



ANNUAL REPORT 2016





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MESSAGE FROM THE CHAIRMAN

I feel honored while presenting the annual report for the year 2016 at the twilight of my professional career and am exceptionally delighted for presenting it for eight consecutive years. From the onset of my responsibilities as Chairman, recognition of PNRA as a world class regulatory body at the national and international arenas remained the highest priority on my agenda. I am proud to say that these years have seen many successful endeavors, with a more strengthened regulatory wisdom and a much improved regulatory oversight of nuclear installations and radiation facilities in the country.

The availability of a comprehensive regulatory framework, commensurate with the latest advancements, is the basis for regulatory decisions. We have integrated all our resources for the establishment of regulations, covering all types of practices and activities involving nuclear or radioactive materials, and have been able to publish 18 regulations up to the end of this year.

Granting licences to nuclear installations remained a landmark during the year 2016. PNRA, upon satisfactory completion of its regulatory processes, granted fuel load permit to Chashma Unit 3; awarded licence to radioactive waste management facility of PINSTECH; approved the design of Type B(U) transport container; and conferred authorization to NPP service provider.

Since I took over as Chairman, bringing the maximum number of radiation facilities under PNRA net has been my topmost desire. We expanded our sphere of efforts from cities to districts and towns and I am delighted to say that the number of licensees of such facilities has been doubled in my tenure. Our efforts included initiation of legal proceedings against those who were violating the regulatory requirements; however, many challenges still remain to be addressed to bring all users in the licensing net.

Provision of comfortable work environment and decent facilities for the employees was my other dream. We were able to establish offices and related amenities including a training institute and auditorium at PNRA Headquarters; expansion of regional directorates; colony for officers and staff; regional inspectorates in Peshawar, Multan and Quetta; and laboratories in Islamabad, Chashma and Karachi. We have successfully completed five public sector development programme projects while three other projects are being implemented.


PNRA strongly believes that the general public should also be familiarized with the role of regulatory body in ensuring safety of nuclear installations and radiation facilities. I am glad to share that PNRA, during the year 2016, has organized around 125 lectures/seminars in various cities across Pakistan and conveyed its message to more than 21,000 individuals.

PNRA maintains a close liaison with the international community and participates in various technical meetings and workshops as well as provides technical support to IAEA and its Member States. Hosting of the IAEA Annual Meeting of the International Network for Nuclear Security Training and Support Centres and OIC Ministerial Standing Committee on Scientific and Technological Cooperation in Pakistan are major achievements of the year. This indicates trust-worthiness of PNRA at the international forum.

With the expanding nuclear power programme and considering the advancements and new developments in nuclear technology, PNRA will have to further enhance coordination with national stakeholders and international organizations to broaden its knowledge-base for improving safety at its licensed facilities, with the ultimate goal to make the country and the world safe from the harmful effects of ionizing radiations.

Today, I am glad to have a team of professionally competent, dedicated, skilled, committed and enthusiastic personnel, capable to amicably meet the current and future regulatory challenges. I feel proud that I have been successful in achieving the vision and mission of PNRA and feel much satisfied in handing over this national responsibility to a competent and dedicated team. I wish PNRA may continue its prosperous journey in future endeavors for ensuring protection of workers, public and environment from harmful effects of ionizing radiations.




(Mohammad Anwar Habib)

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 staff members 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



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1. INTRODUCTION

Background

Nuclear and radioactive materials are widely used throughout the world for peaceful purposes in numerous fields with the aim to improve life of the human beings. Pakistan is also benefiting from their application in power generation, research, agriculture, medical and industrial use for more than five decades. However, the application of radioactive material may also be hazardous for the workers, the public and the environment in case when such material is handled without due safety measures; or when the regulatory control is lost over the material or an activity associated with the use of radioactive material. Therefore, there is a need for establishment of an effective legislative and regulatory framework to govern the safety of nuclear installations and radiation facilities.

Such need was realized way back in 1965, when it was considered essential to regulate the use of nuclear and radioactive materials in the country in line with the international standards of radiation protection. Thus, a Nuclear Safety Committee (NSC) was constituted within the Pakistan Atomic Energy Commission (PAEC) to monitor the radiation safety matters of the first research reactor (PARR-1) installed at PINSTECH. NSC performed safety oversight till 1970 after which the committee was upgraded, as Nuclear Safety Licensing Division (NSLD), to grant permission for the startup and full power operation of the first nuclear power plant (KANUPP) installed near Karachi. The responsibilities of NSLD were limited to the safety issues within PAEC establishments and there was a need to extend the regulatory control over the use of radioactive material by the private industry.

In early 80's, it was realized that the use of nuclear and radioactive material both at the Government level and in private sector needs to be brought under the regulatory net. The Government of Pakistan promulgated "Pakistan Nuclear Safety and Radiation Protection Ordinance -1984" under which the Directorate of Nuclear Safety and Radiation Protection (DNSRP) was established for the implementation of nuclear safety and radiation protection regulations in the country. This setup continued its functions under the administrative auspices of PAEC, which was simultaneously responsible for the promotion of nuclear technology and overseeing nuclear and radiation safety of the facilities and activities.

In 1994, the Government signed the IAEA Convention

on Nuclear Safety which required the Member States to ensure effective separation between the functions of the regulatory body from the organizations responsible for promotion or utilization of nuclear energy. As a first step towards fulfillment of this obligation, Pakistan Nuclear Regulatory Board (PNRB) - as a quasi-independent regulatory body - was established in 1994.

A complete separation of promotion and regulatory functions was achieved in 2001, when the Pakistan Nuclear Regulatory Authority Ordinance was promulgated. Consequently, Pakistan Nuclear Regulatory Authority (PNRA) was established as the national regulatory authority, independent from the promoters, mandated with the powers to regulate all nuclear installations, radiation facilities and activities in Pakistan to ensure the protection of workers, general public and the environment. The Ordinance empowered PNRA to supervise, control, and regulate all matters related to nuclear safety and radiation protection in Pakistan by establishing and implementing an effective regulatory framework for the protection of life, health and property against the potential risk of ionizing radiation.

The Ordinance also outlines the composition of the Authority which consists of a Chairman, two full time Members and seven part time Members including representatives of the Ministry of Health; Pakistan Environmental Protection Agency; Pakistan Atomic Energy Commission; Strategic Plans Division of the Joint Staff Headquarters; and eminent professionals from the science, engineering and medical sectors. The operational working of the Authority is managed by various organizational units; established across the country with its headquarters in Islamabad and regional offices located in different cities. The organizational structure of PNRA is presented in Figure 1.

