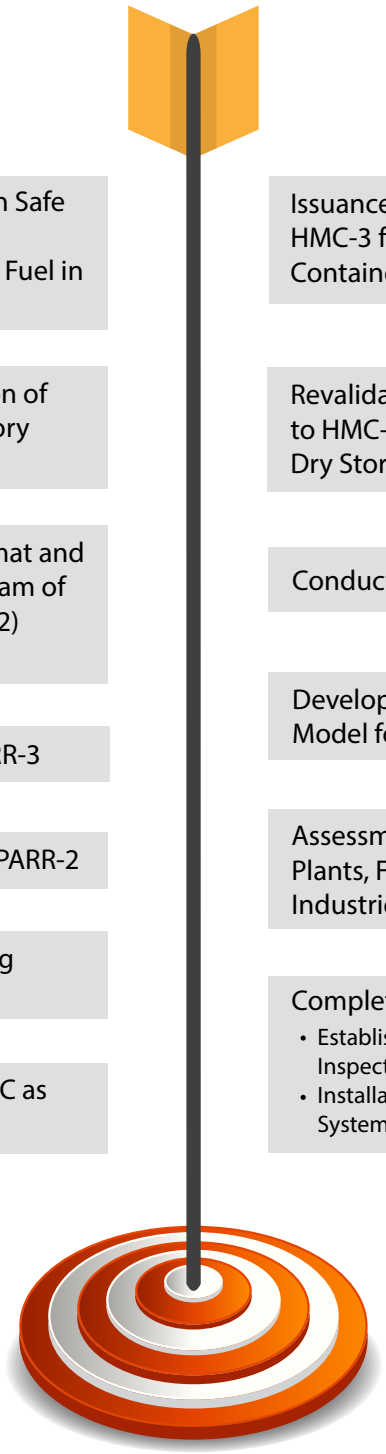
In addition, on behalf of the Government of Pakistan, PNRA participated in the combined 8th and 9th review meeting of the Convention on Nuclear Safety and in Technical Meeting of the Representatives of Parties to the Convention on the Physical Protection of Nuclear Material (CPPNM) and the CPPNM Amendment. PNRA also deployed handheld radiation detection equipment at Karachi Seaport Container Terminal (KICT) for strengthening the secondary inspection of the containerized cargo alarmed during passage from Radiation Portal Monitors (RPMs).

Further, to enhance coordination for regulatory oversight, PNRA conducted meetings with provincial health care authorities, health departments and law enforcement agencies. PNRA also held meetings with the PDMA and DDMA to sensitize them about security of radioactive material and integrated response to nuclear security events.

Keeping in view the above activities, PNRA performance against this indicator is rated as “Satisfactory” for the year 2023.

Conduct of 5th Internal Audit of PNRA Departments

PNRA TARGETS FOR THE YEAR 2024



- Issuance of Revised National Policy on Safe Management of Radioactive Waste, Decommissioning and Spent Nuclear Fuel in Islamic Republic of Pakistan
- Issuance of Regulations on Transaction of Business of Pakistan Nuclear Regulatory Authority - (PAK/901) (Rev.1)
- Issuance of Regulatory Guide on Format and Contents of Physical Protection Program of Nuclear Installations (PNRA-RG-909.02) (Rev.1)
- Permission for Commissioning of PARR-3
- Revalidation of Operating License of PARR-2
- Issuance of Design and Manufacturing License to NEW-1
- Licensing of Organizations under PAEC as NDE Service Providers
- Issuance of Design Approval Certificate to HMC-3 for Pakistan New Fuel Assembly Container (PNAFC)
- Revalidation of Design Approval Certificate to HMC-3 for KANUPP Spent Nuclear Fuel Dry Storage Cask (SC-108)
- Conduct of Security Culture Self-Assessment
- Development of Regulator's Level-2 PSA Model for C-1
- Assessment of NORM at Coal Fired Power Plants, Fertilizer and Other Potential Industries
- Completion of Two PSDP Projects:
  - Establishment of Regional Nuclear Safety Inspectorate at Lahore
  - Installation of 80KW Solar Power Generation System at PNRA HQs Buildings

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