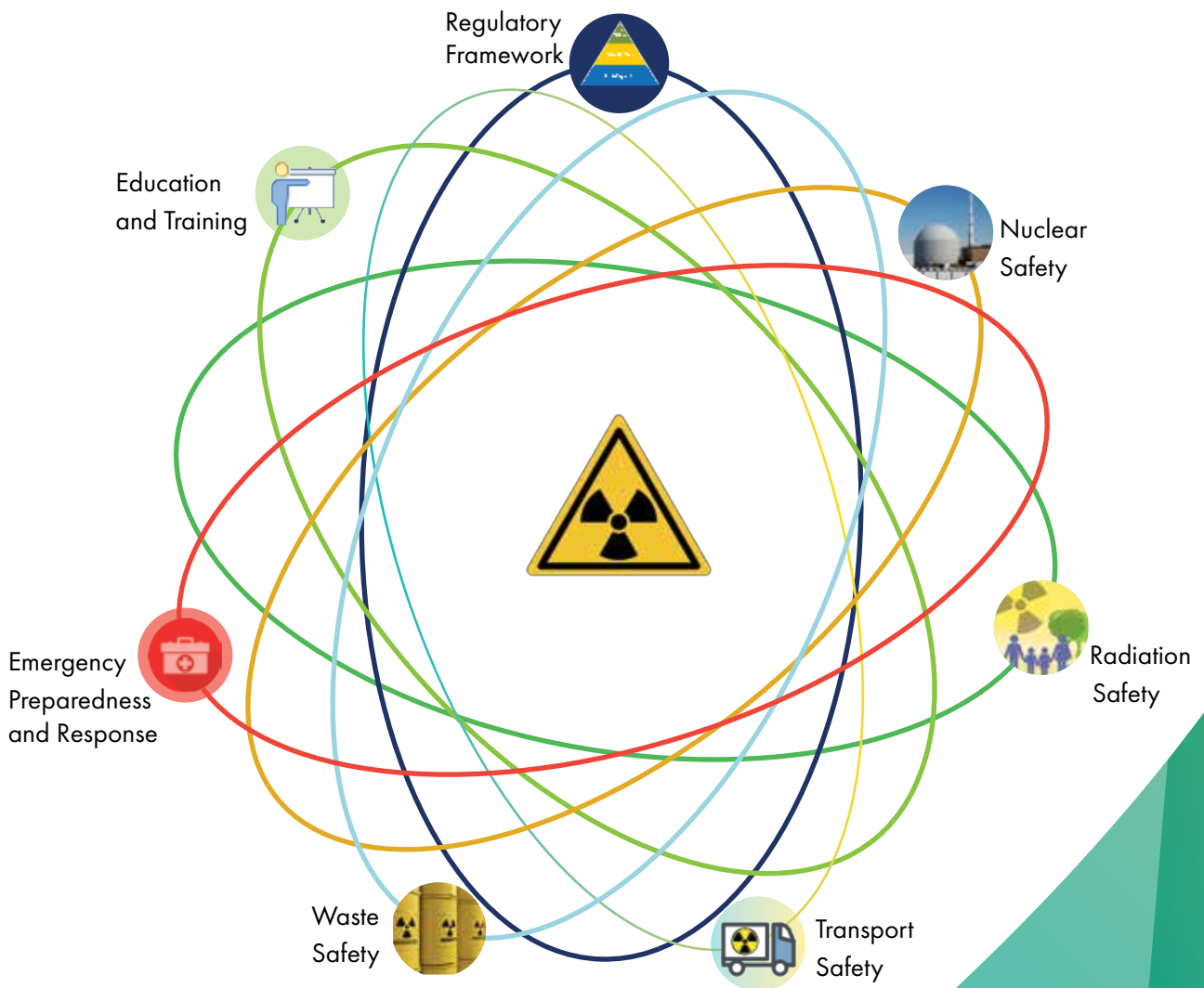


ANNUAL REPORT

2019



MEMBERS OF THE AUTHORITY



Mr. Zaheer Ayub Baig, HI
Chairman



Mr. Mohammad Saleem Zafar
Member Corporate



Mr. Faizan Mansoor
Member Executive



Lt. Gen. Sarfraz Sattar, HI(M)
Part-time Member



Dr. Muhammad Aslam
Part-time Member



Prof. Dr. Tariq Mahmood
Part-time Member



Mr. Saeed-ur-Rehman
Part-time Member



Ms. Farzana Altaf
Part-time Member



Dr. Rana Muhammad Safdar
Part-time Member

VISION, MISSION & CORE VALUES

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.



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

PNRA employees work in an atmosphere of openness and trust. They observe the following core values while continuously assessing the quality of their work and directing their efforts towards excellence in performance:

- > Integrity
- > Transparency
- > Independence in Decision Making
- > Competence and Professionalism
- > Mutual Respect
- > Caring and Compassionate Attitude



CHAIRMAN'S MESSAGE

Zaheer Ayub Baig, HI



I am delighted to share the progress and achievements made by PNRA during 2019. With the grace of Allah Almighty, PNRA has been able to take considerable steps towards achieving its mission of protecting the radiation workers, the general public and the environment from harmful effects of ionizing radiation.

My team has always been striving to raise itself up to the highest professional standards, take every step to broaden the regulatory outreach, tackle complex challenges and deliver optimum services. PNRA continued its efforts in optimizing the use of human, financial and administrative resources for ensuring a sustainable nuclear regulatory regime in the country.

Sound regulatory decision making depends on availability of a comprehensive regulatory framework, effective enforcement regime and experienced regulatory professionals. Gazette notification of new Regulations on Physical Protection of Nuclear Material and Nuclear Installations and the Regulations on Dispute Resolution is a landmark of the year. In addition,

revision of four regulations by incorporating the regulatory experience feedback has strengthened the regulatory regime. Issuance of six regulatory guides will also help the licensees in fulfilling regulatory requirements in technical areas. PNRA finalized and issued its 3rd Strategic Plan for the years 2019-2023. We have launched an online No Objection Certificate (NOC) verification system for Pakistan Customs. This will facilitate concerned officials to verify NOCs issued for import/export of Radiation Sources in real time.

Constantly evolving safety requirements and scientific research pose additional challenge to the regulatory body in licensing and oversight of nuclear installations and radiation facilities. Nevertheless, we made appreciable strides in carrying out rigorous inspections of facilities, with focus on ports, scrap yards, junk yards and transport activities of radioactive material.

Although, assessment of safety culture of an organization is a new subject for many regulatory bodies, however, I am pleased that PNRA has successfully performed safety culture inspections at a nuclear power plant. We extended operating licence of K-1 till May 2020 and expanded the licensing net of radiation facilities to more than 5900 facilities. PNRA, under the Convention on Nuclear Safety, submitted Pakistan's 8th National Report to IAEA.

PNRA is now being recognized worldwide as a competent regulator because of its performance. PNRA signed MoU with Nigerian Nuclear Regulatory Authority (NNRA) in 2019 under the Technical Cooperation Programme of IAEA for capacity building of NNRA regulatory staff.

I am grateful to my hardworking and competent team for achieving the goals set in 2019. I would also like to thank the Authority Members for supporting PNRA. I believe that PNRA senior management will successfully oversee the execution of our new Strategic Plan and continue to elevate PNRA to sky heights of achievements in 2020. It has been my honour to lead PNRA through a challenging and inspiring year. We are proud of our progress and are firm in our resolve to continue gaining the confidence of the general public.

ACHIEVEMENTS OF 2019



- > Issued Regulations on Physical Protection of Nuclear Material(s) and Nuclear Installation(s);
- > Issued Regulations on Dispute Resolution;
- > Revised Regulations for the Licensing of Radiation Facility(ies) other than Nuclear Installation(s);
- > Revised Regulations on the Safety of Nuclear Power Plant Design;
- > Revised Regulations on Radioactive Waste Management;
- > Amended Regulations on Radiation Protection;
- > Issued Six Regulatory Guides for Nuclear Installations and Radiation Facilities;
- > Approved the Revised Final Safety Analysis Report (FSAR) of Pakistan Research Reactor 1;
- > Extended the Operating Licence of Karachi Nuclear Power Plant Unit 1 till May 2020;
- > Granted Permission for Commissioning of Karachi Nuclear Power Plant Unit 2 and 3;
- > Granted Design Approval Certificate of Spent Nuclear Fuel Dry Storage Cask for K-1 Site;
- > Granted 29 New Licences and Renewed 158 Licences of Operating Personnel of Nuclear Installations;
- > Awarded Construction Licence to Chashma Nuclear Power Generating Station PWR Dry Storage Facility;
- > Expanded the Licensing Net of Radiation Facilities to more than 5900;
- > Conducted more than 1700 Inspections at Nuclear Installations and 3100 Inspections at Radiation Facilities;
- > Established Background Radioactivity Level across the Country due to Natural as well as Man-Made Sources;
- > Conducted Safety Assessment of Medical and Industrial Radiation Facilities based on Performance Objectives and Criteria;
- > Signed MoU with Nigerian Nuclear Regulatory Authority under Auspices of IAEA for Capacity Building of NNRA Regulatory Staff;
- > Continued Successful Implementation of IAEA TC Project PAK/2007 Activities;
- > Finalized and Issued PNRA Strategic Plan 2019-23;
- > Finalized and Uploaded the 8th National Report under Convention on Nuclear Safety on IAEA Secure Website; and
- > Approval for Establishment of PNRA Inspectorates in Gilgit and Muzaffarabad by the Respective Governments.

1	PNRA at a Glance	02
2	Legislative and Regulatory Framework	06
	2.1 PNRA Ordinance.....	07
	2.2 Regulations.....	07
	2.3 Regulatory Guides.....	09
3	Licensing and Authorization	10
	3.1 Nuclear Installations.....	11
	3.2 Licensing of Operating Personnel of Nuclear Installations	13
	3.3 Management of Spent Nuclear Fuel.....	13
	3.4 Equipment Manufacturers and Service Providers.....	14
	3.5 Radiation Facilities	14
	3.6 Permits and NOCs	15
4	Review and Assessment	16
	4.1 Review of Nuclear Installations' Submissions.....	17
	4.2 Review of Equipment Manufacturers' and Service Providers' Submissions	18
	4.3 Review of Radiation Facilities' Submissions	18
	4.4 Safety Assessment of Radiation Facilities	19
5	Inspection and Enforcement.....	20
	5.1 Inspections of Nuclear Installations	21
	5.2 Inspections of Equipment Manufacturers and Service Providers	22
	5.3 Inspections of Radiation Facilities	22
	5.4 Enforcement Activities.....	23
6	Radiation Protection and Radioactive Waste Management	24
	6.1 Radiation Protection of Workers.....	25
	6.2 Environmental Monitoring	27
	6.3 Management of Radioactive Waste.....	28
7	Emergency Preparedness and Response	30
	7.1 Emergency Preparedness and Response Arrangements.....	31
	7.2 National Radiation Emergency Coordination Centre (NRECC).....	32
	7.3 Sharing of Information about Events Involving Ionizing Radiation	33
8	Capacity Building	34
	8.1 Competence Development of Regulatory Officials.....	35
	8.2 Public Sector Development Programme (PSDP) Projects	39
9	Collaboration with National and International Organizations.....	42
	9.1 Collaboration at National Level	43
	9.2 Collaboration at International Level.....	45
10	Performance Review.....	50
	10.1 Progress Monitoring.....	51
	10.2 Self Assessment	51
	10.3 Independent Assessment	51
	10.4 Performance Indicators-2019	51
	10.5 Overall Performance	55

1. PNRA AT A GLANCE

Regulatory Functions

Regulatory Framework

Licensing

Authorization

Review & Assessment

Inspection

Enforcement

Regulatory Domains

Nuclear Safety

Radiation Protection

Emergency Preparedness

Transport and Waste Safety

Physical Protection

Civil Liability



Pakistan Nuclear Regulatory Authority (PNRA) was established as a national nuclear regulatory body with the promulgation of PNRA Ordinance on January 22, 2001. Under the Ordinance, PNRA is empowered to regulate nuclear installations, radiation facilities and associated activities in the country for ensuring protection of the workers, the public and the environment from harmful effects of ionizing radiation.

The Ordinance entrusts PNRA to establish and implement regulations, grant licences and perform inspections of all types of facilities and activities under its regulatory domain to ensure compliance with these requirements.

The Ordinance also mandates PNRA to take enforcement actions in case of violation of the regulatory requirements. In order to grant authorizations and licences, PNRA performs review and assessment of licensing submissions of the applicant to verify compliance of regulatory requirements.

PNRA also ensures that appropriate physical protection and emergency preparedness and response measures are taken by the licensees to cater for potential threats and consequences of incidents.

Further, PNRA is also responsible to fix the extent of civil liability for nuclear damage resulting from nuclear incidents.

The Authority comprises a Chairman, two full-time Members and seven part-time Members representing various national stakeholders. In order to effectively carry out assigned responsibilities, PNRA has established a number of organizational units which are assigned different regulatory functions. The Headquarters of the Authority is in Islamabad while its regional offices are located in different cities across the country.

Figure-1 reflects the locations of PNRA offices and Figure-2 shows the current organizational structure of PNRA.

The regulatory ambit of PNRA includes nuclear power plants, research reactors, Molybdenum producers, equipment manufacturers, service providers, medical and industrial radiation facilities, educational and research organizations and associated activities.

At present, PNRA regulates seven Nuclear Power Plants (NPPs) out of which five NPPs are operational while two are under construction phase.

Furthermore, two research reactors are operational in the country. A Molybdenum Production Facility (MPF) is also operational in



Members of the Authority at 56th meeting of the Authority held at PNRA HQs



the country since 2013.

Currently, two Nuclear Safety Class-1 (NSC-1) equipment manufacturers are licensed while licensing process of third NSC-1 equipment manufacturer is in progress. Moreover, National Centre for Non-Destructive Testing (NCNDT) is authorized to provide non-destructive

examination services to nuclear installations.

Currently, there are more than 5900 radiation facilities in the regulatory ambit of PNRA.

These include 5170 diagnostic X-ray facilities, 88 medical facilities, 214 industrial facilities, 84 educational and research institutes, 144 importers and 203 other facilities.

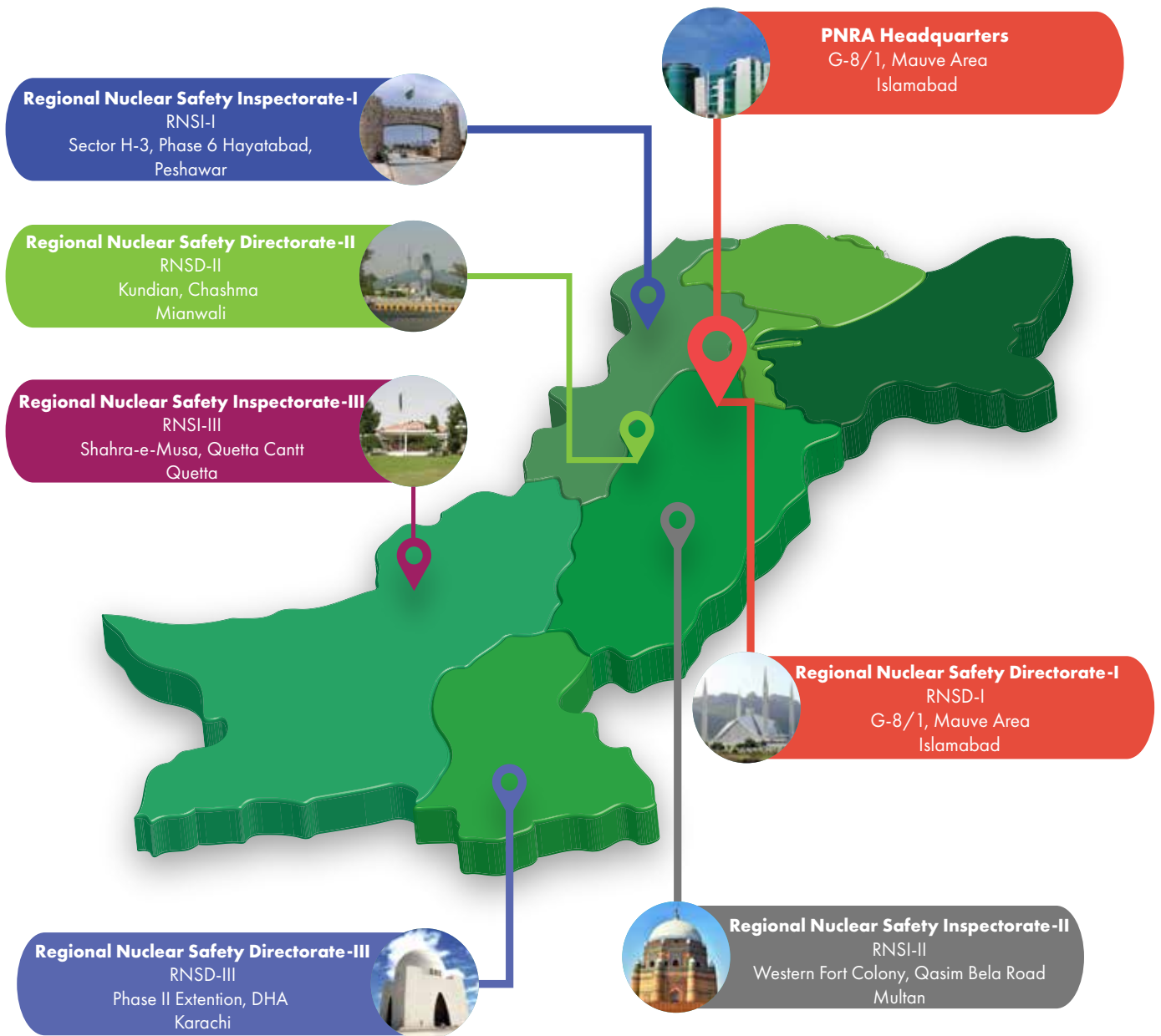


Figure-1: Location of PNRA offices

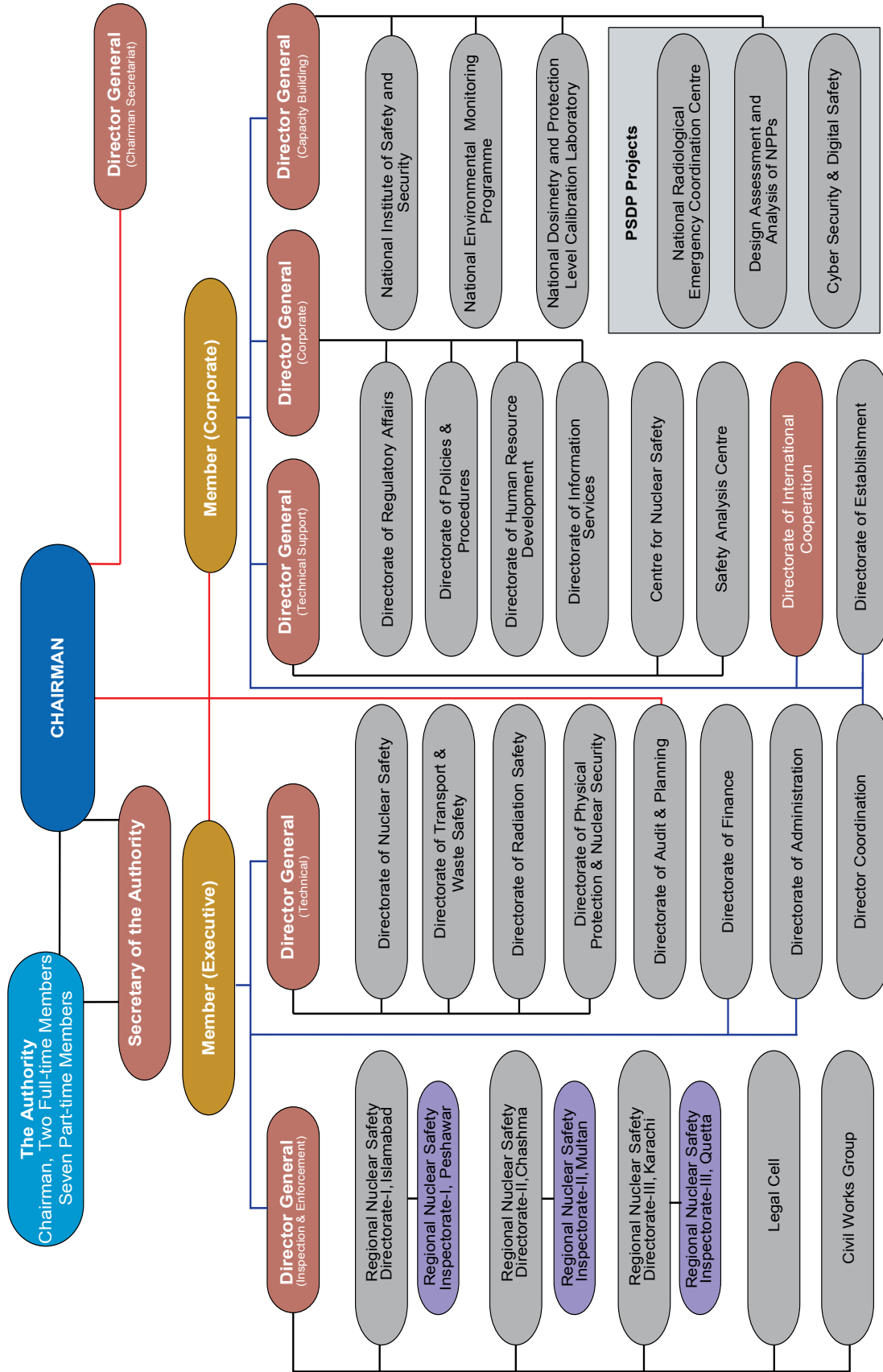


Figure-2: Organizational structure of PNRA

2. LEGISLATIVE AND REGULATORY FRAMEWORK



2019

The infographic for 2019 Regulations features a blue circular graphic on the left with the year '2019' in white. To its right is a blue arrow pointing right, containing the word 'Regulations' in white. Below the arrow is a white box with a blue border containing the text: 'Issued: 06', 'Under Revision: 06', and 'Under Development: 03'.