Under the Ordinance, PNRA is entrusted with the responsibility of licensing and authorization of nuclear installations and radiation facilities for the safe use of nuclear and radioactive materials in the country. It is empowered to inspect all such installations and facilities to verify that regulatory requirements concerning safety and physical protection are being complied with and exercise enforcement measures in case of non-compliance. The regulatory jurisdiction also covers transportation and disposal of radioactive materials. In addition, PNRA is responsible to ensure that such installations and

facilities maintain effective preparedness and coordination for managing nuclear and radiological accidents and emergencies.

Structure of PNRA Annual Report 2016

This report highlights the activities and overall achievements of PNRA during the year 2016.

Chapter one of this report summarizes the background of PNRA; and major achievements and targets.

Chapter two describes PNRA's activities performed in relation to the regulatory framework for the safety of nuclear installations; and radiation facilities and activities. The key priority at PNRA has always been the development and strengthening of a comprehensive regulatory framework in line with national and international standards and advancements in the peaceful use of nuclear applications.

Chapter three provides information about regulatory oversight of different stages of nuclear installations starting from site registration up to decommissioning and release from regulatory control. It also documents trending and analysis of radiation exposure of workers.

Chapter four addresses details regarding licensing, inspections and radiation exposures with respect to radiation facilities and authorizations for import and export of radiation sources.

Chapter five summarizes PNRA's activities related to radioactive effluents where PNRA strictly ensures that the radiation doses due to effluents discharged from nuclear installations and radiation facilities remained within regulatory limits and keeps an eye on their impact on environmental radioactivity levels. Moreover, it also describes PNRA's efforts for regulating radioactive waste generated in nuclear installations, radiation facilities and associated activities; spent nuclear fuel; and transportation of radioactive material in the country.

Chapter six presents description of activities of PNRA regarding emergency preparedness and response to nuclear accidents or radiation emergencies including functioning of national radiation emergency coordination centre, acceptance of emergency response plans, evaluation and conduct of emergency exercises and other related activities. PNRA ensures, coordinates and enforces preparation of emergency plans for actions to be taken by the relevant onsite and offsite authorities following any foreseeable nuclear incident that might affect the public or the environment.

Chapter seven of this report highlights the efforts made for the capacity building of PNRA manpower through in-house, national and international trainings and workshops arranged

during 2016. PNRA believes that effectiveness in regulatory oversight depends on the competence of its workforce in all regulatory disciplines including legal, technical, regulatory and inter-personnel proficiencies. PNRA has established an in-house training facility for professional training of its staff. Moreover, it has also maintained relationships with various national and international institutions and organizations through bilateral and multilateral initiatives for training of its employees.

Chapter eight of this report shares information about PNRA's coordination at national level with its stakeholders including Government organizations, educational & research institutes as well as about public awareness programme of PNRA. It also describes PNRA's collaboration with other countries and organizations. It gives an overview of PNRA's contributions in the international endeavors for promoting nuclear safety and security including provision of technical expert's support and consultancy services to IAEA in strengthening nuclear regulatory infrastructure worldwide.

Chapter nine of this report presents the progress of PNRA technical support centres, laboratories and development projects during 2016. It summarizes the activities of the technical support centres for review & assessment and safety analysis of licensing submissions; and laboratories for monitoring and cross verification of personal exposure and environmental monitoring. Furthermore, it also reflects the progress of development projects of PNRA.

PNRA understands the importance of performance appraisal and accordingly has established a comprehensive process of performance evaluation to assess the efficiency and effectiveness of its regulatory processes on annual basis against predefined Strategic Performance Indicators (SPIs). Accordingly, chapter ten of this report highlights the evaluation of PNRA's performance indicators based on the achievements made and areas for improvement noted during the year 2016. The performance assessment is conducted on the basis of various performance elements, qualitatively and quantitatively.



PNRA Management on Pakistan's Independence Day 2016



MAJOR ACTIVITIES IN 2016

Major activities of PNRA during 2016 are summarised as follows:

1. Granted Fuel Load Permit to Chashma Nuclear Power Plant Unit 3 (C-3);
2. Continued regulatory oversight of nuclear installations and radiation facilities;
3. Awarded licence to the PINSTECH Pre-disposal Radioactive Waste Management Facility (PPRWMF);
4. Issued design approval certificate to PINSTECH for Type B(U) Transport Container;
5. Granted authorization to the National Centre for Non-Destructive Testing (NCNDT) to perform Non-Destructive Examination (NDE) of nuclear safety class components and systems of Nuclear Power Plants;
6. Acquired ISO 9001:2008 certification for NISAS;
7. Promulgated "Regulations on Decommissioning of Facilities using Radioactive Material" (PAK/930);
8. Expanded the licensing net for diagnostic radiation facilities by about 8 percent;
9. Revised and issued updated PNRA Management System Manual;
10. Continued implementation of IRRS Mission Action Plan and PNRA Strategic Plan 2015-2018;
11. Reviewed a number of programmes and plans pertaining to radioactive waste management, radiation protection, decommissioning, emergency response and physical protection;
12. Completed rationalization of human resource requirements of PNRA directorates;
13. Conducted 25 training courses in the field of nuclear & radiation safety; and nuclear security & physical protection. More than 550 personnel from PNRA and other stakeholder organizations benefited from these training courses;
14. Organized more than 120 lectures/seminars as part of its public awareness programme in various cities across Pakistan; in which more than 21,000 personnel participated;
15. Made functional Physical Protection Exterior Laboratory (PPEL) at Pakistan Center of Excellence; and
16. Progressed satisfactorily in implementing activities of PSDP Projects of PNRA.