Regulations

Issued: 06
Under Revision: 06
Under Development: 03



2019

The infographic for 2019 Regulatory Guides features a yellow circular graphic on the left with the year '2019' in white. To its right is an orange arrow pointing right, containing the words 'Regulatory Guides' in white. Below the arrow is a white box with an orange border containing the text: 'Issued: 06' and 'Under Development: 03'.

Regulatory Guides

Issued: 06
Under Development: 03



Legislative and regulatory framework provides basis for effective regulatory control on nuclear installations, radiation facilities and associated activities within the country. In Pakistan, application of nuclear energy and use of ionizing radiation is governed through PNRA Ordinance and regulatory framework developed by PNRA.

This framework has a three tiered approach comprising PNRA Ordinance, PNRA Regulations and Regulatory Guides, as depicted in Figure-3.

2.1 PNRA Ordinance

PNRA Ordinance 2001 serves as the primary legislation for regulating nuclear safety and radiation protection in the country. It establishes the mandate, composition, structure, powers and functions of PNRA. It empowers the regulatory body to develop, issue and enforce necessary rules, policies, regulations, orders or codes of practice for ensuring nuclear safety and radiation protection in the country.

All the rules and regulations issued by the Authority are mandatory in nature. The Ordinance empowers PNRA to ensure compliance with these requirements. For this purpose, PNRA utilizes various regulatory tools such as review, assessment, inspection and enforcement.

2.2 Regulations

PNRA regulations constitute the second tier of the legislative framework. These are developed by PNRA to ensure protection of workers, public

and the environment from the harmful effects of ionizing radiation. Regulations present mandatory regulatory requirements for safety and security of nuclear and radioactive materials, facilities and associated activities. PNRA issues two types of regulations, namely Administrative Regulations and Technical Regulations.

Administrative regulations describe the procedural steps for regulatory functions such as licensing, enforcement, dispute resolution, etc.

Technical regulations, on the other hand, describe detailed technical requirements set by PNRA in different areas of nuclear safety and radiation protection. These areas include design, operation, quality assurance, occupational and public exposure control, emergency preparedness and response, radioactive waste management, physical protection and nuclear security, etc.

The regulations are developed and revised following a rigorous process which includes feedback from all stakeholders including general public. During this process, the draft regulations are shared with licensees and uploaded on PNRA website (www.pnra.org) for acquiring feedback of public and other stakeholders. This helps in gaining confidence of stakeholders in the development process of regulations.

PNRA gives due consideration to emerging regulatory needs foreseen for coming years. Accordingly, regulations in new areas are identified based on the experience

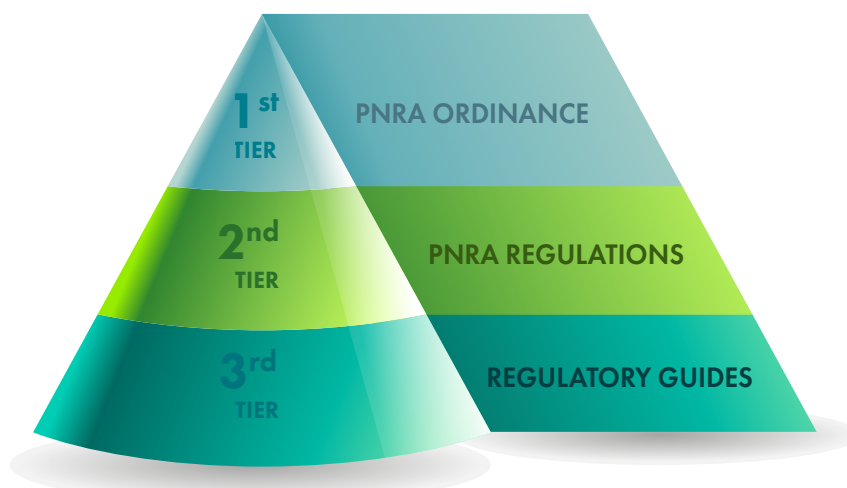


Figure-3: Statutory framework for PNRA regulatory operations



feedback, update in international standards and practices in the country. Regulation are developed based on intense review and thorough deliberations.

The regulations issued during the year 2019 are reflected in Figure-4.

The regulations once approved by the Authority are notified in the official gazette of Pakistan and are placed on PNRA website for information and compliance by all concerned.

Furthermore, development of following new regulations remained in progress during the year 2019:

- i. Regulations on Authorization of Organizations for Providing Services to Nuclear Installations and Radiation Facilities - (PAK/906);

- ii. Regulations for the Safe Management of Spent Nuclear Fuel - (PAK/918); and
- iii. Regulations on Leadership and Management for Safety - (PAK/921).

Moreover, revision of following regulations remained under progress during 2019:

- i. Regulations on Licensing Fee by Pakistan Nuclear Regulatory Authority - (PAK/900) (Rev. 2);
- ii. Regulations on Radiation Protection - (PAK/904);
- iii. Regulations on the Safety of Nuclear Power Plants Operation - (PAK/913) (Rev. 1);
- iv. Regulations on Management of a Nuclear or Radiological Emergency - (PAK/914) (Rev. 0);
- v. Regulations for the Safe Transport of Radioactive Material - (PAK/916); and
- vi. Pakistan Nuclear Safety and Radiation Protection Regulations, 1996.

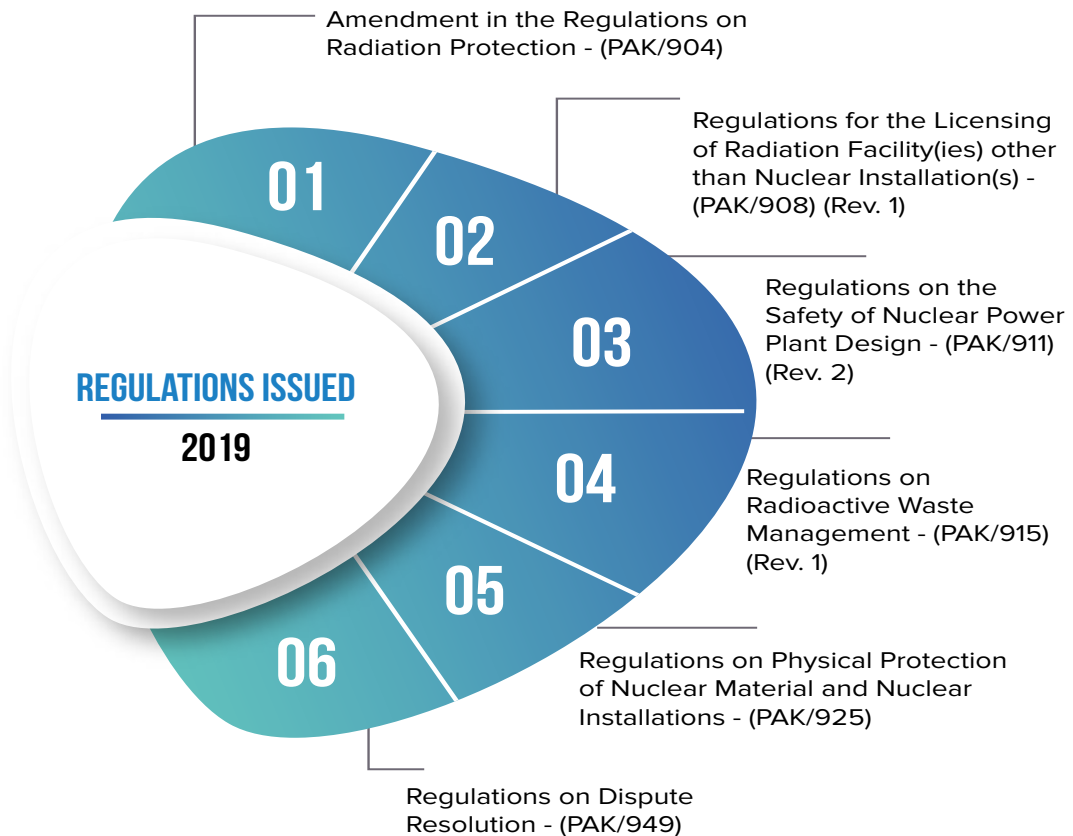


Figure-4: Regulations issued in 2019

2.3 Regulatory Guides

Regulatory Guides are the third tier of PNRA's regulatory framework. The regulatory guides issued by PNRA are non mandatory and provide guidance to the licensees for compliance with the regulatory requirements.

The regulatory guides describe the acceptable methodology for complying with the requirements described in PNRA regulations. The licensees may choose any alternate approach to comply with the regulatory requirements by demonstrating that the adopted approach provides similar or higher level of safety and quality as that of the methodology presented by the regulatory guides.

The regulatory guides are developed by following a detailed process which involves feedback from the stakeholders including general public.

on PNRA website (www.pnra.org) for seeking input from licensees, public and the interested parties during the development process.

All the regulatory guides are issued, published and distributed among the stakeholders after their approval. The regulatory guides are also placed on PNRA website for information of the public and other stakeholders.

The regulatory guides issued during the year 2019 are reflected in Figure-5.

In addition, following new regulatory guides remained in the process of development during the year 2019:

- i. Format and Content of Physical Protection Plan for Radioactive Sources (PNRA-RG-926.01);
- ii. Management of Contaminated and Overexposed Individuals in case of Nuclear or Radiological Emergency (PNRA-RG-914.03); and
- iii. Implementation of Access Control System (ACS) measures at Nuclear Installations.

The draft regulatory guides are also uploaded

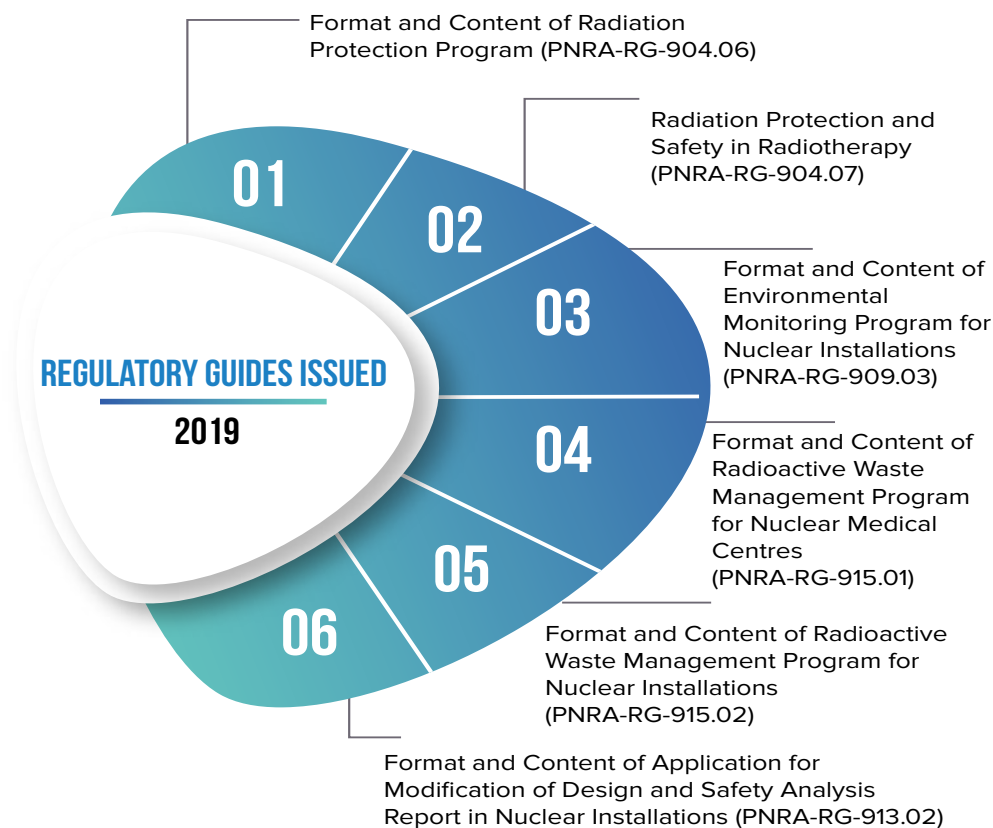


Figure-5: Regulatory Guides issued in 2019

3. LICENSING AND AUTHORIZATION





Under the PNRA Ordinance, all nuclear installations, radiation facilities, safety class equipment manufacturers, service providers and importers in the country are required to obtain licence or authorization from PNRA.

PNRA has notified licensing processes for various types of installations and facilities. These processes are based on extensive review of submissions and witnessing the practices through inspections. These licensing processes aim to ensure that the activity for which the licence is required would not be hazardous to the workers, the public and the environment.

Furthermore, PNRA issues licences to operating personnel of nuclear power plants and research reactors to ensure that only qualified and trained personnel operate these installations. PNRA also certifies specially designed casks for transport of spent nuclear fuel.

In addition, PNRA issues No Objection Certificates (NOCs) and permits for import and export of nuclear materials and radiation sources; and for transportation of radioactive materials.

The detail of licensing and authorization activities performed during 2019 is briefly described in this Chapter.

3.1 Nuclear Installations

The nuclear installations which require licence include nuclear power plants, research reactors, pre-disposal facilities and molybdenum production facility.

At present, five Nuclear Power Plants (NPPs) are in operation while two NPPs are under construction in Pakistan. Operational NPPs include Karachi Nuclear Power Plant Unit 1 (K-1), Chashma Nuclear Power Plant Unit 1 (C-1), Chashma Nuclear Power Plant Unit 2 (C-2), Chashma Nuclear Power Plant Unit 3 (C-3) and Chashma Nuclear Power Plant Unit 4 (C-4). Karachi Nuclear Power Plant Unit 2 (K-2) and Karachi Nuclear Power Plant Unit 3 (K-3) are under construction.

K-series NPPs i.e. K-1, K-2 and K-3 are located near Karachi. K-1 is a Pressurized Heavy Water Reactor (PHWR) operating since 1972 while K-2 and K-3 are three loop Pressurized Water Reactors (PWRs).

C-series NPPs i.e. C-1, C-2, C-3 & C-4 are located at Chashma site. These are two-loop PWRs and are in operation since 2000, 2011, 2016 & 2017 respectively.

Moreover, two research reactors, namely Pakistan Research Reactor 1 (PARR-1) and Pakistan Research Reactor 2 (PARR-2) are operating in the country since 1965 and 1991 respectively.

Furthermore, a Molybdenum Production Facility (MPF) is operational in the country since 2013. The MPF produces radionuclide which is used in nuclear medicine centres for diagnosis of different types of cancers.

The licences and authorizations are granted after fulfillment of regulatory requirements and satisfactory resolution of all the issues raised by PNRA.

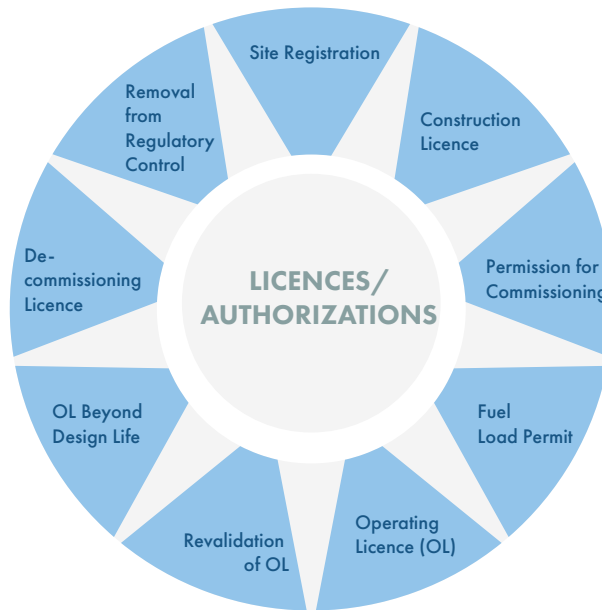
3.1.1 Nuclear Power Plants

K-1 remained in shutdown state from September 2018 to April 2019 for necessary maintenance, inspections and assessments. During this period, K-1 performed a number of assessments, examinations, replacements and clean-up works of various plant equipment and components. PNRA extended operating licence of K-1 in December 2019 till May 2020 after resolution of all regulatory concerns.

K-2 and K-3 plants are under commissioning phase. Construction of various structures and installation of equipment of K-2 and K-3 were completed during 2019. PNRA granted permission for commissioning of K-2/K-3 in September 2019 after fulfillment of regulatory requirements.

Furthermore, K-2/K-3 submitted application for fuel load permit in February 2019 along with required documents in accordance with PNRA regulations. The regulatory process for granting fuel load permit remained in progress during 2019.

C-1 operating licence is valid till December 2020. The plant was shutdown and disconnected from the national grid on December 05, 2019



Various types of licences / authorizations issued to nuclear power plants

for its 13th Refueling Outage (RFO). The licensee planned to carry out major overhauling and maintenance activities along with replacement of fuel during RFO.

Further, in December 2019, C-1 submitted its application along with necessary documents for revalidation of operating licence upto 2030. The application is under review.

C-2 operating licence is valid till December 2021. During the year 2019, C-2 completed its 6th RFO. The plant was shutdown on May 14, 2019 to complete all the planned outage activities. PNRA granted permission for plant start-up after successful completion of all activities and subsequently plant was connected to grid on June 25, 2019.

C-3 operating licence is valid till December 2026. During 2019, the plant was shutdown for 2nd RFO on July 31, 2019 to carry out planned maintenance and refueling activities. PNRA granted permission for start-up after successful completion of all activities and subsequently the plant was connected to grid on September 17, 2019.

C-4 operating licence is valid till December 2027. The plant was shutdown for its 1st RFO on April 16, 2019 to perform refueling activities. PNRA granted permission for plant start-up

after successful completion of all activities and subsequently C-4 was connected to grid on June 17, 2019.

K-1 operating licence was extended till May 2020.

All C-series plants operated safely during the reporting period. C-2, C-3 and C-4 successfully completed RFOs in 2019.

3.1.2 Research Reactors

The operating licences of PARR-1 and PARR-2 are valid till December 31, 2021 and December 31, 2024 respectively. These research reactors are used for isotope production and training purposes.