TARGETS FOR 2017

The targets set for 2017 are summarised as follows:

1. Revision of "Regulations for Licensing of Nuclear Safety Class Equipment and Component Manufacturers" (PAK/907);
2. Issuance of the Regulatory Guides on;
 - a. Radiation Safety in Industrial Radiography (PNRA-RG-904.03);
 - b. Protection of Patients in Diagnostic Radiology (PNRA-RG-904.05); and
 - c. Format and Contents of Radiation Protection Programme of Radiation Facilities / Activities (PNRA-RG-904.07);
3. Continue monitoring of licensees' activities in order to avoid any major incidents, overexposure of workers and radiation releases to the environment;
4. Regulatory Decision on the extension of Operating Licence to Karachi Nuclear Power Plant Unit 1 (K-1);
5. Issuance of Operating Licence to Chashma Nuclear Power Plant Unit 3 (C-3);
6. Issuance of Fuel Load Permit to Chashma Nuclear Power Plant Unit 4 (C-4);
7. Review of Site Evaluation Report of Chashma Nuclear Power Plant Unit 5 (C-5);
8. Licensing of Nuclear Equipment Workshop - 2 (NEW-2) as nuclear safety class-1 equipment manufacturer;
9. Revalidation of Heavy Mechanical Complex (HMC-3) Licence as nuclear safety class-1 equipment manufacturer;
10. Review of Safety Analysis Reports (SAR) of spent fuel dry storage casks of Karachi Nuclear Power Plant Unit 1 (K-1) and Chashma Nuclear Power Plant Unit 1 (C-1);
11. Enhancing the licensing net for diagnostic radiation facilities by another 5 percent;
12. Continue cooperation with national and international organizations;
13. Continue implementation of PNRA Strategic Plan 2015-2018;
14. Continue implementation of PNRA's Action Plan developed for IRRS Mission's recommendations & suggestions for further improvement in the regulatory framework and processes; and
15. Continue implementation of activities of Public Sector Development Programme (PSDP) Projects of PNRA.

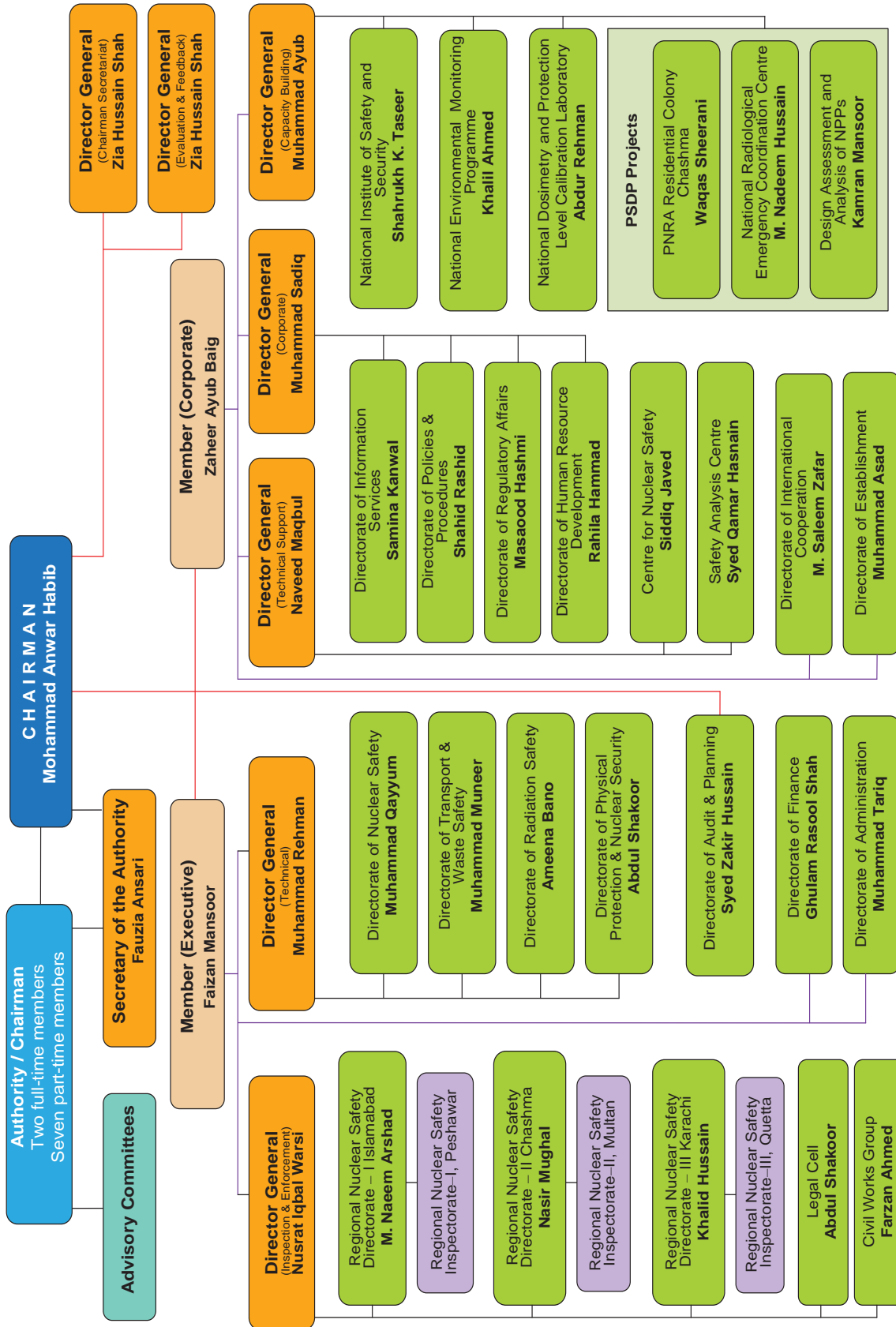


Figure 1: Organisational Structure of PNRA

2. REGULATORY FRAMEWORK

The continuous strengthening of PNRA regulatory framework since its establishment has significantly contributed towards exercising effective regulatory control over nuclear installations, radiation facilities and activities across Pakistan. The regulatory framework of PNRA is depicted by the pyramid presented in Figure 2 below. The top tier of the pyramid comprises PNRA Ordinance enacted by the Government of Pakistan in 2001 which presents basic objectives, structure, and powers of the Authority. The Ordinance empowers PNRA

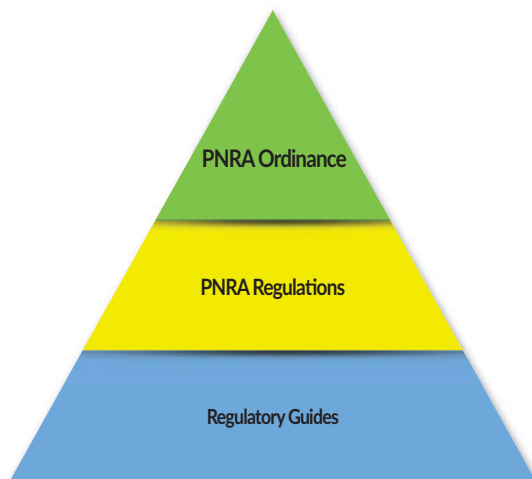


Figure 2: Statutory Framework for the PNRA's Regulatory Operations

to develop, issue and enforce necessary regulations for ensuring nuclear safety and radiation protection in Pakistan. The regulations are represented by the second tier of the pyramid. PNRA regulations establish the administrative and technical regulatory requirements which are mandatory for the licensees. The compliance of these requirements is ensured by PNRA through review and assessment; regulatory inspections and enforcement.