3.1.3 Molybdenum Production Facility

The operating licence of Molybdenum Production Facility (MPF) is valid till December 31, 2022. During the year 2019, MPF applied for approval of a programme for design modification in the facility and submitted an updated licensing document i.e. revised Final Safety Analysis Report (FSAR). The programme for design modification was approved in March 2019. The regulatory process for approval of revised FSAR remained in progress.

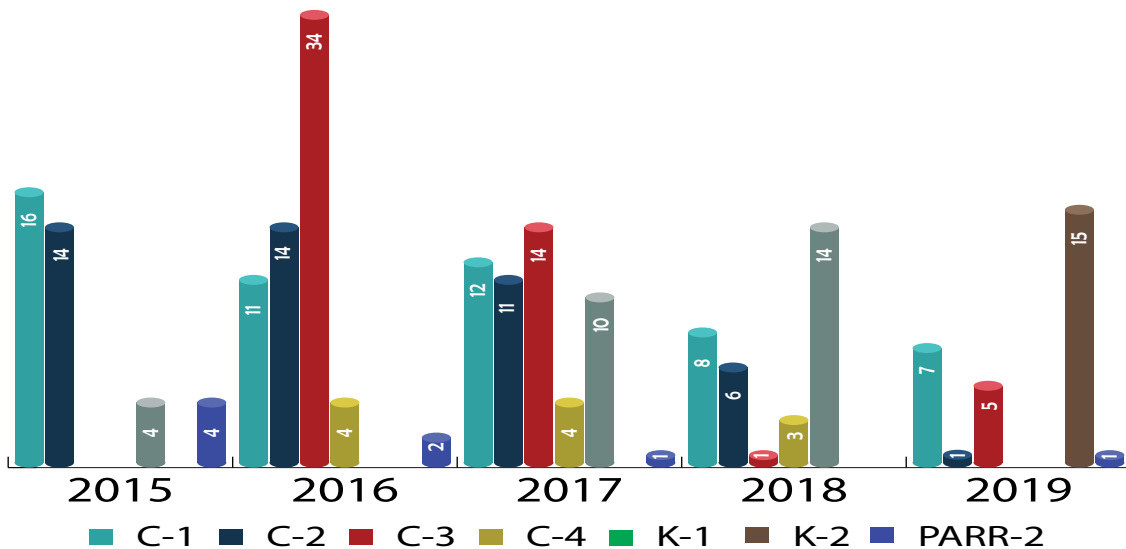


Figure-6: New licences issued to operating personnel of nuclear power plants and research reactors

3.2 Licensing of Operating Personnel of Nuclear Installations

Qualified and trained manpower is required for safe operation of nuclear power plants and research reactors. To ensure this, PNRA conducts licensing examination of operating personnel for the positions of Shift Supervisors (SSs), Shift Engineers (SEs) and Reactor Operators (ROs).

PNRA examines these personnel through field check out, panel interview and operation examination at training simulator.

The licences of the operating personnel are

renewed annually based on verification of their technical and professional competence, fulfillment of requirements of minimum shift operation, re-training and medical fitness.

The detail of issuance of new licences and renewed licences to operating personnel of nuclear power plants and research reactors is presented in Figures-6 and 7 respectively.

3.3 Management of Spent Nuclear Fuel

Spent Nuclear Fuel (SNF) generated from the operation of nuclear power plants and research reactors requires to be safely managed after its removal from the reactor.

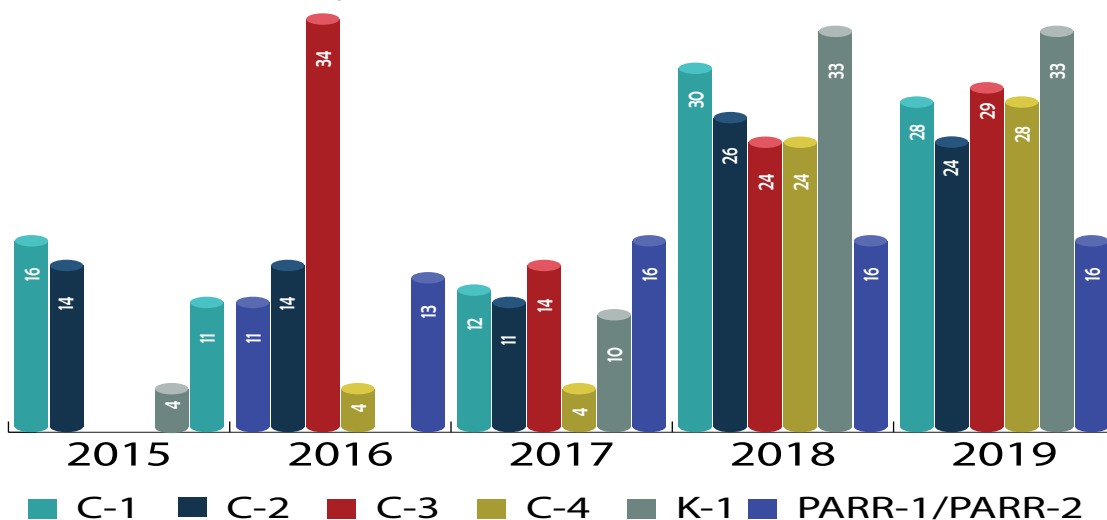


Figure-7: Renewal of licences to operating personnel of nuclear power plants and research reactors



Design approval certification ceremony of K-1 spent nuclear fuel dry storage cask

The SNF is first stored in spent fuel pools of nuclear power plants for cooling and is then transferred to dry storage facilities.

SNF already cooled for about ten years in the pools can be shifted to dry storage facilities using specially designed casks certified by PNRA.

K-1 has maintained a Spent Fuel Dry Storage Facility (KSFDSF) for interim storage. PNRA granted design approval certificate for K-1 SNF dry storage cask upon compliance with all applicable regulatory requirements in May 2019.

During this year, 540 spent fuel bundles were shifted from spent fuel pool to KSFDSF using PNRA certified casks.

PNRA has also registered site for PWR Dry Storage (PDS) facility for storage of SNF of C-series plants at Chashma. During 2019, codes and standards to be followed for construction of dry storage facility were agreed between PNRA and licensee.

PNRA received an application for the construction licence for PDS facility along with necessary submissions in January 2019.

PNRA awarded construction licence to PDS facility at C-series plants site upon compliance of regulatory requirements in December 2019.

3.4 Equipment Manufacturers and Service Providers

Currently, two manufacturers of Nuclear Safety

Class-1 (NSC-1) equipment including Heavy Mechanical Complex-3 (HMC-3) and NOVEL Engineering Works-2 (NEW-2) are licenced since 2016 and 2018 respectively. The licences of HMC-3 and NEW-2 are valid till June, 2022 and December, 2022 respectively. During the year 2019, PNRA received submissions for licensing of third NSC-1 equipment manufacturer namely, Instrumentation Control & Computer Complex (ICCC). The regulatory process for licensing of ICCC remained in progress in 2019.

During the year 2019, PNRA received an application for licensing of manufacturer of X-ray baggage scanners. The licensing process of X-ray baggage scanners manufacturer remained in progress.

National Centre for Non-Destructive Testing (NCNDT) is authorized since 2017 to provide non-destructive examination services to nuclear installations. The authorization of NCNDT is valid till December, 2020.

Furthermore, in 2019, PNRA stopped the authorization process of Inspectest Private Limited (IPL) as non-destructive examination service provider on request of IPL.

3.5 Radiation Facilities

At present, most of the radiation facilities in the country except some diagnostic X-ray facilities are in PNRA's licensing net. A pro-active approach is being implemented to bring the un-licensed X-ray facilities under the regulatory control.

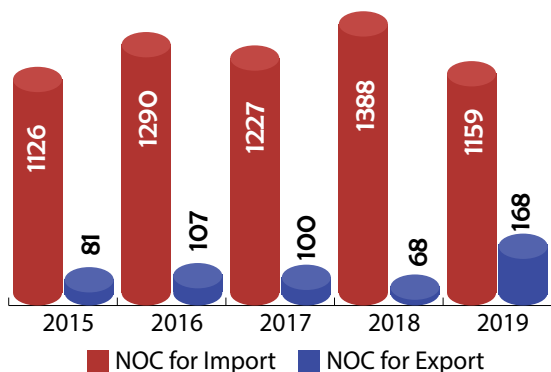


Figure-8: NOCs issued for import/export of radiation sources

Currently, there are more than 5900 radiation facilities in the regulatory ambit of PNRA. These include 5170 diagnostic X-ray facilities, 88 medical facilities, 214 industrial facilities, 84 educational and research institutes, 144 importers and 203 other facilities.

719 new radiation facilities entered into PNRA licensing net this year.

During the year 2019, the licensing net of PNRA has increased by 10 % with the addition of new radiation facilities.

3.6 Permits and NOCs

PNRA issues authorizations for import, export, local procurement and disposal of radiation sources. The entry or exit of any shipment of radiation source in the country requires a valid No Objection Certificate (NOC) issued by PNRA. Furthermore, PNRA grants NOC for the export of empty containers and disused radiation sources.

In addition, PNRA issues permit for local importers, required by foreign vendors or suppliers before procurement of any radiation source. PNRA is collaborating with Federal Board of Revenue for strengthening regulatory control over consignments containing radiation sources by launching an online NOC verification system.

During 2019, PNRA issued 1159 NOCs for import of radiation sources; 168 NOCs for export of empty containers and disused sources; and more than 307 permits for transportation/ procurement of radiation sources. Figure-8 reflects trend of issuance of NOCs during last five years.

PNRA also maintains an inventory of sealed radioactive sources used in all types of radiation facilities and activities in Pakistan. Figure-9 presents an overview of distribution of sealed radioactive sources with respect to their usage in various disciplines.

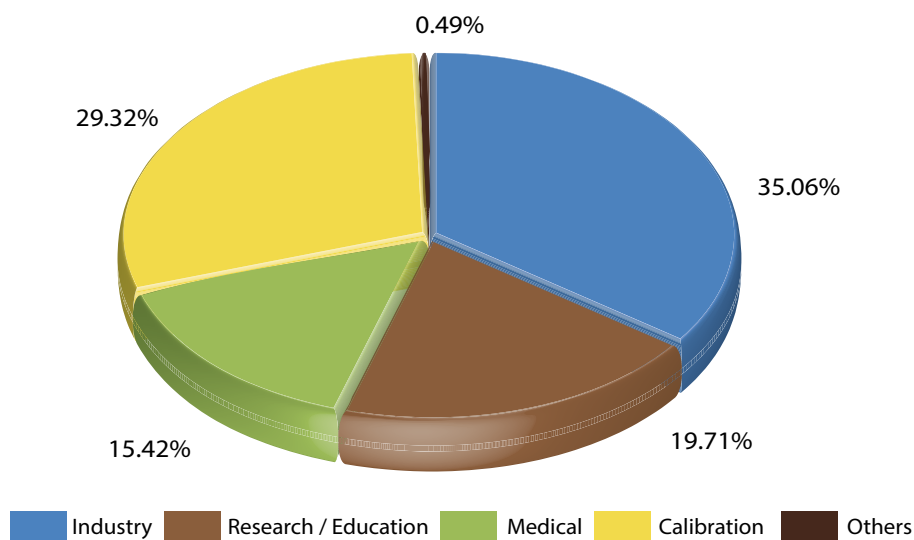
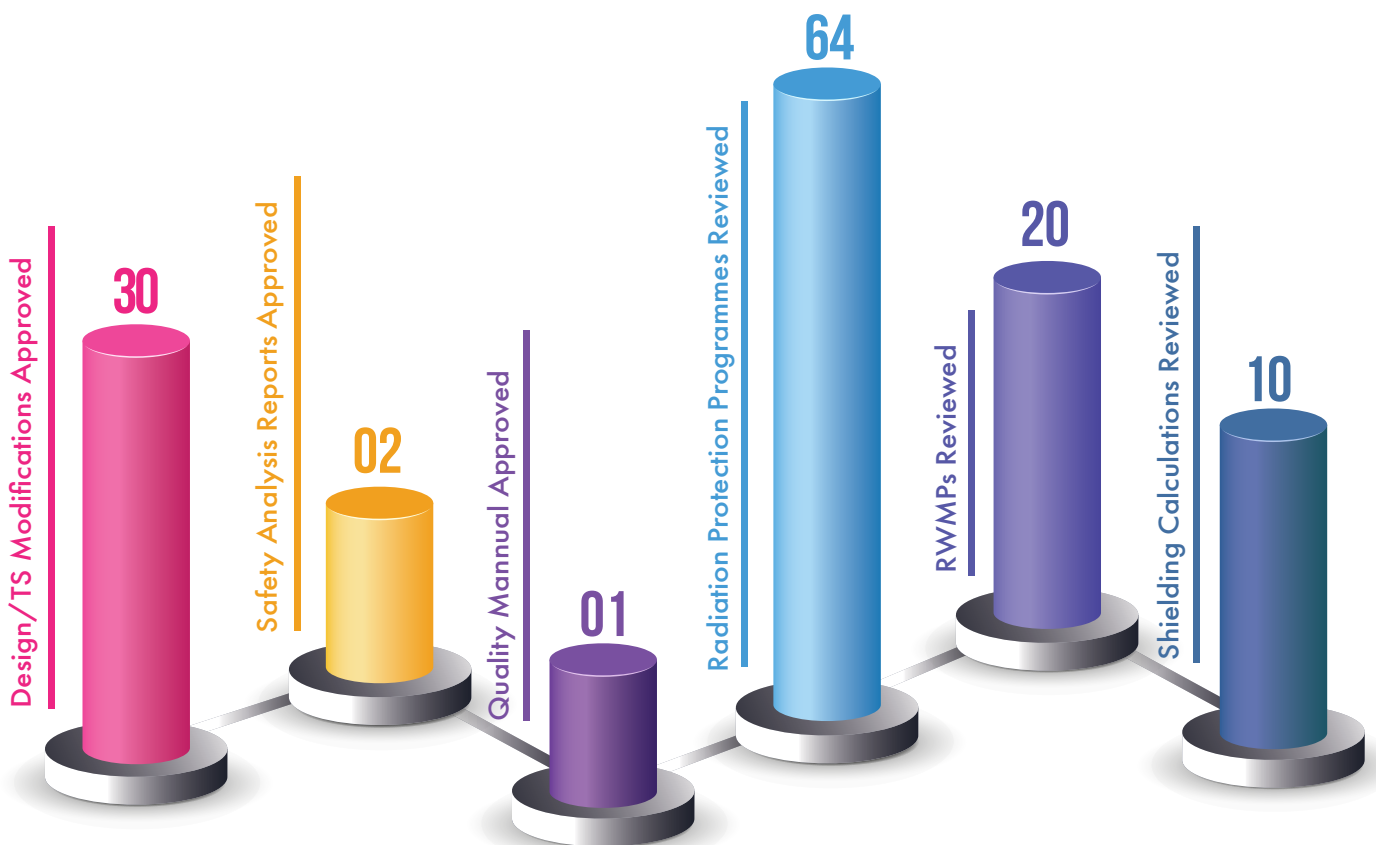


Figure-9: Sealed radioactive sources by usage

4. REVIEW AND ASSESSMENT





During the lifetime of a nuclear installation or radiation facility, a number of documents have to be submitted by the owner/operator of the facility to the regulatory body for review. Based on this review, safety of the nuclear installation or radiation facility is assessed. PNRA reviews and assesses a number of such documents to ensure compliance of regulatory requirements. These include documents submitted for grant of a specific licence or authorization and routine submissions required periodically. Licensees also submit a number of documents for information and record reflecting compliance of regulatory requirements. PNRA follows a systematic approach to conduct regulatory process of review and assessment.

PNRA also performs safety assessments to evaluate the safety of installations and facilities. Further, PNRA utilizes analytical software to perform analysis of data presented in some specific submissions. The detail of review and assessment activities carried out by PNRA in 2019 is given in subsequent sections.

4.1 Review of Nuclear Installations' Submissions

PNRA requires the licensees of nuclear installations to submit various documents and reports at various stages for regulatory review and assessment. The nuclear installations include nuclear power plants, research reactors and molybdenum production facility in the country. The subsequent sections describe review and assessment of these installations performed by PNRA.

4.1.1 Review of K- Series Nuclear Power Plants (NPPs) Submissions

PNRA reviewed a number of documents of K-1 on safety related issues during 2019. These submissions mainly included annual safety review report, event reports and special technical reports related to various equipment. In addition, four design modifications were reviewed and approved during this year.

During 2019, K-2 and K-3 submitted Final Safety Analysis Report (FSAR) for grant of fuel load permit. PNRA raised a number of queries during review of FSAR based on the applicable regulatory requirements and agreed codes & standards.

Subsequently, PNRA shared comments with the licensee in the form of licensing queries. These queries were discussed with the licensee and the representatives of designers and contractors during a review meeting held in Beijing, China in December 2019. Another review meeting with the licensee was held in Karachi to discuss site related queries. As an outcome of the safety review conducted so far, the designer agreed to incorporate necessary improvements in design including installation of thermal fatigue monitoring system and technical specifications with incorporation of additional Limiting Conditions for Operation (LCOs) and surveillance requirements. The regulatory review process is expected to be completed during first quarter of next year.

PNRA successfully completed detailed review of K-2/K-3 Final Safety Analysis Report (FSAR). Licensing queries were discussed in review meetings held in Beijing and Karachi.

Furthermore, PNRA reviewed and accepted one design modification of K-2/K-3 in 2019. PNRA also reviewed and approved programmes on plant inspections and initial decommissioning plan. In addition, K-2/K-3 programmes related to radioactive waste management, environmental monitoring and decommissioning remained under review during 2019.

During this year, major analytical tasks related to K-2/K-3 include analyses of atmospheric dispersion factors, tsunami hazards, system malfunctions and grid stability were performed. The analyses revealed that data submitted by licensee was in compliance with applicable standards and specifications.

4.1.2 Review of C-Series NPPs' Submissions

During 2019, PNRA reviewed a number of submissions received from C-series nuclear power plants. These included refueling outage submissions, programmes, technical reports and licensee event reports. In addition, PNRA also reviewed 27 modifications in design and specifications submitted by licensees during 2019. In this regard, 25 modifications were



Participants of K-2/K-3 FSAR first review meeting held in Beijing China

approved whereas two remained under review. Most of these modifications were related to improvements made in view of the lessons learnt from Fukushima accident. During this year, main analytical tasks performed include structural, stress and seismic analyses related to C-series NPPs.

4.1.3 Review of Research Reactors' Submissions

During 2019, PNRA completed review of revised Final Safety Analysis Report (FSAR) of PARR-1, which was updated by licensee to incorporate identified changes. The revised FSAR was approved in March 2019 upon satisfactory resolution of regulatory queries.

Furthermore, PNRA also reviewed a number of other submissions of research reactors like technical reports, programmes, annual safety report, licensee event reports, etc. during 2019.

4.1.4 Review of Molybdenum Production Facility Submissions

Molybdenum Production Facility (MPF) submitted revised FSAR during 2019 by incorporating updates to fulfill regulatory requirements. PNRA reviewed the FSAR in light of applicable regulatory requirements and raised a number of review queries. Accordingly, these were communicated and discussed in detail with the licensee. The deficiencies identified by PNRA

are being incorporated by the licensee.

PNRA also reviewed and approved the commissioning programme for a design modification submitted by the licensee.

4.2 Review of Equipment Manufacturers' and Service Providers' Submissions

During 2019, PNRA reviewed several documents submitted by Nuclear Safety Class-1 (NSC-1) equipment manufacturers and service providers of nuclear industry including Heavy Mechanical Complex-3 (HMC-3), NOVEL Engineering Works-2 (NEW-2), National Centre for Non-Destructive Testing (NCNDT) and Instrumentation Control & Computer Complex (ICCC).

During this year, quality manual of NEW-2 was reviewed and approved, whereas review of quality manual of ICCC remained in progress.

Furthermore, quality plans, operating procedures and corrective action plans of HMC-3, NCNDT and ICCC were reviewed to verify compliance of regulatory requirements.

4.3 Review of Radiation Facilities' Submissions

Review and assessment of submissions of



PNRA reviewers attending an IAEA workshop on review and assessment held at PNRA Headquarters

radiation facilities is conducted to ensure conformity of practices with applicable regulatory requirements. During this process, PNRA verifies arrangements for personal protective measures; personal and area monitoring; health surveillance; etc. Any discrepancy highlighted in the review process is communicated to licensees for rectification before formal approval or acceptance of the submission by PNRA.

During 2019, major submissions received from radiation facilities include radiation protection programmes, physical protection programmes, quality assurance programmes and safety analysis reports. In addition, the licensees submitted a number of other documents for information and record.

In 2019, PNRA reviewed and approved Safety Analysis Report of an advance medical diagnostic equipment being installed in a health facility in Rawalpindi. PNRA also reviewed and accepted commissioning reports of modern radiation devices being installed at three nuclear medicine centres in Karachi and Lahore. Similarly, shielding calculations of ten radiation facilities for installation of latest radiation devices were evaluated and found to be in line with the regulatory requirements.

During 2019, PNRA reviewed 64 radiation

protection programmes of various radiation facilities. The gaps identified in the light of applicable regulatory requirements were communicated to licensees. Further, physical protection plans and transport security plans of a number of radiation facilities having category 1-3 radioactive sources were reviewed. In addition, PNRA reviewed 20 radioactive waste management programmes. Four of these programmes were accepted during 2019.

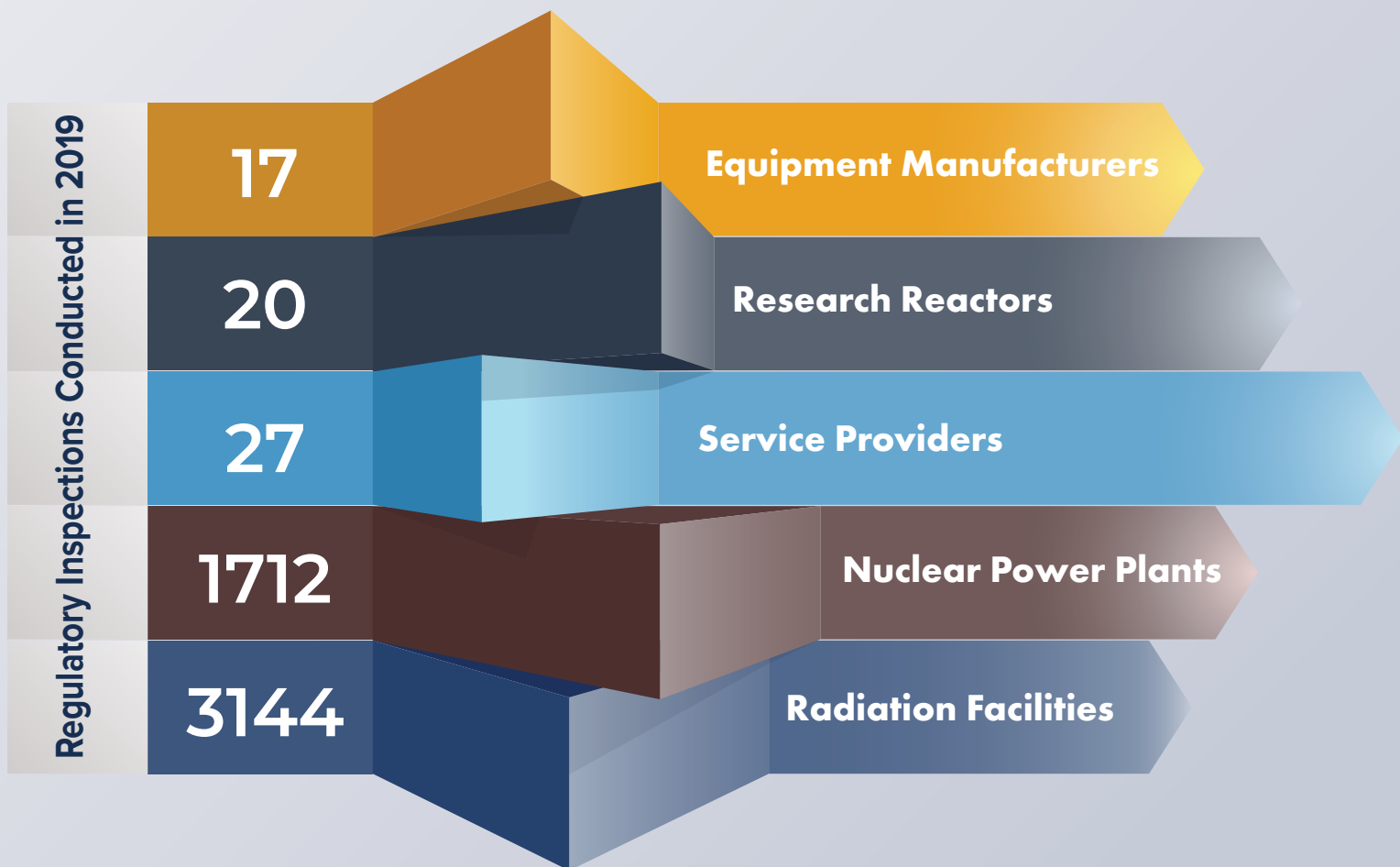
4.4 Safety Assessment of Radiation Facilities

PNRA performs safety assessment of medical and industrial radiation facilities to verify the compliance of regulatory requirements. This assessment is based on pre-defined Performance Objective and Criteria (PO&C).

During 2019, PNRA performed safety assessment of 59 industrial and 82 medical radiation facilities.

The assessment revealed that the overall safety performance of the radiation facilities is satisfactory. However, some radiation facilities need improvement and relevant Regional Directorates are taking necessary measures to improve the identified areas.

5. INSPECTION AND ENFORCEMENT





Regulatory inspections are vital tool for effective regulatory oversight and control of the licensed facilities.

PNRA conducts regulatory inspections of nuclear installations, radiation facilities, equipment manufacturers and service providers to ensure compliance of regulatory requirements and licence conditions. Enforcement actions are taken in case of any non-compliance of regulatory requirements.

PNRA has devised inspection programmes which are based on the safety significance and risk posed by a facility or activity.

The inspections are broadly categorized in two distinct types namely, planned inspections and reactive or special inspections. Either type of inspection may be announced or unannounced; however, announced inspections are more common.

Planned inspections are carried out in accordance with the annual inspection plans developed by the respective departments of PNRA. These inspections are conducted in accordance with frequency defined in relevant inspection programmes.

On the other hand, reactive or special inspections are initiated in response to some unexpected situation or unusual event at any facility or during an activity. All these inspections are conducted by PNRA authorized inspectors.

The observations and findings identified during the inspections along with the corresponding recommendations are communicated to the facilities for rectification and compliance within a specified period of time.

PNRA takes enforcement actions in case of violations of PNRA Ordinance, applicable regulations, directives or licence conditions.

These actions include issuance of directives, show cause notices, violation notices, work stop notices, suspension or revocation of licence.

The enforcement process may also lead to prosecution and imposition of penalty through court of law in case the violator does not take the required corrective action.

PNRA Enforcement Regulations and the underlying enforcement procedure provides mechanism to deal with violators.

PNRA has established three Regional Nuclear Safety Directorates supplemented by three Regional Nuclear Safety Inspectorates in order to perform inspection activities in an effective and efficient manner.

These Directorates and Inspectorates are strategically located to cover the nuclear installations and radiation facilities spread all over the country.

During 2019, PNRA initiated efforts to establish new Inspectorates in Gilgit Baltistan and Azad Jammu and Kashmir to effectively regulate radiation facilities and activities in these regions.

The Governments of Gilgit Baltistan and Azad Jammu and Kashmir have approved the establishment of PNRA Inspectorates in Gilgit and Muzaffarabad. These Inspectorates are expected to be made functional during the next year.

5.1 Inspections of Nuclear Installations

During the year 2019, PNRA carried out 1712 inspections of nuclear power plants, 20 inspections of research reactors and 02 inspections of molybdenum production facility.

PNRA performed rigorous inspections during Refueling Outage activities at C-series nuclear power plants.

Similarly, inspections during the construction and commissioning activities at K-series nuclear power plants remained under special focus during this year.

The inspections of the nuclear installations mainly included control point inspections, general surveillances, periodic inspections, reactive inspections, etc.

Summary of inspections of the nuclear power



PNRA management, RNSD-III inspectors and Chinese contractors at K-2/K-3 intake and outfall site

plants and research reactors performed during last five years is presented in Figure-10.

5.2 Inspections of Equipment Manufacturers and Service Providers

Inspections of nuclear safety class equipment manufacturers are carried out at the vendor facilities located within the country or abroad. Inspections of service providers are performed at their premises or at the licensed facilities where the services are provided.

During 2019, 17 regulatory inspections at Heavy Mechanical Complex-3 (HMC-3), and 27 inspections at National Centre for Non-

Destructive Testing (NCNDT) were conducted. In addition, PNRA also performed 05 control point inspections to witness equipment manufacturing of under construction nuclear power plants i.e. K-2 and K-3 at vendor's sites in China.

5.3 Inspections of Radiation Facilities

During 2019, PNRA conducted more than 3140 inspections of radiation facilities and activities throughout Pakistan. Follow up inspections were also carried out to ensure implementation of required corrective actions. Figure-11 reflects an overview of regulatory inspections of

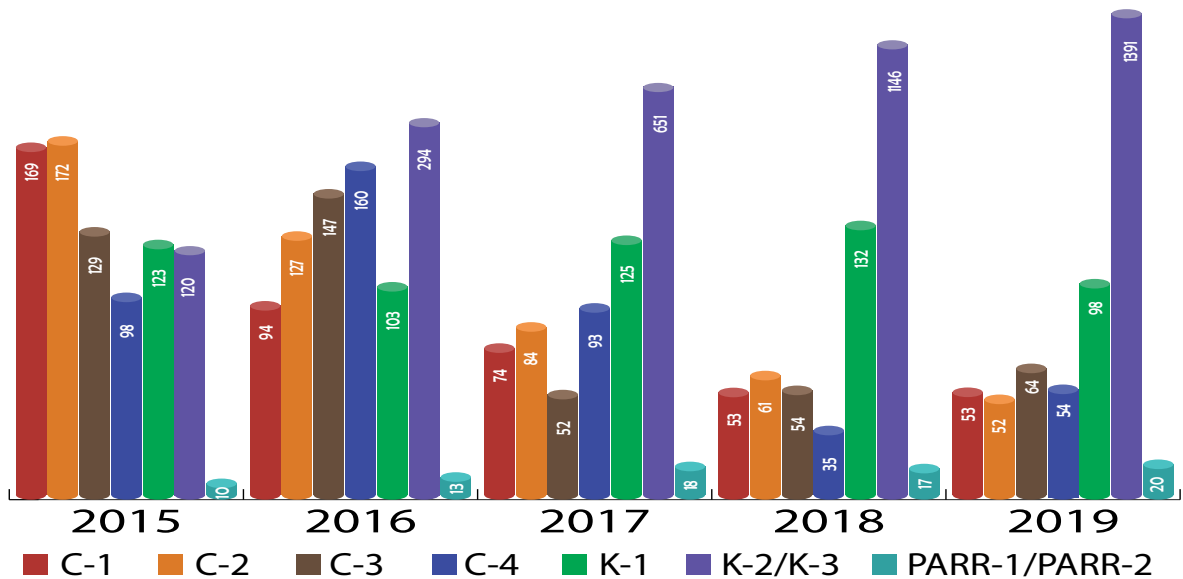


Figure-10: Regulatory inspections conducted at nuclear power plants and research reactors

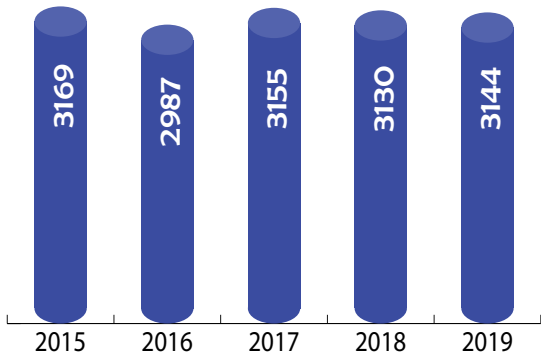


Figure-11: Regulatory inspections of radiation facilities

radiation facilities conducted during last five years.

Furthermore, PNRA conducts surveys in order to identify non-licensed radiation facilities so that these may be brought under regulatory control. Accordingly, 276 non-licensed facilities were identified during the surveys in 2019 and efforts were made to bring these facilities in the regulatory net.

5.4 Enforcement Activities

During 2019, appropriate enforcement actions were taken against a number of violators. These



PNRA legal team conducting hearing of defaulters at RNSI-II, Multan

actions included issuance of special directives, show cause notices, offence reports and work stoppage notices. Licensees were also required to submit corrective action plan against PNRA findings and timely implementation of corrective actions were ensured through follow-up inspections. A number of hearings were also conducted against the violators in different regional offices. These enforcement measures resulted in significant improvements in safety of the licensed facilities. Various enforcement actions taken by PNRA during 2019 are reflected in Figure-12.



Figure-12: Enforcement actions taken by PNRA during 2019

6. RADIATION PROTECTION AND RADIOACTIVE WASTE MANAGEMENT

14700

Radiation
Workers
Registered in
PNRA Data
Base

Reviewed
Investigation
Reports
of
Occupational
Overexposure

16

329

Soil and
Water
Samples
Collected
to Establish
Background
Radiation
Level

Solid
Radioactive
Waste Drums
Generated at
K-1 and
C-Series
NPPs

876

223

Disused
Sealed
Radioactive
Sources
(DSRS)
Returned to
Suppliers in
2019



Radiation sources and radioactive materials are widely used in various sectors like medicine, agriculture, industry, security, research and development, etc. due to their numerous benefits.

However, these could be extremely hazardous if used without appropriate safety measures, as they have potential to expose the workers, the general public and the environment to the ionizing radiation.

PNRA monitors and assesses the radiation exposure record of workers to verify that their doses are within the regulatory limits. PNRA also independently monitors and cross verifies the environmental monitoring results submitted by the licensees.

In addition, PNRA regulates the radioactive waste management activities of nuclear installations, radiation facilities and associated activities.

PNRA keeps an eye on radiation exposure of workers, environmental monitoring results and radioactive waste generation to identify any adverse trend. Accordingly, necessary recommendations to the licensees are made for taking corrective measures.

6.1 Radiation Protection of Workers

Nuclear installations and radiation facilities are required to monitor doses received by their workers during the operation of these facilities and to submit these records to PNRA on annual basis.

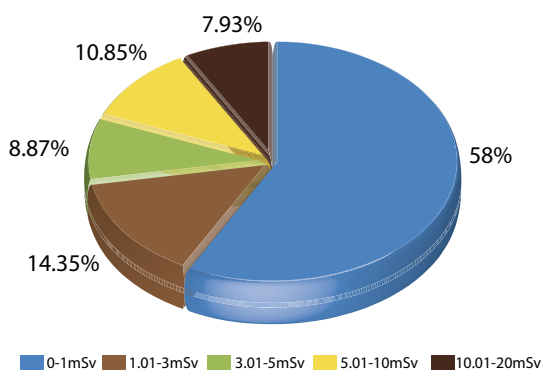


Figure-13: Annual radiation doses to K-1 workers

This includes information about number of persons exposed and radiation doses received by each worker.

As per regulatory requirements, the annual radiation dose limit for a worker is 20 mSv. However, in special circumstances, radiation dose of up to 50 mSv in a single year may be permitted provided that the average dose over five consecutive years does not exceed 20 mSv/year.

PNRA maintains a database of radiation exposure record of radiation workers all over the country. For this database, PNRA obtains exposure records of workers directly from dosimetry service providers in addition to records received from the licensees.

This record is used to evaluate variations in occupational exposures and effectiveness of radiation protection programmes in routine work practices.

6.1.1 Radiation Exposure of Workers at Nuclear Installations

PNRA closely monitored radiation doses to the workers during operation and refueling outages at NPPs in 2019.

During 2019, at K-1 and C-series NPPs, radiation dose received by workers remained well below the regulatory limit i.e. 20 mSv.

Figures-13, 14, 15, 16 and 17 present radiation doses received by workers of K-1, C-1, C-2, C-3 and C-4 respectively during this year.

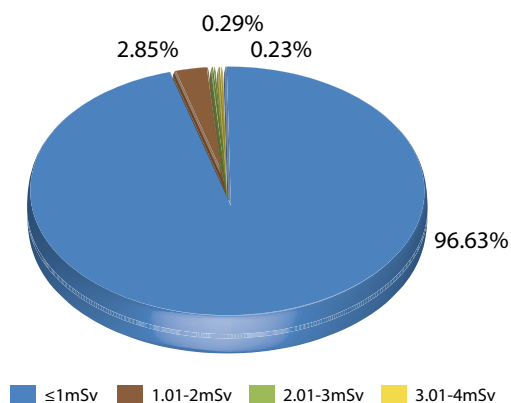


Figure-14: Annual radiation doses to C-1 workers

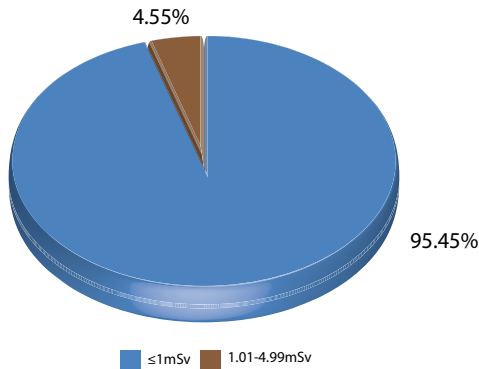


Figure-15: Annual radiation doses to C-2 workers

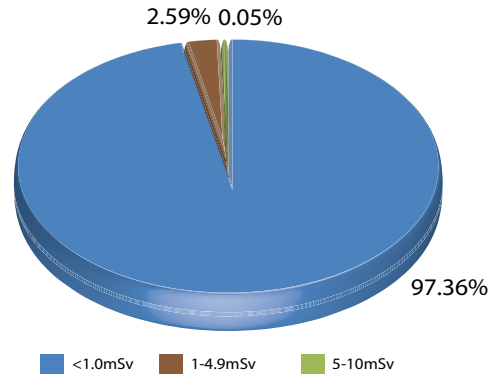


Figure-17: Annual radiation doses to C-4 workers

Furthermore, workers' exposure at C-series NPPs during refueling outages remained within the estimated dose as reflected in Figure-18.

Radiation exposure of workers at research reactors and MPF for the year 2019 was also noted to be well within the regulatory limits.

Figure-19 reflects dose distribution of research reactor and MPF workers.

In addition, National Dosimetry and protection level Calibration Laboratory (NDCL) has provided external and internal Dosimetry services to about 1300 radiation workers of licensees including K-1, CNPGS Personnel and Chinese contractors.

6.1.2 Radiation Exposure of Workers at Radiation Facilities

During 2019, PNRA focused on efforts to link the dose record of radiation workers with their

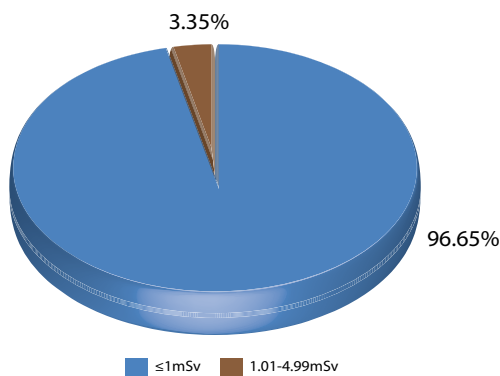


Figure-16 : Annual radiation doses to C-3 workers

Computerized National Identity Card (CNIC). This will enable PNRA to identify and smoothly retrieve dose record of relevant radiation workers. At present, dose records of 14700 workers of radiation facilities are maintained in PNRA database. These radiation workers belong to various types of radiation facilities as shown in Figure-20.

The evaluation of record during the year 2019 revealed that the exposures to more than 99% of the workers remained within the regulatory limit of 20 mSv. However, there were some cases where an exposure higher than 20 mSv was reported. These cases were appropriately investigated and it was ensured that five years average exposure of such workers is managed such that the average dose over five consecutive years does not exceed 20 mSv/year. During this year, 16 investigation reports of occupational overexposures were reviewed and the licensees were advised to take corrective actions accordingly. Figure-21 reflects the overall occupational exposure of all radiation workers in different dose ranges.