The regulatory guides which are represented by the third tier of the pyramid present the acceptable methodologies for compliance with the regulatory requirements set forth by PNRA regulations. The licensee has the freedom to choose any alternate approach to comply with the regulatory requirements however, in such cases, the licensee has to demonstrate that the adopted approach provides similar or higher level of safety as that of the methodology presented by the regulatory guides.

PNRA Regulations

The Regulations are developed and effectively implemented to fulfil PNRA's mission of protecting the public, the workers and the environment from harmful effects of ionizing radiation. The management system of PNRA controls the process for development of these regulations which involves an effective participation of all stakeholders including licensees, Government and general public.

The regulations once approved by the Authority and cleared by the Government are notified in the official gazette and are placed at PNRA website (www.pnra.org) for information of all concerned. PNRA has, so far, issued 18 regulations as shown in Table 1.

During the year under review, "Regulations on Decommissioning of Facilities using Radioactive Material" (PAK/930) was approved and gazette notified.

PNRA remained involved in preparation of the following new regulations during the year 2016:

1. Regulations on Authorization of Organizations for Non Destructive Examination (NDE) of Safety Class Equipment for Nuclear Installation(s) - (PAK/906);
2. Regulations on Safety of Spent Nuclear Fuel Management - (PAK/918);
3. Regulations on Physical Protection of Nuclear Material(s) and Nuclear Installation(s) - (PAK/925); and
4. Regulations on Security of Sealed Radioactive Sources (SRS) - (PAK/926).

The regulations which remained in the process of revision during the year 2016, are as under:

1. Regulations on Licensing Fee by Pakistan Nuclear Regulatory Authority (PAK/900) (Rev. 2);
2. Regulations on Radiation Protection (PAK/904);
3. Regulations for Licensing of Nuclear Safety Class Equipment and Components Manufacturers - (PAK/907) (Rev.0);
4. Regulations for the Licensing of Radiation Facility(ies) other than Nuclear Installation(s) - (PAK/908);
5. Regulations on the Safety of Nuclear Power Plant Design - (PAK/911) (Rev.1);

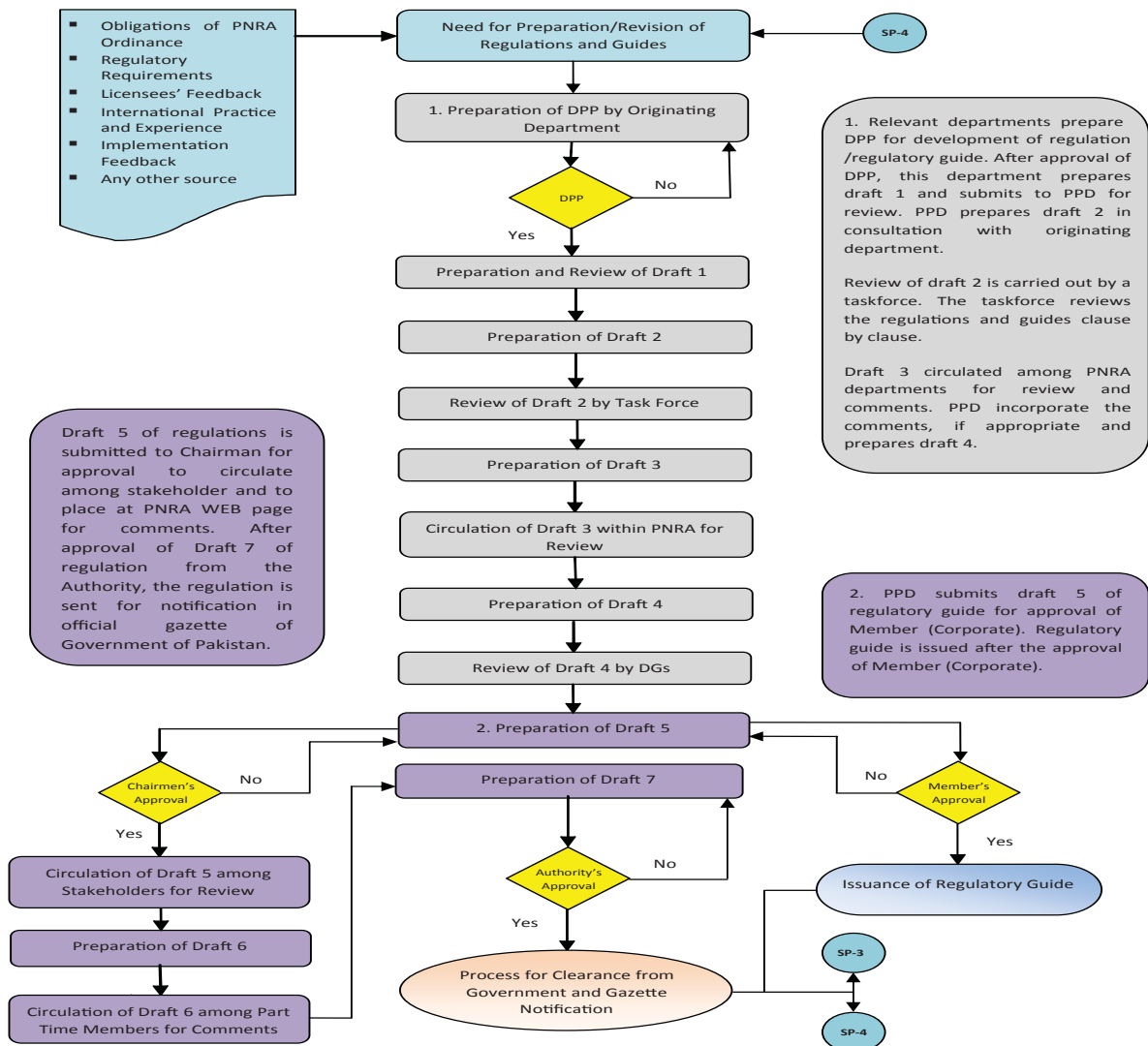
- 6. Regulations on the Safety of Nuclear Power Plants Operation - (PAK/913) (Rev.1); and
- 7. Regulations on Radioactive Waste Management - (PAK/915)