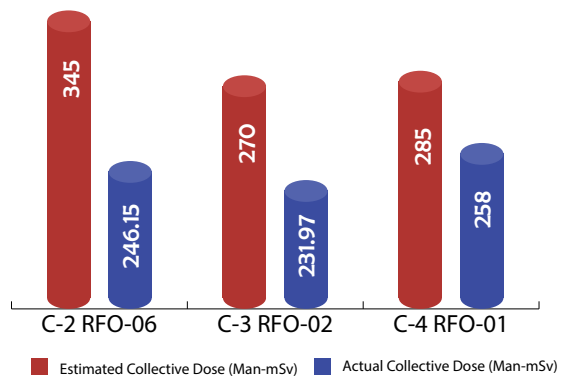


Figure-18 : Estimated and actual collective doses during RFOs at C-series NPPs

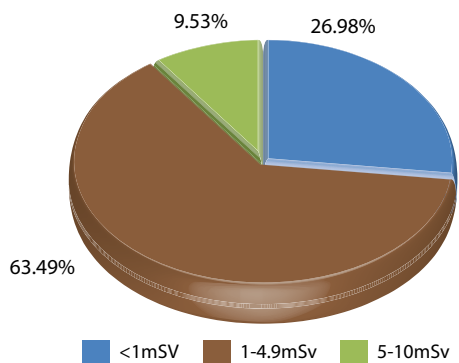


Figure-19 : Annual radiation doses to research reactor and MPF workers

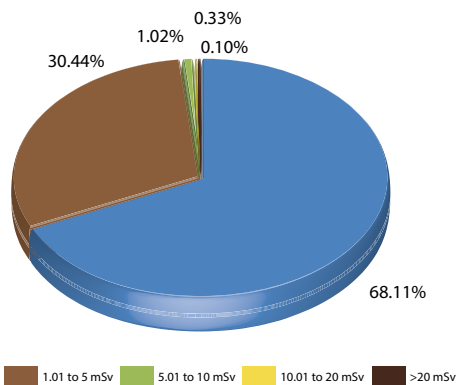


Figure-21 : Dose ranges of workers in radiation facilities

6.2 Environmental Monitoring

PNRA is responsible to ensure, implement and coordinate national programme of environmental surveillance to check any buildup of radioactivity in the environment across the country that might affect the public. To fulfill this obligation, PNRA requires its relevant licensees to continuously monitor and report the impact of radioactive discharges on the surrounding environment. Further, PNRA has also established laboratories under its National Environmental Monitoring Programme for monitoring of environmental radioactivity levels and verification of data provided by licensees.

6.2.1 Environmental Radioactivity Reported by Nuclear Installations

Nuclear Power Plants and Research Reactors in the country have established radiological environmental monitoring programmes and are required to periodically submit the monitoring results to PNRA.

During 2019, PNRA cross verified some of the reported data on sample basis. On the whole, it was noted that the radioactivity in the environment remained well below the applicable regulatory limits.

6.2.2 Establishment of National Background Radiation Level

PNRA is working on determining the background radioactivity level across the country due to natural as well as man-made sources. PNRA, under this study, conducted analysis of soil and water samples collected from different parts of the country. A systematic approach was adopted to distribute whole of the country into a number of grids and sample collection was carried out accordingly.

In 2019, more than 300 samples were collected from different locations. By now, sample collection from all the planned grids and their analysis has been completed. The analysis revealed that no potential radiological health

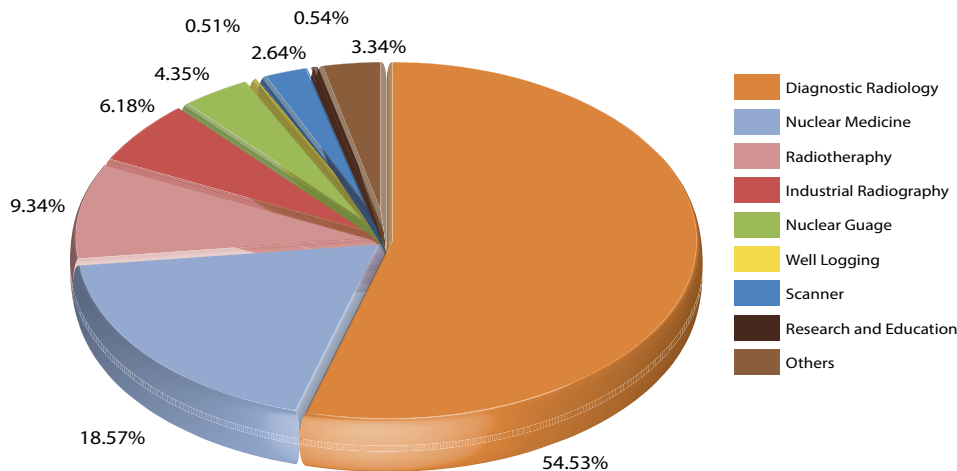


Figure-20: Distribution of radiation workers in radiation facilities

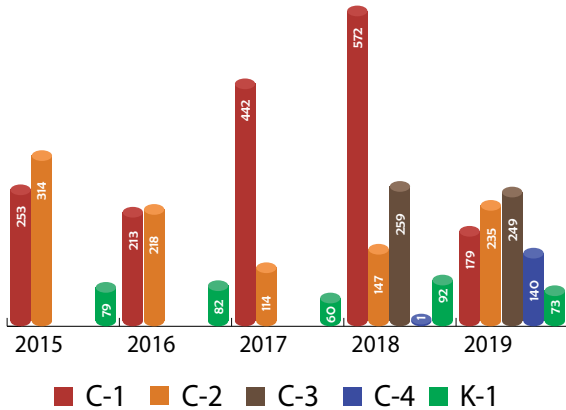


Figure-22: Number of radioactive waste drums generated at K-1 and C-series NPPs

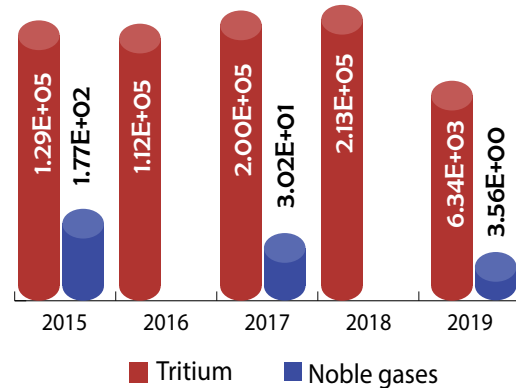


Figure-23: Gaseous effluents (GBq/yr) from K-1

hazard is associated with the background radiation level from the soil and water of Pakistan. This study has provided a baseline radiation level which will serve as a reference to detect any possible changes in the environmental radioactivity in the country.

6.3 Management of Radioactive Waste

Safe management of radioactive waste generated at nuclear installations and radiation facilities in the country is an important aspect of regulatory oversight. PNRA ensures that necessary measures are taken to keep the generation of radioactive waste at a minimum.

6.3.1 Radioactive Waste at Nuclear Power Plants

Radioactive waste generated at nuclear power

plants could be solid waste or in the form of effluents comprising liquids and gases. PNRA keeps strict oversight on generation of solid radioactive waste and discharge of effluents to ensure compliance with authorized limits.

PNRA maintains the inventory of solid radioactive waste generated at NPPs. During 2019, no abnormal trend of generation of solid radioactive waste was noted at K-1 and C-series NPPs as reflected in Figure-22.

Radioactive effluents from NPPs are required to be discharged in a controlled manner. During the year 2019, the gaseous and liquid radioactive effluents discharged to the environment from K-1 and C-series NPPs remained well below the authorized limits.

Figures-23 and 24 present the trend of effluents



PNRA team collecting environmental samples from the vicinity of research reactors

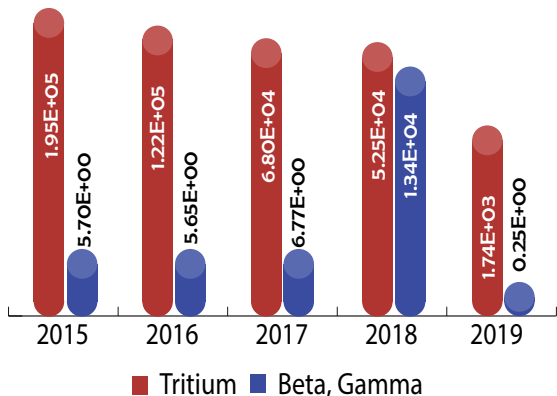


Figure-24: Liquid effluents (GBq/yr) from K-1

released from K-1; whereas Figures-25 and 26 show the trend of effluents released from C-series NPPs.

6.3.2 Radioactive Waste at Radiation Facilities

The application of radioactive materials in medical, industrial and other sectors also generates radioactive waste. PNRA ensures that radioactive waste generated from these facilities is managed as per applicable regulatory requirements.

Nuclear medicine centres produce short lived radioactive waste which can be in solid or liquid form. The solid radioactive waste is stored until its activity falls below acceptable levels and is then disposed of as ordinary waste. Similarly, liquid radioactive waste can only be discharged, directly or through delay tanks, when its activity is below acceptable limits.

Long lived sealed radioactive sources used

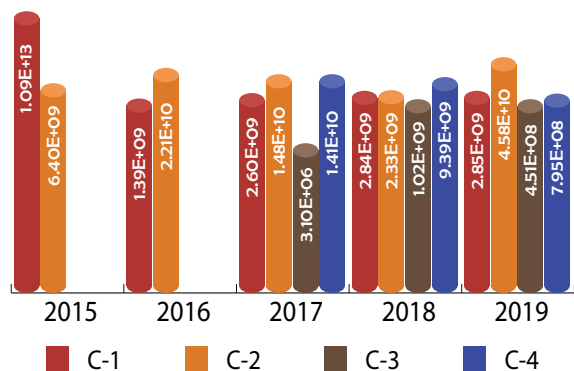


Figure-25: Gaseous effluents (Bq/yr) from C-series NPPs

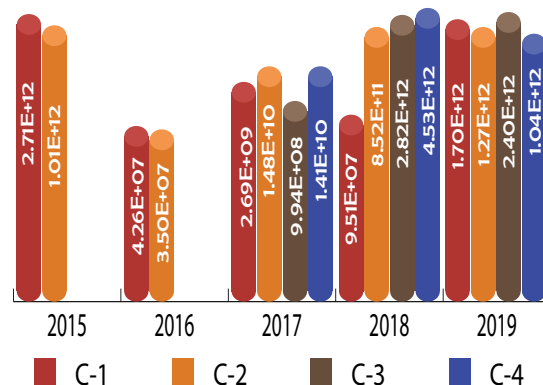


Figure-26: Liquid effluents (Bq/yr) from C-series NPPs

in various sectors become radioactive waste after their useful life. These are termed as Disused Sealed Radioactive Sources (DSRS). According to regulatory requirements, DSRS having half life of more than one year and initial activity greater than 100 GBq are required to be returned to suppliers. The DSRS which are not returned to suppliers are stored at designated storage facility in the country. These sites are Radioactive Waste Storage Area (RAWSA), Karachi and PINSTECH Predisposal Radioactive Waste Management Facility (PPRWMF), Islamabad. RAWSA stores radioactive waste generated in the southern part of country; while PPRWMF stores radioactive waste generated in the northern part of the country.

PNRA maintains inventory of DSRS stored in designated sites and those returned to suppliers. As per current inventory, the disused sources stored at these sites mainly include Co- 60, Cs-137, Ir-192 and Ra-226. The status of DSRS stored in the country and those returned to the suppliers is reflected in Figure-27.

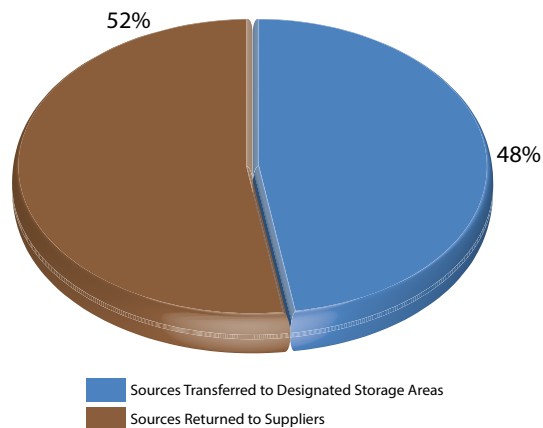


Figure-27: Status of disused sealed radioactive sources

7. EMERGENCY PREPAREDNESS AND RESPONSE

MAJOR ACTIVITIES CONDUCTED FOR EMERGENCY PREPAREDNESS AND RESPONSE

02

Conduct of Training Courses
and Workshops

04

Visits of Delegates to NRECC

04

Activation of Radiation Monitoring
Teams

12

Conduct of Emergency Exercises

24

Approval of Emergency Response Plans

38

Sharing of Information on Events received through IAEA



Nuclear installations and radiation facilities are designed and constructed according to highest safety standards in order to operate safely throughout the intended design life. In addition, numerous safety features are incorporated to prevent accidents and avoid chances of undue radiation exposure to the radiation workers, the general public and the environment to the extent possible.

However, like other conventional industries, possibilities of occurrence of accidents may not be ruled out in these facilities. Therefore, there is always a need to be well prepared for any undesirable occurrence to effectively respond and mitigate the consequences of any such event.

In 1989, Pakistan acceded to two international conventions related to nuclear accidents and radiological emergencies. These are Convention on Early Notification of a Nuclear Accident and Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency. These conventions require designation of a national competent authority to deal with notifications and requests for assistance in case of a nuclear accident or radiological emergency.

The Government of Pakistan has designated PNRA to ensure fulfillment of the international obligations under these conventions.

PNRA is also assigned with the responsibility to notify federal, provincial, local and other concerned authorities to immediately take necessary safety measures in case of any risk to public health.

Furthermore, PNRA advises relevant departments, institutions, industries, etc. on matters related to nuclear safety and radiation protection.

The detail of PNRA activities related to emergency preparedness and response is briefly described in this Chapter.

7.1 Emergency Preparedness and Response Arrangements

PNRA has been mandated with the responsibility to ensure availability of appropriate arrangements for emergency preparedness and response at nuclear installations and radiation facilities. Accordingly, PNRA has established

regulatory framework for emergency preparedness and response. The facilities with high potential hazards are required to formulate on-site and off-site emergency response plans.

The emergency plans provide information on the potential emergency situations, mechanisms of notifications, response actions and measures for mitigation of potential consequences. These also describe arrangements for medical response, measures for preventing ingestion of contaminated food stuff and long term protective actions.

In addition, these plans contain information on emergency response arrangements for protection of personnel at nuclear installations and radiation facilities.

PNRA requires the licensees to submit the emergency preparedness and response plans for review and assessment. PNRA reviews and provides recommendations for improvement in response plans on the basis of regulatory requirements and experience feedback.

Accordingly, PNRA approves or accepts these plans. PNRA ensures that necessary measures are in place for implementation of these plans.

PNRA also requires the licensees to test these plans periodically through emergency drills and exercises. PNRA witnesses the conduct of some of the emergency drills and exercises to assess effectiveness of these plans.

During 2019, PNRA reviewed and accepted revised emergency response plan of PARR-1 research reactor.

In addition, PNRA reviewed 57 emergency response plans of radiation facilities and approved 23 of these plans. Other facilities were recommended to further improve the plans.

Furthermore, nuclear installations and major radiation facilities conduct emergency exercises in accordance with the frequency and timeline agreed with PNRA.

During 2019, PNRA witnessed and evaluated annual emergency exercises at K-1, C-series plants and PARR-1. Further, 26 emergency drills were conducted at radiation facilities.

7.2 National Radiation Emergency Coordination Centre (NRECC)

PNRA has established a National Radiation Emergency Coordination Centre (NRECC) at PNRA HQs in Islamabad to fulfill the obligations of the international conventions and PNRA Ordinance. NRECC serves round-the-clock as a national warning point.

NRECC is authorized to make and receive notifications, coordinate requests and is always ready to respond and coordinate in case of a nuclear accident or radiological emergency. Main functions of NRECC in such a scenario are presented in Figure-28.

Upon notification of an incident, NRECC is activated to one of its emergency response modes as reflected in Figure-29.

Each event is classified and responded according to the extent of the actual or potential radiological consequences.

NRECC is equipped with radiation detection equipment, means of communication, personal protective equipment, Mobile Radiological Monitoring Laboratories (MRMLs), operating procedures and well trained and competent manpower. In case of any emergency situation, NRECC is supported by technical support teams comprising experts from other departments of PNRA in various areas.

A network of six Radiation Monitoring Teams (RMTs) has been established under NRECC in

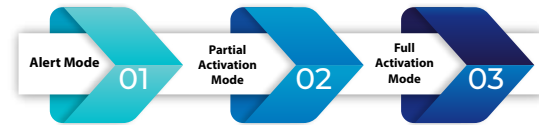


Figure-29: Modes of NRECC activation

PNRA offices across the country, as shown in Figure-30. RMTs are equipped with necessary equipment along with MRMLs. The radiation monitoring teams provide technical assistance to response authorities and are capable to perform independent assessment of any situation related to nuclear accident or radiological emergency.

Furthermore, licensees are required to inform NRECC about any movement of radioactive sources in the country. As appropriate, this information is shared with relevant national authorities and PNRA regional directorates for conducting inspection during source movement to verify compliance with safety and security requirements.

7.2.1 Conduct of and Participation in Emergency Exercises

NRECC conducts various in-house exercises to test its own emergency preparedness and response arrangements for nuclear accidents or radiological emergencies. These exercises include MRML Exercises, Communication Test Exercises (COMTEX) and PNRA level exercises.

Furthermore, NRECC also participates in various exercises conducted under emergency conventions i.e. IAEA Convention Exercises

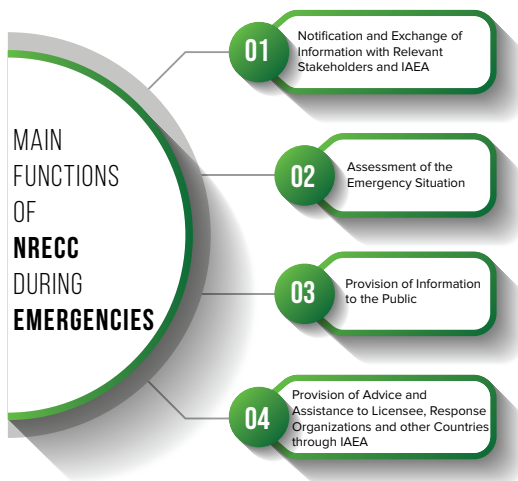


Figure-28: Main functions of NRECC

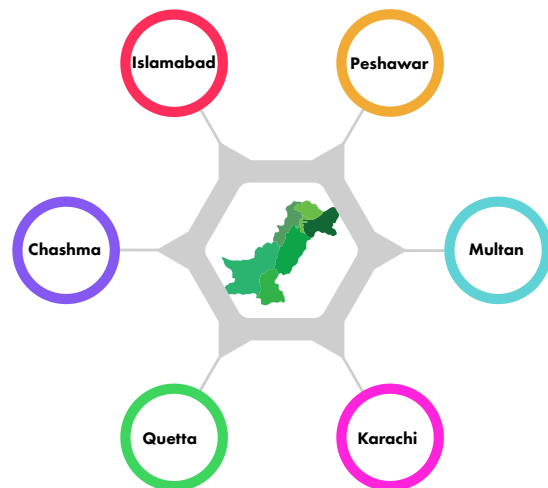
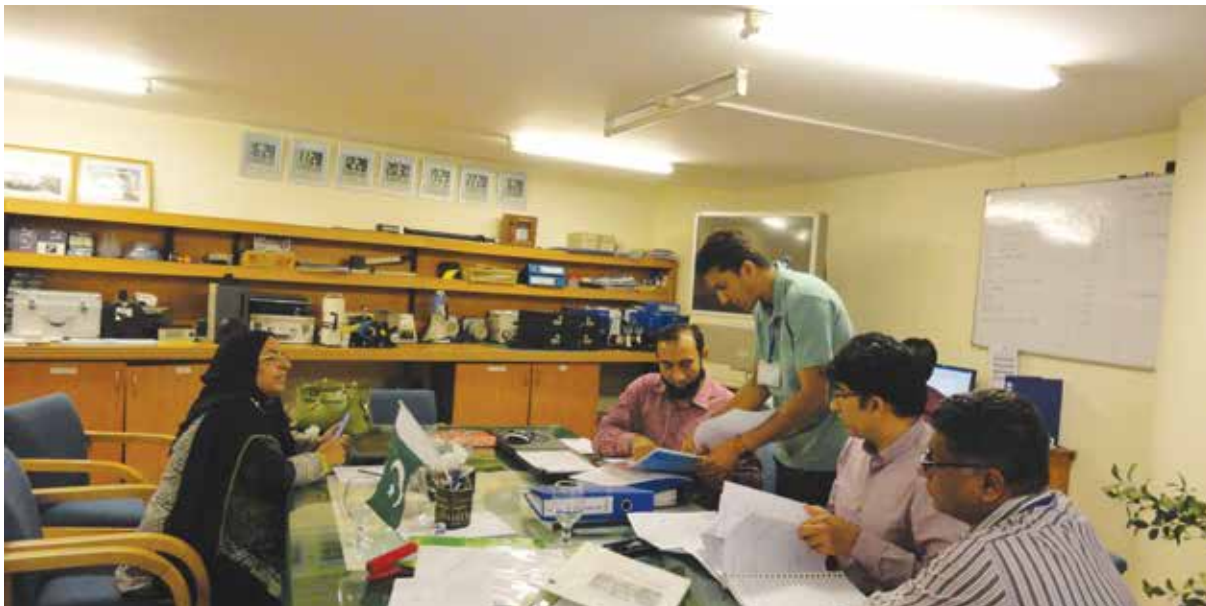


Figure-30: Location of RMTs in Pakistan



PNRA technical support team during emergency exercise

(ConvEx) and exercises under Nuclear Emergency Management System (NEMS).