PNRA Regulatory Guides

Regulatory guides play a significant role in facilitating the licensee in implementation of the regulatory requirements contained in the regulations. PNRA requires its licensees to follow the latest versions of applicable IAEA Safety and Security Standards or the US-NRC regulations and regulatory guides in the areas where PNRA regulations and regulatory guides have not yet been issued. PNRA has so far issued eight regulatory guides as shown in Table 2.

PNRA remained involved in development of following new regulatory guides, during the year 2016:

- 1. Radiation Safety in Industrial Radiography (PNRA-RG-904.03);
- 2. Protection of Patients in Diagnostic Radiology (PNRA-RG-904.05);
- 3. Radiation Protection and Safety in Radiotherapy (PNRA-RG-904.06);
- 4. Format and Contents of Radiation Protection Programme of Radiation Facilities / Activities (PNRA-RG-904.07);
- 5. Guidelines for Medical Professionals on Transport, Diagnosis & Management of Overexposed & Contaminated Individuals in Radiological Emergency (PNRA-RG-904.08);
- 6. Format and Content of Safety Analysis Reports (SARs) of NPPs (PNRA-RG-909.01);
- 7. Format and Contents of Physical Protection Programme of Nuclear Installation(s) (PNRA-



RG-909.02); and

8. Format and Contents of Radiation Emergency Plans of Radiation Facilities and Activities (PNRA-RG-914.02).

Moreover, a regulatory guide on “Format and Contents of Application for Design and FSAR Modification in Nuclear Installation” is currently in the process of revision based on the experience feedback.

As described in PNRA Management System Manual, Figure 3 represents the process, for preparation and issuance of PNRA regulations and regulatory guides.

PNRA Management System Documents

PNRA Policies

In addition to the regulations and regulatory guides which constitute PNRA’s regulatory framework, PNRA also issues policies, under its management system, on different facets of internal working in compliance with the prevailing rules and regulations. Such policies usually describe a strategy adopted by PNRA, to guide present and future decisions on matters of public interest or social concern. PNRA has issued nine policies so far. These policies have been developed to create common understanding for deciding a course of action thus ensuring a uniformity of actions within the organization.

PNRA Procedures

Internal working procedures are usually prepared to

demonstrate compliance with the prevailing rules, address operational needs, manage risks and ensure continuous improvement. PNRA has developed more than 300 technical and administrative procedures for the effective management of its routine activities.

All such procedures provide guidance to the users for undertaking and completing certain activities. PNRA procedures are mainly of two types i.e. “PNRA Level Procedures” which describe the process related to tasks involving more than one department whereas the “Department Level Procedures” are the procedures which deal with the working of a single department of PNRA.

Central Registry

The documents generated within PNRA are categorized as regulatory and management system documents. These include PNRA Ordinance, regulations, regulatory guides, manuals, policies, strategic plans, tasks and functions, programmes, procedures (internal / PNRA level), plans, checklists, forms, guidelines, schedules, research articles, reports, etc.

PNRA central registry maintains regulatory and management system documents that are generated within PNRA including regulations, regulatory guides, policies, manuals and procedures.

The overall status of PNRA regulations, regulatory guides, policies and procedures registered in the central registry is given in Figure 4 below.

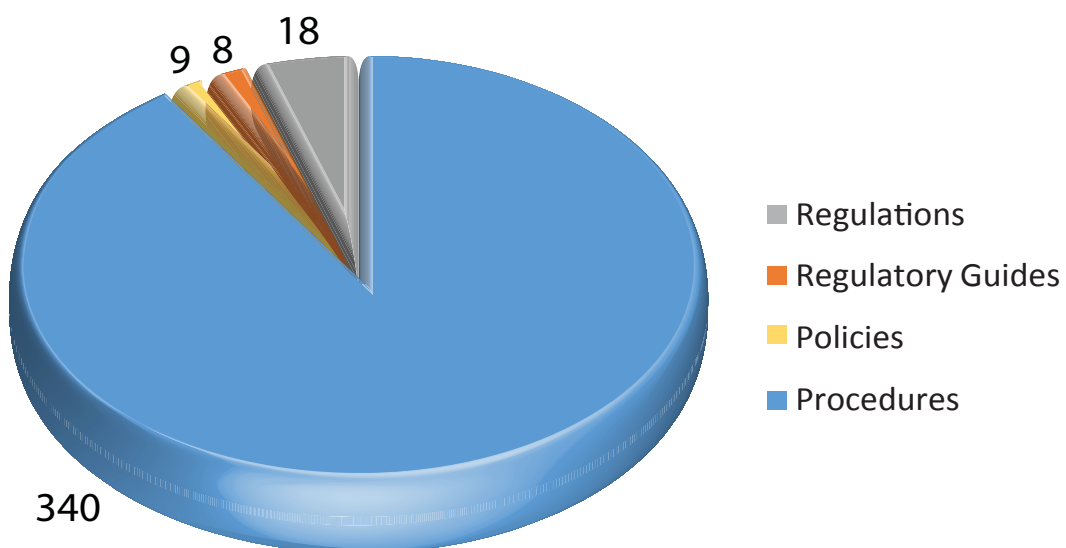


Figure 4: Status of PNRA Central Registry

Table 1: List of Gazette Notified Regulations

1	Regulations on Licensing Fee by Pakistan Nuclear Regulatory Authority - (PAK/900)	10	Regulations on Safety of Nuclear Power Plants-Operation - (PAK/913)
2	Regulations on Transaction of Business of Pakistan Nuclear Regulatory Authority - (PAK/901)	11	Regulations on Management of a Nuclear or Radiological Emergency - (PAK/914)
3	Regulations on Radiation Protection - (PAK/904)	12	Regulations on Radioactive Waste Management - (PAK/915)
4	Regulations for Licensing of Nuclear Safety Class Equipment and Components Manufacturers - (PAK/907)	13	Regulations for the Safe Transport of Radioactive Material - (PAK/916)
5	Regulations for the Licensing of Radiation Facilities other than Nuclear Installations - (PAK/908)	14	Regulations on the Safety of Nuclear Research Reactor(s) Operation - (PAK/923)
6	Regulations for Licensing of Nuclear Installation(s) - (PAK/909)	15	Regulations on Decommissioning of Facilities using Radioactive Material - (PAK/930)
7	Regulations on Safety of Nuclear Installations - Site Evaluation - (PAK/910)	16	Pakistan Nuclear Regulatory Authority Enforcement Regulation - (PAK/950)
8	Regulations on the Safety of Nuclear Power Plant Design - (PAK/911)	17	Pakistan Nuclear Safety and Radiation Protection Regulations, 1990
9	Regulations on the Safety of Nuclear Power Plants-Quality Assurance - (PAK/912)	18	Pakistan Nuclear Safety and Radiation Protection (Treatment of Food by Ionizing Radiation) Regulations, 1996

Table 2: List of Regulatory Guides

1	Quality Assurance in Nuclear Medicine (PNRA-RG-904.01)
2	Guidance for the Users of Iodine - 131 in Nuclear Medicine Centers (PNRA-RG-904.02)
3	Probabilistic Safety Assessment of Nuclear Power Plants Level-1 (PNRA-RG-911.01)
4	Format and Contents of Application for Design Modifications in Nuclear Power Plants (PNRA-RG-913.02)
5	Format and Contents of Application for Modifications in Technical Specifications and Operating Policies and Principles of Nuclear Power Plants (PNRA-RG-913.03)
6	Dosage and Distribution of Potassium Iodide Tablets (a Thyroid Blocking Agent) in Radiation Emergencies (PNRA-RG-914.01)
7	Transportation of Radioactive Material by Road in Pakistan (PNRA-RG-916.01)
8	Registration/Licensing and Issuance of NOC to the Exporter(s) of Radiopharmaceuticals (PAK/9801)

3. OVERSIGHT OF NUCLEAR INSTALLATIONS

In pursuance of Pakistan Nuclear Regulatory Authority Ordinance 2001, PNRA is mandated to perform regulatory oversight of all civilian nuclear installations in the country. PNRA uses different processes to regulate nuclear installations and associated activities i.e. developing regulations; granting authorizations and licences; performing review & assessment and inspections; and executing enforcement measures. Nuclear Installations remain under regulatory control throughout their lifetime from site registration till decommissioning. During different stages of the life time, PNRA issues various authorizations and licences e.g. site registration, construction licence, permission to introduce nuclear material, operating licence and licence for decommissioning.

As per regulatory framework, these authorizations and licences are issued subject to several generic and specific

licensing conditions which stipulate different regulatory requirements based on review, assessment and inspection processes. Currently, there are seven operational nuclear installations in Pakistan which include four Nuclear Power Plants (K-1, C-1, C-2 and C-3), two Research Reactors (PARR-1 and PARR-2) and one Molybdenum isotope Production Facility (MPF). In addition, commissioning of one nuclear power plant (C-4) and construction of two nuclear power plants (K-2 and K-3) is in progress. All the construction and commissioning activities are being performed under regulatory oversight of PNRA.

Details of nuclear installations that are in operation, undergoing commissioning or are under construction in Pakistan are provided in Table 3.

PNRA reviews and assesses the technical documents

Table 3 : Civilian Nuclear Installations under PNRA's Purview

S.No.	Installation	Type	Capacity	Commercial Operation
IN OPERATION				
1.	Karachi Nuclear Power Plant Unit 1 (K-1)	Pressurised Heavy Water Reactor	137 MWe	1972
2.	Chashma Nuclear Power Plant Unit 1 (C-1)	Pressurised Light Water Reactor	325 MWe	2000
3.	Chashma Nuclear Power Plant Unit 2 (C-2)	Pressurised Light Water Reactor	340 MWe	2011
4.	Chashma Nuclear Power Plant Unit 3 (C-3)	Pressurised Light Water Reactor	340 MWe	2016
5.	Pakistan Research Reactor-1 (PARR-1)	Swimming Pool	10 MWt	1965
6.	Pakistan Research Reactor-2 (PARR-2)	Tank-in-Pool	30 KWt	1991
7.	Molybdenum Production Facility (MPF)	--	100 Ci	2013
IN COMMISSIONING PHASE				
8.	Chashma Nuclear Power Plant Unit 4 (C-4)	Pressurised Light Water Reactor	340 MWe	2017 (expected)
UNDER CONSTRUCTION				
9.	Karachi Nuclear Power Plant Unit 2 (K-2)	Pressurised Light Water Reactor	1100 MWe	2020 (expected)
10.	Karachi Nuclear Power Plant Unit 3 (K-3)	Pressurised Light Water Reactor	1100 MWe	2021 (expected)

submitted by the applicants and licensees in support of their applications for acquiring licences or authorizations at different stages as required by PNRA regulations PAK/909. To verify the compliance of licensees' activities, PNRA also reviews modifications, event reports, routine reports, plans, programmes and other documents required under various regulations, licence conditions and other regulatory requirements issued from time to time.

In case of non-compliance with the regulatory requirements, PNRA may reject licence application or may take an enforcement action necessary to ensure the safety of the installation, radiation workers, public and the environment.

During 2016, PNRA reviewed a number of licence submissions, design modifications and event reports related to nuclear installations. The information on major review and assessment activities conducted by PNRA in the year 2016 is given in Table 4.

Nuclear Installations in Pakistan

Nuclear installations in Pakistan, licensed under the regulatory regime of PNRA, include nuclear power plants in operation, at commissioning phase and under construction; research reactors; and isotope production facility. PNRA also regulates nuclear safety class equipment manufacturers and service providers.

Nuclear Power Plants in Operation

By the end of reporting year, there are four nuclear power plants in operation in the country. These include Karachi

Nuclear Power Plant Unit 1; and Chashma Nuclear Power Plants Units 1, 2 and 3.

Karachi Nuclear Power Plant Unit 1 (K-1)

Karachi Nuclear Power Plant Unit1 (K-1) is a CANDU type pressurized heavy water reactor having design capacity of 137 MWe, operating beyond its design life since 2003. During the year 2016, K-1 was manually shutdown five times due to loss of transmission lines and various maintenance activities. The plant tripped two times due to loss of offsite power during the reporting period, however, the plant safety systems remained available to perform their intended safety functions.