During the year 2019, NRECC conducted eight MRML exercises, three COMTEX exercises and one PNRA level exercise.

In addition, NRECC participated in five ConvEx exercises. Summary of emergency exercises is reflected in Figure-31.

7.3 Sharing of Information about Events Involving Ionizing Radiation

PNRA is the national contact point for reporting and receiving information from different international platforms of IAEA about radiation incidents and accidents. These platforms include

Nuclear Events Web-based System (NEWS), Unified System for Information Exchange in Incidents and Emergencies (USIE) and Incident and Trafficking Database (ITDB).

NEWS is a publically 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. The ITDB is a database that records incidents of illicit trafficking or unauthorized acquisition of nuclear or radioactive material.

PNRA also analyzes the information received from above forums. PNRA identifies the lessons learnt and shares them with relevant stakeholders for improvement of radiation safety in the country.

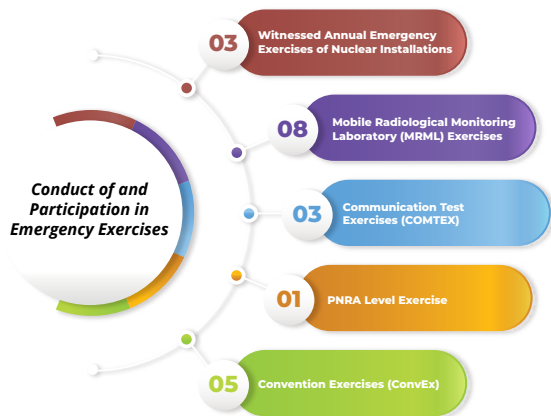
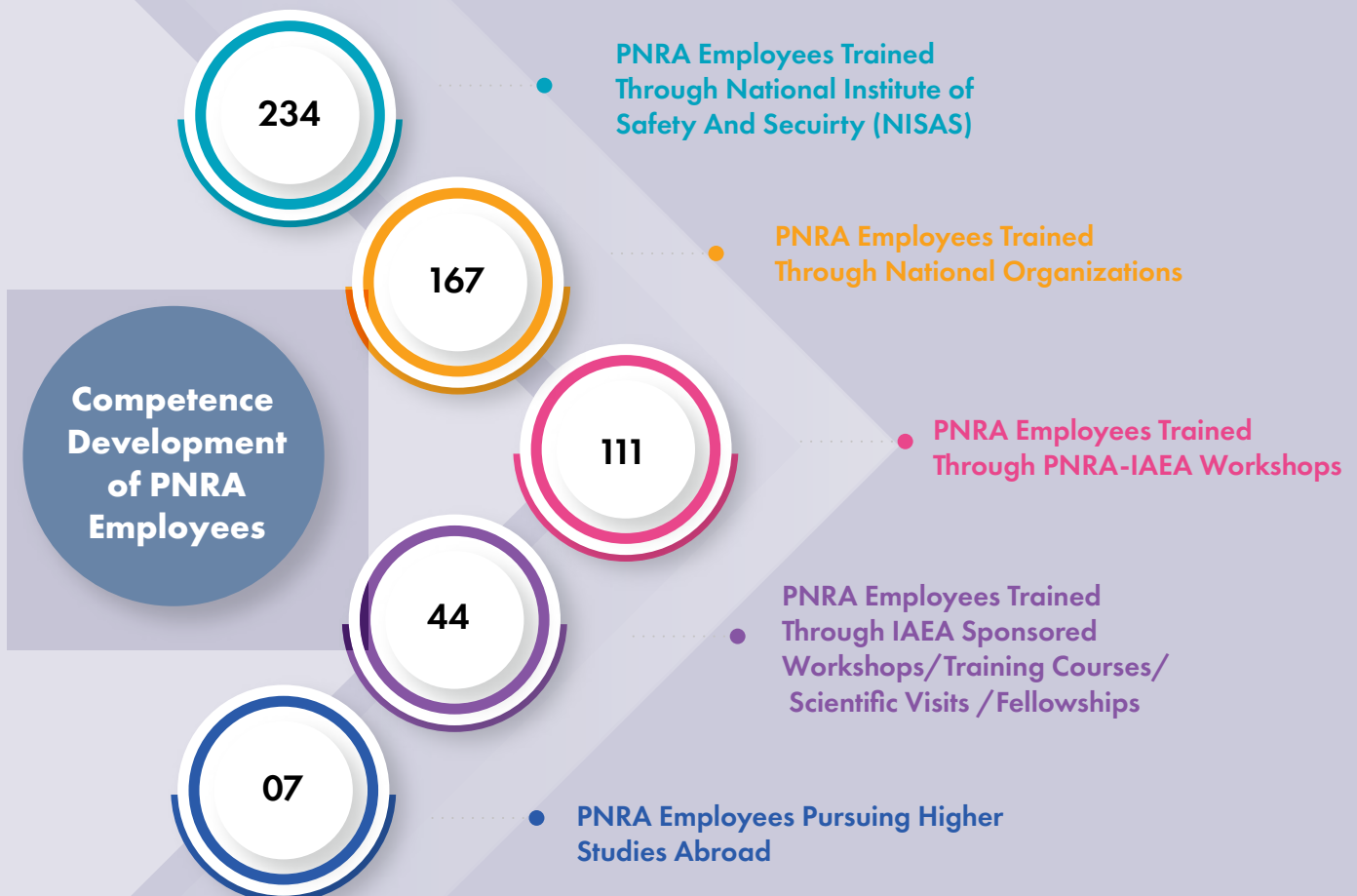


Figure-31: Status of emergency exercises

During 2019, PNRA reported one incident regarding loss and subsequent recovery of an industrial radiography source to NEWS and ITDB.

During this year, information about 38 events was received and shared with relevant stakeholders. 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.

8. CAPACITY BUILDING



Nuclear installations and radiation facilities use nuclear / radioactive material which may pose radiation risks to the workers, the people and the environment in case of unusual or abnormal occurrences.

The responsibility of regulating safety of such facilities is vested in PNRA to ensure that all regulatory requirements are being fulfilled during their life time. Therefore, it is essential for PNRA to have competent, experienced and skilled manpower.

PNRA strives for capacity building of its employees to be abreast with the latest technological advancement in nuclear safety, radiation protection and nuclear security.

In this regard, PNRA has in place a systematic approach to perform competence need assessment of its employees. This helps in identification of gaps in the existing and desired competencies of the employees.

Based on the gaps, PNRA adopts various strategies for achieving the desired competencies. PNRA also makes efforts for improving technical resources, infrastructure, manpower and desired competencies of employees through various Public Sector Development Programme (PSDP) projects as well.

These efforts are ultimately contributing towards improvement in regulatory oversight of nuclear installations and radiation facilities in the country. This Chapter describes PNRA strategies for organizational capacity building.

8.1 Competence Development of Regulatory Officials

Capacity building at PNRA is performed through in-house training facilities, training at national institutes, training through international organizations arranged under the auspices of the IAEA and bilateral agreements.

8.1.1 Competence Development through In-House Training Facility

PNRA has established a training institute namely, National Institute of Safety and Security (NISAS), for arranging in-house training courses for professionals of the regulatory body and stakeholders. NISAS is an ISO 9001:2015 certified training institute with necessary training aids.

The available training resources include class room aids, scaled down models of NPP equipment and various laboratories such as radiation detection and physical protection laboratories, etc. In addition, a soft panel training simulator is available for training of PNRA inspectors to understand plant behaviour during normal operation and accident conditions.

The institute has well qualified and professional faculty capable to provide guidance in all regulatory domains like nuclear safety, radiation protection and nuclear security. In addition, experts from different PNRA departments are also invited to support and contribute towards the competence development programme. Some of the major training facilities available at NISAS are shown in Figure-32.



Figure-32: Major training facilities of NISAS

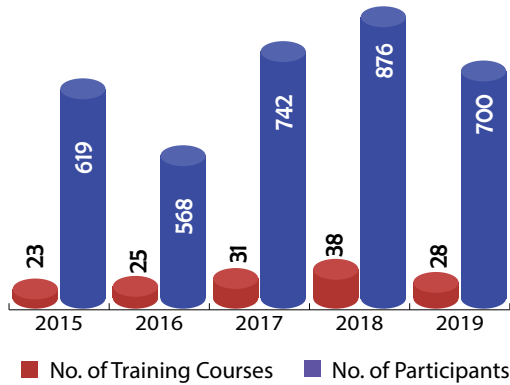


Figure-33: Summary of training courses conducted at PNRA

NISAS finalizes its annual training calendar in consultation with other PNRA departments. Training courses and workshops are included in the training calendar according to the needs of different organizational units of PNRA and its stakeholders.

During the year 2019, PNRA conducted 28 training courses at NISAS in the areas of nuclear safety, nuclear security, radiation protection, regulatory framework, emergency response, management skills, etc.

More than 230 professionals from PNRA and around 460 professionals from other organizations participated in these training

courses at NISAS in 2019.

Figure-33 presents a trend of training courses conducted along with number of participants during the last five years.

8.1.2 Competence Development through National Organizations

There are several organizations in Pakistan which provide education and training in different specialized areas which are helpful for enhancing competence in regulatory functions.

PNRA nominates its officials to participate in education and training activities arranged at reputed national organizations for improving their qualification, knowledge and skills.

a) Higher Education at National Organizations

There are two reputed national educational institutions in Pakistan namely Pakistan Institute of Engineering and Applied Sciences (PIEAS) and Karachi Institute of Nuclear Power Engineering (KINPOE).

These institutes provide higher studies in nuclear science and relevant fields leading to the award of Master's and doctoral degrees.

PNRA has signed memorandums of understanding with these institutions for fellowship scheme, under which young graduates are awarded fellowships for higher



Briefing to DG ESA-SPD on his visit to NISAS laboratories

studies in nuclear engineering, systems engineering, medical/health physics and nuclear power engineering.

Moreover, in-service employees are also encouraged and facilitated to pursue higher studies at other national institutes/universities.

In 2019, nine graduates from PIEAS have joined the organization after successful completion of Master's degree programmes in various disciplines.

Currently, nine PNRA employees are pursuing their postgraduate and doctoral degree programmes in various national universities in technical as well as management disciplines.

b) Training at National Organizations

There are several training institutes in the country which arrange training courses, workshops and seminars in various disciplines. The most important among these organizations include Pakistan Welding Institute (PWI); National Centre for Non-Destructive Testing (NCNDT); Pakistan Manpower Institute (PMI); and Secretariat Training Institute (STI).

These institutes conduct trainings in welding techniques, technical skills in non-destructive examinations, managerial and interpersonal skills.

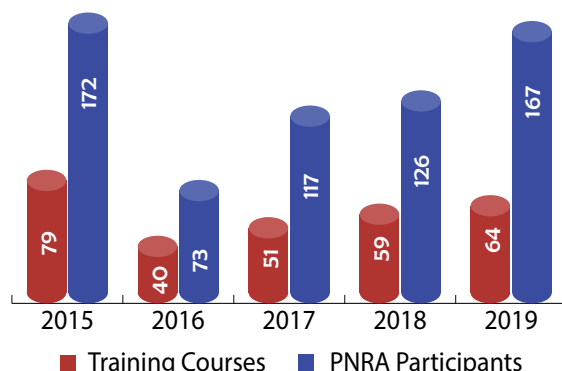


Figure-34: Participation of PNRA officials in training opportunities at various national institutions

PNRA nominates officials for trainings in these training centres. During the year 2019, more than 160 officials of PNRA participated in around 60 training events at these national institutions.

Figure-34 reflects participation of PNRA employees in various training courses arranged at national institutions during the last five years.

8.1.3 Competence Development through International Organizations

PNRA gives due consideration to the advancements in the nuclear field that are taking place at the international level. PNRA benefits from the opportunities offered by international organizations for the capacity building of its regulatory staff. The main part of



IAEA expert addressing participants during workshop on review and design assessment of NPP spent fuel dry storage facility held at PNRA HQs



the training activities relates to that offered by the International Atomic Energy Agency (IAEA) at its Headquarters or arranged at the regulatory bodies of other countries.

In addition, the IAEA also arranges training courses and workshops at PNRA HQs under its technical cooperation programme. Further, PNRA also utilizes bilateral cooperation with China and educational opportunities at international universities for the capacity building of its officials. The succeeding sections briefly describe PNRA's competence development through these arrangements.

a) Competence Development through IAEA

The International Atomic Energy Agency (IAEA) organizes various events for the capacity building of professionals from Member States. These events include training courses, workshops, fellowships and scientific visits in the areas of nuclear safety, radiation safety, waste safety, transport safety, emergency preparedness & response, physical protection, nuclear security, etc.

PNRA officials regularly participate in competence development events organized by IAEA. During the year 2019, five PNRA officials participated in fellowships offered by IAEA in technical areas of regulatory domains in different countries.

Furthermore, ten officials proceeded to various

foreign organizations for scientific visits and 29 received training through participation in IAEA workshops and training courses.

Moreover, seven workshops were arranged at PNRA in collaboration with IAEA. More than 190 officials of PNRA and other stakeholders participated in these workshops.

b) Competence Development under Bilateral Cooperation

PNRA has bilateral agreements of cooperation with National Nuclear Safety Administration (NNSA), Nuclear Safety Centre (NSC) and China Nuclear Power Operation Technology Corporation, Ltd. (CNPO) of the People's Republic of China. This bilateral cooperation has played significant role in the capacity building of PNRA.

These institutes / organizations provide various training opportunities like workshops and attachments of PNRA officers to enhance their knowledge, expertise and skills.

During this year, 12 PNRA officials completed trainings at various Chinese institutions. In addition, a training course was also organized by CNPO personnel at PNRA Headquarters.

c) Competence Development at International Universities

PNRA encourages its employees to improve their academic qualification by allowing them to



Briefings to Moroccan and Malaysian delegates on PNRA physical protection laboratories

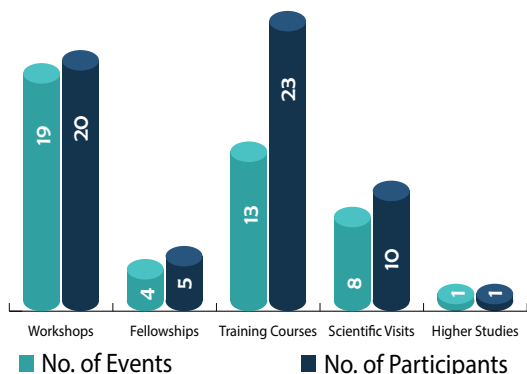


Figure-35: Competence development through international organizations and institutions

pursue higher studies at foreign universities. The officers take part in competition for the award of Higher Education Commission scholarships and foreign universities funded scholarships.

During 2019, two employees joined PNRA after successful completion of higher studies from reputed international universities / institutes namely Korea Advanced Institute of Science and Technology (KAIST) and Seoul National University (SNU).

In 2019, one PNRA employee was enrolled for Ph.D programme in Nuclear Engineering in China. Currently, seven officials are pursuing Ph.D studies in various universities in Switzerland, South Korea, China and USA. Figure-35 reflects detail of competence development activities of PNRA employees

through international organizations during 2019.

8.2 Public Sector Development Programme (PSDP) Projects

PNRA is also benefitting from Public Sector Development Programme (PSDP) of the Government of Pakistan through development of its infrastructure and human resources for strengthening the regulatory regime.

Three PSDP projects of PNRA are currently being executed. These include up-gradation of National Radiological Emergency Coordination Centre (NRECC); Design Assessment and Analysis of NPPs (DAAP); and Cyber Security and Digital Safety (CSDS).

These projects are aimed to further develop infrastructure and enhance capabilities for response to nuclear accidents or radiological emergencies, cyber security and design assessment of NPPs. The detail of these projects is given in the following subsections.

8.2.1 National Radiological Emergency Coordination Centre

The objective of the project is to enhance PNRA's capabilities for advising Government and relevant organizations to implement protective measures in case of a nuclear accident or radiological emergency. Under



Briefing to Chairman Joint Chiefs of Staff Committee (CJSC) and DG SPD on scaled-down models of NPP's equipment



Participants of IAEA workshop on development of protection strategies for emergency exposure situations held at PNRA HQs

this project, PNRA is upgrading its existing emergency coordination centre. The upgrades include display of online environmental monitoring and meteorological data at PNRA Headquarters. NRECC has also acquired radiological consequence assessment tools and reliable communication means under this project for radiological assessment and secure communication among concerned officials.

The construction of the NRECC building adjacent to PNRA Headquarters building is expected to be completed during next year.

During 2019, NRECC completed testing of detectors for online environmental radiation monitoring and prepared plan for the deployment of these detectors throughout the country.

8.2.2 Design Assessment and Analysis of NPPs

PNRA is executing a PSDP project named "Design Assessment and Analysis of NPPs"



IAEA experts, PNRA management and participants of workshop on licensing of design and manufacturing of class 1E I&C and electrical equipment, components and systems of NPPs held at PNRA HQs

(DAAP) in order to strengthen PNRA's capabilities for design assessment and analysis of NPPs. Under this project, PNRA is enhancing existing capabilities of regulatory officials in assessment and analysis of design of NPPs, acquiring new software and updating available analytical tools.

Eight training events were organized under this project during 2019 at national and international level. Furthermore, one analytical software and one latest design & construction code was procured while licence of one analytical software was renewed. Moreover, 11 PNRA officials were attached with organizations of China and two in Romania for capacity building. These attachments were arranged for trainings on different analytical software, codes & standards.

8.2.3 Cyber Security and Digital Safety

Digital systems introduced in nuclear power

plants are prone to cyber attacks. PNRA initiated a PSDP project titled, Cyber Security & Digital Safety (CSDS) with the aim to develop a team of professionals and enhance their expertise in cyber security to ensure safety of digital based nuclear installations.

The team will also help in developing the regulatory infrastructure for ensuring safety of nuclear installations with digital systems. This project will also be utilized for ensuring the cyber security of PNRA's official network.

PNRA is in process to develop liaison with international institutions having expertise in the domain of cyber security. In this regard, initial discussion was made with NNSA, China to establish liaison with Nuclear and Radiation Safety Centre (NSC), China Nuclear Power Engineering Company (CNPE), Tsinghua University and Nuclear Power Institute of China.



Member Corporate PNRA presenting souvenir to IAEA expert at the conduct of international school of nuclear and radiological leadership for safety at PNRA HQs

9. COLLABORATION WITH NATIONAL AND INTERNATIONAL ORGANIZATIONS

Conduct of Workshops by IAEA in Pakistan under TC Project

05

04

Quarterly Summary Reports on Safety of NPPs for Government

IAEA Sponsored Scientific Visits and Fellowships

12

16

Corporate Level and Coordination Meetings with the Licensees

Officials of other Nuclear Regulatory Bodies Trained at PNRA

21

32

Public Awareness Seminars

Trainings/Workshops/Orientations hosted by Physical Protection Exterior Laboratory (PPEL)

34

42

Participation of PNRA Experts in International Events

Radiation Detection Equipment handedover to National Stakeholders

14

466

Trained Officials of Licensees and other Stakeholders



Collaboration with national and international organizations is very important for improvement of regulatory processes and implementation of regulatory functions in an efficient and effective manner. Sharing of regulatory information, feedback and resources amongst organizations require an effective mechanism of cooperation which ultimately leads to strengthening of global nuclear safety and security regimes.

PNRA has maintained a strong working relationship with relevant organizations for dissemination of information, knowledge and experience in regulatory perspectives. The collaboration also contributes in sharing of experience feedback, education, training and research and development. These efforts enhance confidence of public, Government and other stakeholders on PNRA's performance. PNRA's efforts to establish and enhance this cooperation are described below:

9.1 Collaboration at National Level

PNRA maintains close collaboration at national level with different stakeholders including Government organizations, licensees, general public and educational institutions. PNRA utilizes this cooperation for sharing of information and regulatory decisions with its stakeholders. In

addition, PNRA organizes public awareness campaigns regarding benefits, risks and protection from the hazards of ionizing radiation. Figure-36 reflects the PNRA's cooperation arrangement at national level.

9.1.1 Interaction with Government Organizations

PNRA maintains an effective coordination with relevant Government organizations. These governmental organizations include Strategic Plans Division, Ministry of Foreign Affairs, Planning Commission, Ministry of Finance, Federal Board of Revenue, Law Enforcement Agencies and other organizations.

PNRA shares the safety status of nuclear power plants with the Strategic Plans Division and other relevant stakeholders on quarterly basis. During the year 2019, PNRA prepared and shared four reports comprising information on the operational performance of NPPs, radiation protection and significant events observed during regulatory oversight of nuclear and radiation facilities.

PNRA also provides technical support to national stakeholders in areas of physical protection and nuclear security. During 2019, PNRA distributed 14 radiation detection equipment to different national organizations for detection of illicit

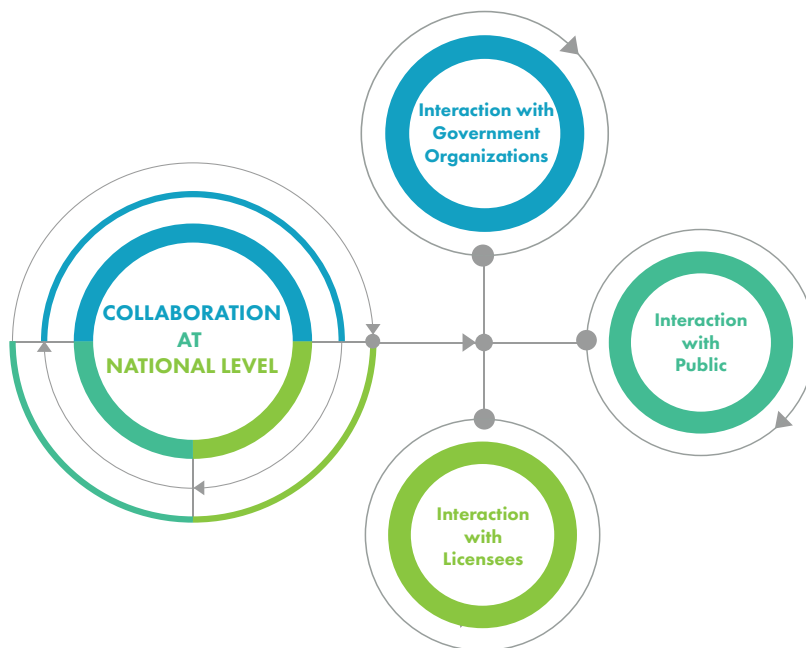


Figure-36: PNRA cooperation arrangements at national level



Meeting of Chairman PNRA with the Chief Minister of Gilgit Baltistan

trafficking of nuclear or radioactive material. These included Pakistan Customs, Civil Defence, National Logistic Cell and Pakistan Institute of Engineering and Applied Sciences.

Furthermore, PNRA provides technical assistance and advice to Federal and Provincial Government and other response organizations in case of radiological emergencies. Moreover, PNRA experts provide technical assistance to national organizations under Nuclear Emergency Management System (NEMS) in case of a radiological emergency or a nuclear security event.

9.1.2 Interaction with Licensees

PNRA conducts periodic meetings with its major licensees to discuss safety and security issues at nuclear installations and radiation facilities.

PNRA also obtains feedback from its licensees on its performance to identify any gaps in regulatory matters for further improvements.

Furthermore, PNRA invites relevant stakeholders in training courses for enhancing their understanding and knowledge in areas related to nuclear safety, radiation safety and nuclear security.

During 2019, PNRA convened two corporate level meetings with the management of its major licensees. In addition, PNRA held 14 coordination meetings with the management of operating and under construction nuclear installations, equipment manufacturers and service providers. PNRA also arranged a meeting with licensees of industrial radiography firms to discuss safety and security related challenges in radiography.



Meeting of Chairman PNRA with the Prime Minister of Azad Jammu and Kashmir



PNRA sent a questionnaire to licensees of radiation facilities to obtain their feedback on regulatory performance of PNRA. The receipt of responses remained in progress during this year.

Furthermore, PNRA provided trainings to more than 460 personnel of licensees and other stakeholders including Pakistan Customs, Rescue 1122, Punjab Police, etc. during the year 2019.

9.1.3 Interaction with Public

PNRA is running a public awareness programme in the country. The aim of this programme is to enhance public awareness on the applications of ionizing radiation in everyday life; associated hazards on human health and environment; and protection from the radiation hazards. Under this programme, PNRA conducts seminars at universities, colleges, schools, hospitals and other organizations all over the country.

During the year 2019, PNRA conducted 32 seminars in various educational institutions. More than 4000 individuals participated in these seminars. Figure-37 shows a graphical representation of public awareness seminars conducted and participation trend in these sessions over the past five years.

9.2 Collaboration at International Level

PNRA maintains close cooperation with several

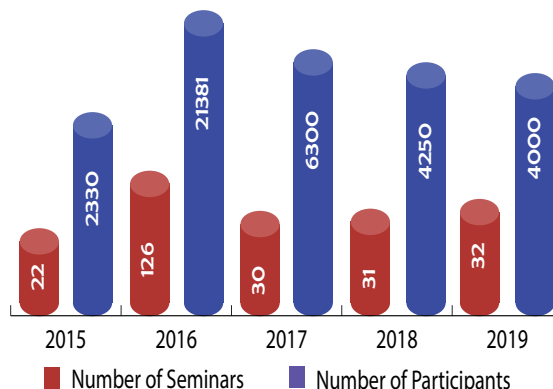


Figure-37: Summary of public awareness campaign

international forums including International Atomic Energy Agency (IAEA), regulatory bodies of other countries and technical support organizations of the People's Republic of China.

These forums are used for sharing regulatory experiences, providing expert services and enhancing technical capabilities of employees.

In addition, PNRA, as the national contact point to several International Conventions, maintains close cooperation with international organizations for the fulfillment of Pakistan's obligations. Further, PNRA represents Pakistan in United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). Figure-38 represents PNRA's cooperation endeavours at international level.

9.2.1 Collaboration with the IAEA

PNRA collaborates with IAEA for technical and



Visit of Chairman Joint Chiefs of Staff Committee to PNRA



Figure-38: PNRA cooperation arrangements at international level

scientific support in nuclear safety, radiation safety, waste and transport safety, nuclear security, radiation protection and emergency preparedness & response. PNRA also collaborates with IAEA for implementation of various international conventions. PNRA also provides technical assistance to other Member States under the auspices of IAEA.

a) IAEA Committees, Forums and Working Groups

Several IAEA Safety Standard Committees comprising of senior representatives from Member States are functional at the Agency. These committees provide guidance and recommendations in the development of international safety standards. PNRA experts regularly participate and contribute in the proceedings of these committees and forums. Moreover, IAEA has established an International Reporting System for operating

experience (IRS). The aim is to report unusual events for sharing of experiences to improve safety of nuclear power plants. Further, PNRA experts participate in the International Generic Ageing Lessons Learned (IGALL) to develop documents containing technical information on ageing management of nuclear power plants. During 2019, PNRA's experts represented Pakistan in a number of events and meetings organized by IAEA. These included meetings of the commission and committees on IAEA safety standards, IGALL Programme, steering committees of Global Nuclear Safety & Security Network and Technical & Scientific Support Organization.

b) IAEA Missions, Consultancies and Technical Meetings

The IAEA convenes different missions, consultancy and technical meetings for different purposes. The activities include Integrated Regulatory Review Service (IRRS), development of safety standards, preparation of training material, technical documents and conduct of training courses, workshops and seminars in Member States.

During 2019, 42 technical experts of PNRA contributed in activities conducted by IAEA.

PNRA provides support to IAEA in the conduct of international missions and consultancies. In addition, PNRA participates in workshops, seminars and conferences and provides



Chairman PNRA presenting souvenirs to Director Division of Nuclear Installation Safety (NSNI) and Head Regulatory Activities Section, NSNI-IAEA during their visit to PNRA HQs



services in other activities like development of technical documents and implementation of trainings for embarking countries. PNRA's contribution has been acknowledged at various forums.

Figure-39 reflects status of expert services provided by PNRA to IAEA during 2019.

c) IAEA Cooperation Programme and Projects

IAEA provides assistance to Member States through various technical cooperation programmes, regional, inter-regional and research projects. PNRA has been participating in a number of activities under these programmes and projects.

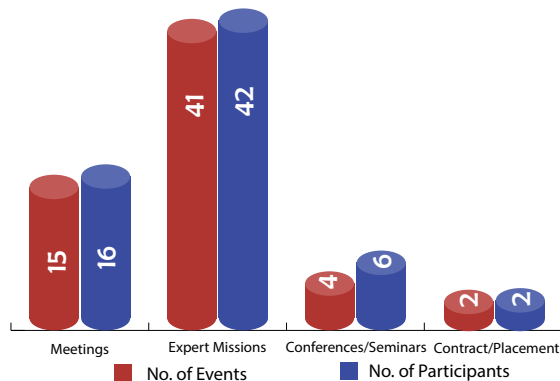


Figure-39 : Expert services provided to IAEA

IAEA is implementing a comprehensive national technical cooperation project for Pakistan titled "Strengthening and Enhancing Capabilities of Pakistan's National Institutes to Support Safe, Reliable and Sustainable Nuclear Power Programme".

technologies such as passive safety features and digital instrumentation & control in new designs of NPPs through this project.

During the year 2019, PNRA conducted five workshops in Pakistan under this project for which 13 international experts visited PNRA. In addition, IAEA TC delegation, headed by PMO Asia and Pacific section, visited PNRA in January 2019 and shared progress of TC Project PAK/2007 with Chairman, PNRA.

The aim of this project is to develop capacities of the national institutions involved in the nuclear power programme. PNRA is benefiting from this project in capacity building of manpower particularly in safety assessments like risk informed decision making, internal and external hazard assessment, ageing management, emergency preparedness and response, waste safety and decommissioning areas. PNRA is also improving understanding in emerging

Moreover, 15 PNRA officials also participated in 12 IAEA sponsored scientific visits and fellowships in different countries.

PNRA also benefits from IAEA regional and inter-regional projects. This year, 16 PNRA officials attended 15 workshops/training courses in the areas of nuclear safety and radiation protection.

PNRA is part of IAEA Coordinated Research Projects (CRPs) on "Improved Assessment



Visit of IAEA officials to PNRA for finalizing technical cooperation programme activities for the year 2019



of Initial Alarm from Radiation Detection Instruments" and "Maintenance, Repair, and Calibration of Radiation Detection Equipment".

During 2019, PNRA participated in third coordination meeting of the research project on Improved Assessment of Initial Alarm from Radiation Detection Instruments and shared annual progress report with IAEA.

Furthermore, during 2019, an IAEA delegation comprising Director, Division of Nuclear Installation Safety (NSNI) and Head of Regulatory Activities Section (RAS) visited PNRA to discuss elements of cooperation for regulatory infrastructure and safety of nuclear installations in Pakistan.

d) Pakistan-IAEA Nuclear Security Cooperation Programme

Since 2005, Pakistan and IAEA are working closely, under Nuclear Security Cooperation Programme, for the establishment and sustainability of an effective nuclear security regime in the country. Under this programme, up-gradation of physical protection measures around nuclear medical centres and Karachi Nuclear Power Plant Unit 1 (K-1) were initiated. PNRA is the designated focal point for implementation of this programme in Pakistan.

During the year 2019, projects on physical protection upgrades at K-1 and 12 nuclear medical centres of PAEC were completed. In this regard, IAEA delegation comprising Director Division of Nuclear Security and Section Head,

Nuclear Security of Materials and Facilities Section visited Pakistan in December 2019 for formal signing-off these projects.

During 2019, Pakistan hosted a number of events at Physical Protection Exterior Laboratory at PCENS, Chakri. These included 13 visits of delegations, four workshops and 30 trainings / orientations.

e) Technical Cooperation with Nuclear Regulatory Bodies

PNRA provides technical and scientific support to regulatory bodies of other Member States under the auspices of the IAEA. During the year 2019, PNRA signed a Memorandum of Understanding (MoU) with Nigerian Nuclear Regulatory Authority (NNRA) for capacity building of NNRA regulatory staff.

Under this MoU, Director General NNRA along with senior officials visited PNRA on Scientific Visit. Accordingly, two batches comprising of seven NNRA officials completed fellowships at PNRA in the field of review and assessment of NPPs.

Further, PNRA hosted four officials from Moroccan Regulatory Body and a delegation of ten officials from Malaysian Atomic Energy Licensing Board (AELB) for trainings in nuclear and radiological safety and security.

f) International Conventions

Pakistan is signatory to Convention on Nuclear Safety, Convention on Early Notification of a



Visit of Director Division of Nuclear Security (NSNS) and Head Nuclear Security of Materials and Facilities Section, NSNS - IAEA to PNRA HQs



Nuclear Accident, Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency and Convention on Physical Protection of Nuclear Material.

Pakistan submitted its national report for the 8th meeting of the Convention on Nuclear Safety (CNS) in September 2019.

PNRA, on behalf of the Government of Pakistan, acts as the National Contact Point for the implementation of obligations under these conventions.

PNRA is also involved in the implementation of Pakistan's volunteer commitments under IAEA Codes of Conduct on Safety of Research Reactors and Safety & Security of Radioactive Sources.

PNRA played lead role in preparation of CNS report. PNRA also reviewed reports of other contracting parties and posted questions on the CNS web portal. PNRA officials including elected Vice Chairperson of CNS Committee and nominated CNS Coordinator participated in meeting of the officers of CNS held in Vienna, Austria.

Further, PNRA represented Pakistan in a workshop arranged by IAEA for the contact points of emergency conventions held in Vienna, Austria.

9.2.2 United Nations Scientific Committee on the Effects of Atomic Radiation

Pakistan is a member of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). PNRA, on behalf of the Government of Pakistan, participates in the proceedings of this committee. During the year 2019, PNRA actively participated in the proceedings of 66th Annual Session of UNSCEAR and contributed in finalization of a number of documents during the session. PNRA also shared simplified national data for UNSCEAR's global survey on occupational exposures.

9.2.3 Bilateral Cooperation with People's Republic of China

PNRA maintains strong cooperation with different Governmental organizations of the People's Republic of China. In this regard, PNRA has established bilateral cooperation agreements for exchange of information and regulatory experience with three organizations. These include National Nuclear Safety Administration (NNSA); Nuclear Safety and Radiation Protection Center (NSC); and China Nuclear Power Operations Technology Corporation Ltd. (CNPO).

During the year 2019, NNSA team comprising three officials participated in joint inspection at Chashma site. In addition, two PNRA officials were placed at China National Nuclear Operations Management Company (CNNOMC) for professional trainings during this year.



Signing of MoU between PNRA and Nigerian Nuclear Regulatory Authority (NNRA) for capacity building of NNRA staff

10. PERFORMANCE REVIEW

PNRA'S PERFORMANCE ASSESSMENT IN 2019

INDICATOR 1 Ensures that acceptable level of safety is being maintained by licensees	INDICATOR 2 Ensures that regulations and guides are in position and understood by licensees	INDICATOR 3 Strives for continuous improvement of its performance
INDICATOR 4 Takes appropriate actions to prevent degradation of safety and to promote safety improvements	INDICATOR 5 Takes appropriate steps for human resource development and has competent and certified regulatory staff	INDICATOR 6 Ensures legal actions are taken in case of violations of regulatory requirements
INDICATOR 7 Performs its functions in a timely and cost-effective manner	INDICATOR 8 Ensures that a well established quality management system exists	INDICATOR 9 Ensures that adequate resources are available for performing its functions and Technical Support Centre is available for specialist assistance when required
INDICATOR 10 Performs its functions in a manner that ensures confidence of the operating organizations	INDICATOR 11 Performs its functions in a manner that ensures confidence of the general public	INDICATOR 12 Performs its functions in a manner that ensures confidence of the Government

SATISFACTORY >  MINIMALLY ACCEPTABLE >  NEEDS IMPROVEMENT > 
UNSATISFACTORY >  NOT ACCEPTABLE > 



Performance monitoring and assessment of organizational activities play a vital role to ensure that assigned tasks and functions are carried out in an effective and efficient manner. PNRA performs monitoring and assessment of its activities and processes to assess its overall regulatory performance through various mechanisms at regular intervals.

These include various mechanisms of monitoring, self assessment and independent assessment. The mechanisms of monitoring include implementation of various action plans, work plans and strategic plans. Self assessment includes assessments made by various departmental units and at organizational level against performance indicators. Independent assessments include internal regulatory audit of various departments and external assessments conducted by international organizations and feedback obtained from PNRA's licensees. Various monitoring and assessment mechanisms in place at PNRA are described below:

10.1 Progress Monitoring

PNRA has developed a strategic plan under which a number of tasks have been identified to achieve the goals and objectives. These tasks are assigned to various departments of PNRA. In addition, regular tasks and functions of each department are also defined. Each department establishes its annual work plan. Progress of these work plans are monitored at department level on monthly basis whereas the progress of all the departments are evaluated at organization level on quarterly basis. Accordingly, monthly progress reports and quarterly evaluation reports are issued. The evaluation reports identify areas for further improvement so that necessary actions are initiated. In addition, progress of strategic plan is reviewed periodically by senior management.

During 2019, upon completion of PNRA strategic plan 2015-18, an overall monitoring of the strategic plan activities was performed and its report was issued. Further, four Quarterly Performance Evaluation Reports (QPERs) were issued in 2019. These reports were shared with relevant PNRA departments for taking necessary actions.

10.2 Self Assessment

Self assessment is another methodology used by PNRA for its performance assessment against predefined Strategic Performance Indicators (SPIs). This assessment is made every year

and its results are shared with public and other stakeholders through PNRA Annual Report. This year, the overall performance assessment of PNRA during 2019 remained satisfactory.

PNRA departments also carry out their self assessment biennially and devise action plans to further improve their performance, effectiveness and efficiency. During this year, a number of PNRA departments performed their self assessment. Accordingly, action plans were prepared and actions initiated.

10.3 Independent Assessment

The regulatory audit of PNRA departments by independent internal teams is conducted once every two years which is followed up next year. During 2019, follow-up of the 4th regulatory audit was performed and a report about the updated progress of all PNRA departments against the audit findings was issued.