The operating licence of K-1 was valid till December 31, 2016. During the year 2016, K-1 submitted a safety case for extension of operating licence beyond 2016. The request for extension has been reviewed at PNRA and the current operating licence has been extended for a further period of three months.

K-1 submits different documents to PNRA which provide information and data about activities related to radiation safety and exposure of workers. The Monthly Technical Reports (MTRs) provide information and data - among other technical information - regarding the number of persons exposed; monthly collective dose; and average & maximum individual dose.

In 2016, review of MTRs submitted by K-1 demonstrated that doses received by the radiation workers during the reporting period were within the regulatory limit of 20 mSv per year. Figure 5 represents the percentage of radiation doses to K-1 workers during 2016.

Table 4: Review and Assessment of NPPs During 2016

S.No.	Installation	Licence submissions	Design modifications	Event reports
1.	K-1	12	3	2
2.	C-1	11	4	5
3.	C-2	18	3	2
4.	PARR-1	6	0	0
5.	PARR-2	8	0	0
6.	MPF	9	0	0
7.	C-3/C-4	70	0	0
8.	K-2/K-3	0	1	0

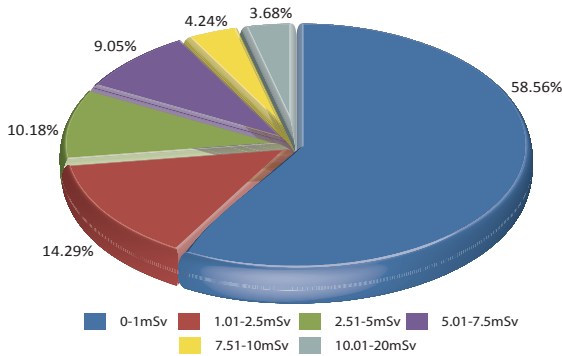


Figure 5: Annual Radiation Doses to K-1 Workers

Chashma Nuclear Power Plant Unit 1 (C-1)

Chashma Nuclear Power Plant Unit 1 (C-1) is a two loop pressurized light water reactor having generation capacity of 325 MWe. During the year 2016, C-1 tripped four times mainly due to fluctuations in the national grid.

After successful completion of its 10th Refueling Outage, the reactor was formally connected to grid on January 17, 2016 upon satisfactory resolution of the problem of crack indications on the turbine blade roots. The regulatory decision was made based on independent inspection, collection of objective evidences and thorough review of the issue.

C-1 submits different submissions to PNRA which provide information and data about activities related to radiation safety and exposure of workers.

The Monthly Technical Reports (MTRs) provide information and data - among other technical information - regarding the number of persons exposed; monthly collective dose; and average & maximum individual dose.

In 2016, review of MTRs submitted by C-1 demonstrated that doses received by the radiation workers during the reporting period were well within the regulatory limit. Figure 6 represents the percentage of radiation doses to

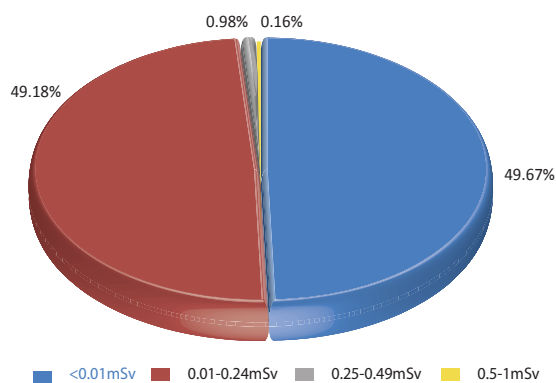


Figure 6: Annual Radiation Doses to C-1 Workers

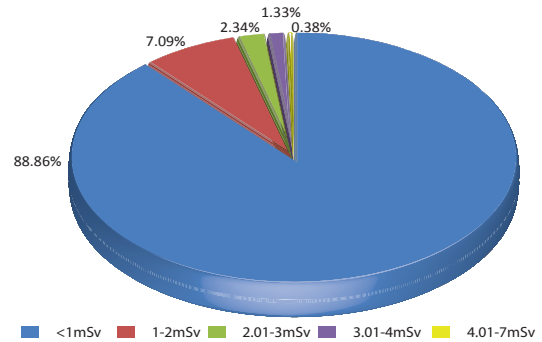


Figure 7: Annual Radiation Doses to C-2 Workers

C-1 workers during 2016.

Chashma Nuclear Power Plant Unit 2 (C-2)

Chashma Nuclear Power Plant Unit 2 (C-2) is a two loop pressurized light water reactor having generation capacity of 340 MWe. The reactor tripped twice during the year 2016 due to loss of offsite power.

C-2 submits different submissions to PNRA which provide information and data about activities related to radiation safety and exposure of workers.

The Monthly Technical Reports (MTRs) provide information and data - among other technical information - regarding the number of persons exposed; monthly collective dose; and average & maximum individual dose.

In 2016, review of MTRs submitted by C-2 revealed that doses received by the radiation workers during the reporting period were within the regulatory limit. Figure 7 represents the percentage of radiation doses of C-2 workers during 2016.

C-2 completed its 4th Refueling Outage (RFO) in the year 2016. During RFO-4 at C-2, the actual collective dose received by workers remained within the estimated collective dose as shown in Figure 8.

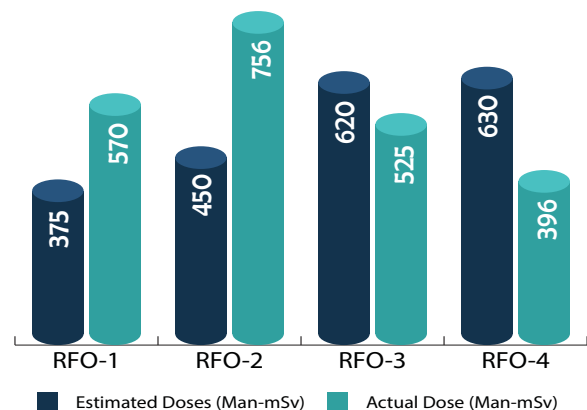


Figure 8: Estimated and Actual Collective Doses during C-2 RFOs



PNRA Top Management at C-3 Full Power Operation Ceremony

Chashma Nuclear Power Plant Unit 3 (C-3)

Chashma Nuclear Power Plant Unit 3 (C-3) is a two loop pressurized light water reactor having generation capacity of 340 MWe . PNRA granted permission to load fuel in the reactor core of C-3 after satisfactory completion of its regulatory process on May 17, 2016. Subsequently, on September 30, 2016, permission to make C-3 critical was also granted to perform low power, power ascension and full power tests during commissioning. All the commissioning activities have been completed safely under the regulatory oversight of PNRA, after which reactor was formally connected to grid in December, 2016.