During 2019, PNRA also continued to monitor the progress on the action plan developed to address recommendations and suggestions of IAEA Integrated Regulatory Review Service (IRRS) Mission. The progress of IRRS action plan is also being monitored at Government level. A steering committee comprising representatives from Strategic Plans Division, Pakistan Atomic Energy Commission, Ministry of Foreign Affairs and PNRA has been formed for oversight of implementation of the action plan. During 2019, several meetings of the steering committee were held to discuss the progress made so far. Actions on seven recommendations and 22 suggestions have been completed, whereas actions on remaining six recommendations and nine suggestions remained in progress.

10.4 Performance Indicators-2019

PNRA has defined 12 Strategic Performance Indicators (SPIs). These are supported by downstream Specific Performance Elements (SPEs). The performance against each indicator is evaluated and rated in five levels i.e. Satisfactory, Minimally Acceptable, Needs Improvement, Unsatisfactory and Not Acceptable. The evaluation made against each indicator during this year is delineated below:

Performance Indicator 1 - "Ensures that acceptable level of safety is being maintained by licensees"

This indicator is assessed on the basis of performance elements related to regulatory processes of review and assessment, inspection



and enforcement and reporting of events.

During 2019, K-2/K-3 submitted FSAR for grant of fuel load permit. Accordingly, PNRA raised a number of queries and shared with the licensee. As an outcome of the safety review, the designer agreed to incorporate improvements in design. PNRA also reviewed a number of submissions of C-series NPPs related to refueling outage, programmes, technical reports, etc. Furthermore, PNRA approved revised FSAR of PARR-1 in 2019 upon satisfactory resolution of regulatory queries. In addition, PNRA reviewed FSAR submitted by MPF in light of applicable regulatory requirements and raised a number of review queries.

PNRA reviewed Safety Analysis Report of an advance diagnostic equipment being installed in a health facility in Rawalpindi. Similarly, shielding calculations of ten radiation facilities for installation of latest radiation devices were evaluated and found in line with the regulatory requirements. Further, PNRA reviewed a number of submissions related to radiation facilities, identified gaps and communicated to licensees.

In 2019, PNRA conducted regulatory inspections of nuclear installations, radiation facilities, equipment manufacturers and service providers to ensure compliance of regulatory requirements. The inspection findings were communicated to the respective licensees and actions were taken accordingly. The enforcement actions were also taken in case of any non-compliance of regulatory requirements.

During this year, PNRA witnessed emergency exercises at K-1, C-series NPPs and PARR-1. 26 emergency drills were also conducted by radiation facilities. Implementation of corrective action plans was also followed up. Further, PNRA analyzed a number of events, identified the lessons learnt and shared with relevant stakeholders for improvement of radiation safety. Chapter 4, 5 and 7 of this report present detail of these activities.

PNRA ensured through these activities that the licensees have maintained an acceptable level of safety during their activities. Accordingly, PNRA's performance against this indicator is rated as **"Satisfactory"** for the year 2019.

Performance Indicator 2 - "Ensures that regulations and guides are in position and understood by licensees"

This indicator is evaluated on the basis of availability of regulations and guides and licensees' perception & understanding of these

regulations and guides.

In 2019, PNRA planned to issue two new regulations, revise and amend one regulation each; and issue four regulatory guides. Accordingly, PNRA promulgated two new regulations, revised and amended four regulations. PNRA also issued six regulatory guides during 2019. Furthermore, development / revision of several other regulations and regulatory guides remained in progress.

During 2019, PNRA shared a number of draft regulations with its stakeholders including licensees. The feedback of stakeholders was given due consideration during the process of development and revision of regulatory framework. In addition, PNRA organized several training courses for licensees. These actions helped to enhance licensees' understanding about PNRA's regulatory framework. Chapter 2 and Chapter 8 of this report present further detail of these activities.

Keeping in view PNRA's efforts regarding development of regulations and regulatory guides and their understanding, PNRA's performance for the year 2019 against this indicator is rated as **"Satisfactory"**.

Performance Indicator 3 - "Strives for continuous improvement of its performance"

This indicator is assessed on the basis of improvements made in regulatory processes / activities as identified by different monitoring and assessment processes. These include activities related to self assessments and independent assessments.

During 2019, a number of PNRA departments performed self assessments. PNRA also conducted follow-up of the 4th regulatory audit and issued report on the progress of recommendations and suggestions. Furthermore, overall progress monitoring of the implementation of Strategic Plan 2015-2018 and quarterly performance evaluation of all departments were conducted as scheduled. Corrective actions were initiated accordingly, where required. In addition, PNRA finalized and issued Strategic Plan for the years 2019-2023.

During 2019, PNRA continued implementation of the recommendations and suggestions of IRRS Mission. In this regard, PNRA periodically monitored progress and shared with relevant stakeholders. These efforts resulted in improvement in a number of regulatory documents and management system procedures of PNRA. Further details of these



activities are presented in section 10.1, 10.2 and 10.3 of this Chapter.

Through these endeavors, PNRA consistently made efforts for improvement in its performance. Accordingly, this indicator is rated as **"Satisfactory"**.

Performance Indicator 4 - "Takes appropriate actions to prevent degradation of safety and to promote safety improvements"

PNRA assesses this indicator keeping in view the activities related to conduct of periodic safety assessment of licensees; implementation of necessary design modifications and international experience feedback.

During 2019, PNRA reviewed safety analysis report of dry storage facility for C-series NPPs. Accordingly, PNRA issued preliminary safety evaluation report upon compliance of regulatory requirements and awarded construction licence in November, 2019. Furthermore, PNRA prepared guidance level document to be used during review of periodic safety reports of NPPs.

PNRA performed safety assessment of a number of industrial and medical radiation facilities to verify compliance of regulatory requirements. The assessment revealed that the overall safety performance of the radiation facilities is satisfactory. However, some radiation facilities need improvement and relevant Regional Directorates are taking necessary measures to improve the identified areas.

PNRA conducts safety assessment to assess overall safety level of nuclear power plants. During this year, PNRA performed integrated safety assessment of K-1. However, finalization of report containing recommendations for improvement in safety remained in progress. Furthermore, safety assessment of C-series NPPs could not be conducted in 2019.

PNRA approved 25 modifications of C-series NPPs during 2019. Most of these modifications were related to improvements made in view of the lessons learnt from Fukushima accident. Furthermore, five modifications submitted by K-series NPPs were reviewed and approved.

During the year 2019, PNRA evaluated operating experience feedback and prepared report which was shared with licensees and within PNRA for taking necessary actions. Further details are presented in Chapters 3 and 5 of this report.

These efforts were aimed to prevent degradation of safety and to promote safety improvements. Considering the delay in conduct

of safety assessment of C-series NPPs, delay in issuance of report of safety assessment of K-1 while keeping in view the completed activities, performance of PNRA against this indicator is rated as **"Minimally Acceptable"**.

Performance Indicator 5 - "Takes appropriate steps for human resource development and has competent and certified regulatory staff"

This indicator is evaluated on the basis of human resource development and competence development carried out during the year.

PNRA conducted 28 training courses related to nuclear safety, nuclear security, radiation protection, regulatory framework, etc. in 2019. More than 230 professionals from PNRA participated in these training courses. Moreover, 167 PNRA officials participated in 64 training courses and workshops organized by different national institutes. Furthermore, 48 officials participated in training courses, workshops and fellowships in various technical areas related to regulatory domains held in different countries. In addition, PNRA in collaboration with IAEA, organized seven workshops in which 198 PNRA officials and other stakeholders participated.

PNRA also promotes and encourages its employees to improve their academic qualification and working knowledge. At present, nine PNRA employees are pursuing postgraduate and doctoral degree programmes in various national universities while seven officials are pursuing doctoral degree programmes in various universities of Korea, China, USA and Switzerland. Chapter 8 of this report presents further detail of these activities.

These efforts supported PNRA in human resource development and to have competent regulatory staff. In view of the above activities, the performance of PNRA against this indicator is rated as **"Satisfactory"**.

Performance Indicator 6 - "Ensures legal actions are taken in case of violations of regulatory requirements"

The assessment against this indicator is based on performance elements related to availability of enforcement mechanism, serving of notices to ensure compliance with regulatory requirements and actions taken against violators.

PNRA has developed and promulgated Enforcement Regulations-PAK/950. The enforcement process is documented in PNRA's Management System Manual and detailed in subsequent organizational procedure. These



documents provide systematic approach for taking enforcement actions in case of non-compliance with regulatory requirements.

At present, all the nuclear installations and almost all the radiation facilities are under the regulatory net of PNRA. However, some medical diagnostic X-ray facilities are still out of the licensing net. PNRA is endeavoring to bring these un-licensed facilities under the regulatory ambit.

During this year, 719 new radiation facilities came under the licensing net of PNRA. Further, PNRA identified and dealt with a number of offenders and defaulters by taking appropriate enforcement actions and accordingly issued 699 directives, 239 show cause notices and 149 offence reports. PNRA also conducted 201 hearing proceedings and filed eight cases in court of law in 2019. Chapter 3 and 5 of this report describes further detail of these activities.

These activities indicate that PNRA is making efforts to ensure availability of legal mechanisms and taking actions in case of violations. However, it is noted that there is a need to further enhance enforcement measures. This is evident from the fact that a number of medical diagnostic X-ray facilities have defaulted or still out of licensing net. Accordingly, PNRA's performance against this indicator is rated as **"Minimally Acceptable"**.

Performance Indicator 7 - "Performs its functions in a timely and cost-effective manner"

This indicator is evaluated by considering the performance against predefined targets and schedules, all assigned activities are executed as planned and resources are optimized.

During 2019, PNRA completed most of the planned activities related to regulatory framework; licensing, review & assessment and inspection & enforcement of licensed facilities. A number of unplanned activities arose during the year were also handled appropriately. Similarly, the targets related to capacity building and monitoring & assessment activities, as set in work plans, were also accomplished timely.

Furthermore, PNRA also completed all planned activities under the PSDP projects, in line with approved cash and work plans. Further details are presented in Chapter 2 to 9 of this report.

In view of the above activities, the performance of PNRA against this indicator is rated as **"Satisfactory"**.

Performance Indicator 8 - "Ensures that a well established quality management system exists"

This indicator is assessed on the basis of existence of updated management system, its understanding by regulatory officials and implementation within PNRA.

During 2019, PNRA realized that some organizational elements and practices were needed to be amended to further enhance the organizational effectiveness. In this regard, an addendum regarding the changes in PNRA management system was issued. Furthermore, a number of programmes, processes and procedures were developed or updated in 2019.

Similarly, implementation of requirements mentioned in PNRA management system was ensured through various mechanisms during 2019. On the whole, PNRA made efforts to ensure complete implementation of its management system.

Considering above efforts, PNRA's performance against this indicator is rated as **"Satisfactory"**.

Performance Indicator 9 - "Ensures that adequate resources are available for performing its functions and technical support centre is available for specialist assistance when required"

PNRA assesses this indicator on the basis of availability of required financial & human resources and provision of assistance needed by technical support centres of PNRA.

In 2019, nine engineers and scientists joined PNRA after completion of PNRA sponsored MS programmes from Pakistan Institute of Engineering and Applied Sciences (PIEAS). In addition, two PNRA officials joined PNRA after successful completion of their higher studies from international universities. Chapter 8 of this report describes detail of these activities.

During 2019, the Government allocated less budget to PNRA than demanded. PNRA had to further optimize the available resources. Nevertheless, PNRA continued to perform all its planned functions and ensured to achieve organizational goals for the year 2019.

Two internal Technical Support Organizations (TSOs) comprising of skilled and experienced personnel are available at PNRA. They perform review, assessment and safety analysis using computer codes and provide necessary support to PNRA in licensing and regulatory



decision making processes. These activities are presented in detail in Chapter 4 of this report .

In general, PNRA took strict austerity measures to ensure that available resources are carefully utilized to perform necessary regulatory functions as planned. Nevertheless, development activities have been suspended due to lack of resources. PNRA ensured that technical support centre is available for specialized assistance when needed. In view of the above, performance of PNRA against this indicator is rated as **"Minimally Acceptable"**.

Performance Indicator 10 - "Performs its functions in a manner that ensures confidence of the operating organizations"

This indicator is evaluated on the basis of acquisition of feedback of licensees through a questionnaire and participation of licensees in various activities organized by PNRA.

During 2019, PNRA developed and shared a questionnaire with more than 115 radiation facilities to seek their feedback about regulatory performance of PNRA. The receipt of responses remained under progress during the year.

PNRA organized 16 meetings at various levels with licensees of NPPs, research reactors, equipment manufacturers, radiation facilities and service providers. Further, PNRA organized 28 training courses / workshops and provided trainings to more than 460 representatives of its licensees. Chapter 8 and 9 of this report describe detail of these activities.

Through these activities, PNRA tried to maintain a strong liaison with its licensees. In view of the above, PNRA's performance against this indicator is rated as **"Satisfactory"**.

Performance Indicator 11 - "Performs its functions in a manner that ensures confidence of the general public"

This indicator is assessed on the basis of performance related to public awareness programme, sharing of information with public and their involvement in preparation of regulatory documents.

During 2019, PNRA conducted 32 public awareness seminars at various organizations. More than 4000 participants attended these seminars. Further detail regarding this activity is presented in Chapter 9 of this report.

PNRA placed four draft regulations at PNRA website (www.pnra.org) for feedback from

public during 2019. The input and comments of public received were given due consideration and addressed appropriately. PNRA has noted that so far the response from public is not very significant. PNRA has to work for active involvement of public. Further detail is presented in Chapter 2 of this report.

Furthermore, PNRA shared information of major activities and regulatory decisions taken on its website and presented in its Annual Report.

Considering PNRA's efforts to ensure confidence of the general public while performing its regulatory functions and noting the need to attract more public involvement in development of regulatory framework, PNRA's performance against this indicator is rated as **"Minimally Acceptable"**.

Performance Indicator 12 - "Performs its functions in a manner that ensures confidence of the Government"

PNRA assesses this indicator on the basis of information sharing, reporting and communication of regulatory decisions to the Government and providing necessary support to Government for fulfillment of international obligations and national responsibilities.

During 2019, PNRA communicated all regulatory decisions to concerned Government organizations. PNRA shared four quarterly reports regarding safety status of NPPs with the relevant governmental departments. Further, PNRA submitted the Eighth National Report of Pakistan to the Convention on Nuclear Safety on behalf of the Government of Pakistan in 2019. This report was prepared by PNRA in collaboration with Pakistan Atomic Energy Commission, Strategic Plans Division and Ministry of Foreign Affairs. PNRA also continued implementation of all other obligations assigned to PNRA under relevant International Conventions. Chapter 9 of this report describes detail of these activities.

These efforts contributed in performing assigned functions in a manner that ensured confidence of the Government. In view of the above, the performance of PNRA against this indicator is rated as **"Satisfactory"**.

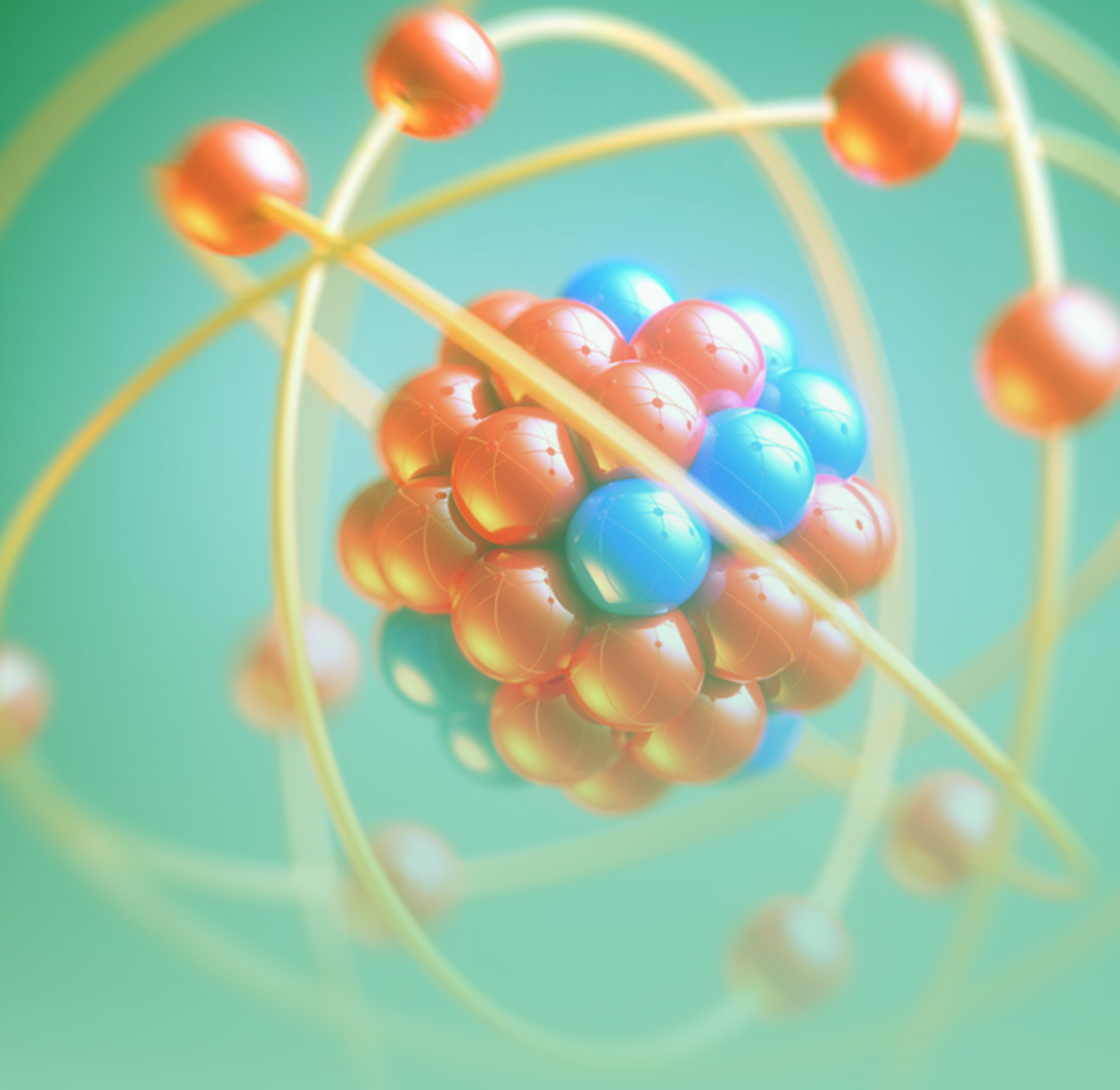
10.5 Overall Performance

Considering the evaluation presented above against 12 Performance Indicators, PNRA rates its overall performance as **"Satisfactory"** for the year 2019.

MAJOR TARGETS FOR 2020



- > Issuance of the Regulations "Safe Management of Spent Nuclear Fuel";
- > Issuance of the Revised Regulations "Safety of Nuclear Power Plants Operation";
- > Issuance of the Revised Regulations "Licensing Fee by Pakistan Nuclear Regulatory Authority";
- > Issuance of "National Policy for Safety";
- > Functioning of the Regional Nuclear Safety Inspectorates in Gilgit and Muzaffarabad;
- > Completion of Review of PAEC Application for Fuel Load Permit of K-2/K-3 and Issuing Decision on the Application;
- > Review and Decision on PAEC Application for Revalidation of the Operating Licence of C-1 up to 2030;
- > Review and Decision on Design Certification of Spent Nuclear Fuel Dry Storage Cask for C-Series Plants;
- > Decision on Licensing Application of Instrumentation Control & Computer Complex (ICCC) for Manufacturing of Safety Class 1E Equipment;
- > Performance Assessment of PNRA based on the Feedback of the Licensees of Radiation Facilities;
- > Implementation of PNRA Strategic Plan 2019-2023;
- > Revision of PNRA Strategic Performance Indicators;
- > Continue Cooperation with National and International Organizations;
- > Continue Implementation of IAEA Technical Cooperation (TC) Projects for the Cycle 2018-21;
- > Continue Implementation of Public Awareness Programme;
- > Completion of PSDP Project "Design Assessment and Analysis of Nuclear Power Plants (DAAP)";
- > Continue Execution of Public Sector Development Programme (PSDP) Projects of PNRA; and
- > Continue Implementation of Recommendations and Suggestions of Integrated Regulatory Review Service (IRRS) Mission.



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