Nuclear Power Plants under Commissioning Phase

By the end of reporting period, one nuclear power plant namely Chashma Nuclear Power Plant Unit 4 (C-4) was under commissioning phase.

Chashma Nuclear Power Plant Unit 4 (C-4)

Chashma Nuclear Power Plant Unit 4 (C-4) is also a two loop pressurized light water reactor similar to C-3. During the current year, PNRA received an application from PAEC for granting permission for fuel loading in C-4 along with Final Safety Analysis Report (FSAR) and other

documentation as required by PNRA regulations. The application and subsequent submissions of C-4 remained under review during the year 2016.

Nuclear Power Plants under Construction

Karachi Nuclear Power Plant Unit 2 (K-2) and Karachi Nuclear Power Plant Unit 3 (K-3) are two loop pressurized light water reactors having larger generation capacity of 1100 MWe. PNRA registered K-2 and K-3 in 2013 and 2014 respectively and issued construction licence to both NPPs in 2015. During the reporting period, the construction activities at K-2 and K-3 remained in progress. The major construction activities for K-2 project include the progress in construction of reactor building, fuel and electrical buildings. While at K-3, raft foundation of containment building has been completed and construction of containment building structure has been started. During the current year, all the construction activities at K-2 and K-3 were performed safely under the regulatory oversight of PNRA.

Research Reactors

Pakistan Research Reactor-1 (PARR-1) is a swimming pool type research reactor of 10 MWt capacity, operating since 1965. Pakistan Research Reactor-2 (PARR-2) is a tank-in-pool type research reactor of 30kWt capacity, operating since 1991.

PNRA performs review and assessment of regulatory submissions related to PARR-1 and PARR-2. In 2016, PNRA reviewed the revised radiation protection programme of PARR-1 and PARR-2. In addition, PARR-1 and PARR-2 submitted the Monthly Technical Reports (MTRs) and annual safety report describing operation history, reportable incidents, system performance & evaluation tests, personal radiation exposures, QA activities, etc.

Review of MTRs and annual safety report demonstrated



PNRA's Inspectors Conducting Inspection at K-2

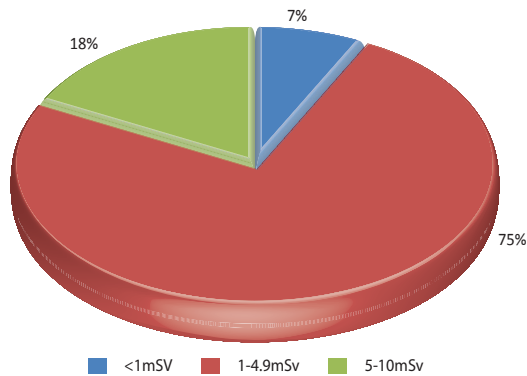


Figure 9: Annual Radiation Doses to Research Reactor Workers

that the occupational exposure of radiation workers at PARR-1 and PARR-2 for the year 2016, were well within the regulatory limits. Figure 9 represents the percentage of workers exposed to different dose ranges in 2016.

Molybdenum Production Facility (MPF)

Molybdenum Production Facility (MPF) produces Molybdenum-99 (Mo-99) isotope as the mother product for production of Technetium-99m (Tc-99m) used for diagnosis of different types of cancer. During the reporting period, PNRA reviewed and approved radioactive waste management and radiation protection programmes of MPF after resolution of queries. During the reporting year, MPF submitted a number of documents including Monthly Technical Reports (MTRs), Initial Decommissioning Plan (IDP), Emergency Preparedness Plan (EPP) and Operational Limits & Conditions (OLCs) as licensing submissions which remained under review at PNRA.

In addition, review of one design modification of MPF remained in progress regarding duplication of Hot Cell-1. The occupational exposure of radiation workers at MPF for the year 2016 were well within the regulatory limits.

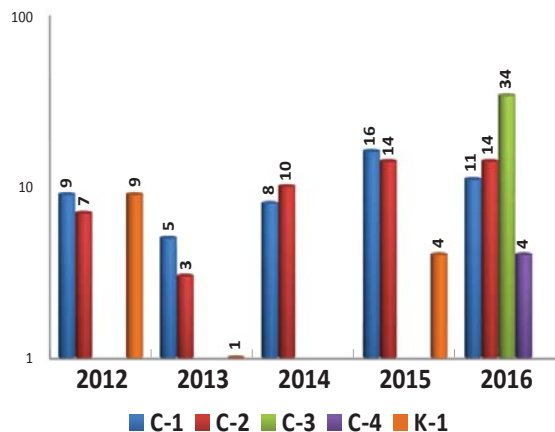


Figure 10: New Licences Issued to Operating Personnel of NPPs

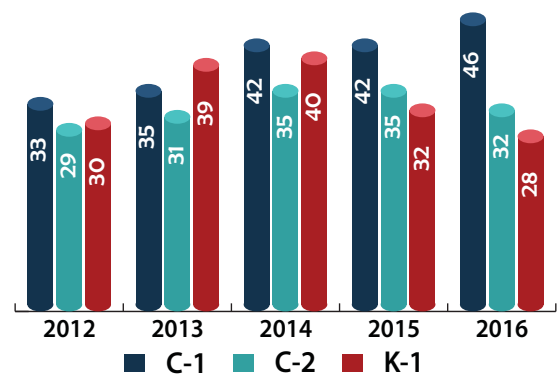


Figure 11: Renewal of Licences for Operating Personnel of NPPs

Licensing of Operating Personnel

PNRA considers that qualified and trained operating personnel play vital role in the safe operation of nuclear installations. Consequently, efforts are continuously made to ensure that operating personnel are duly qualified and competent to operate the nuclear installations as required under the regulatory regime.

PNRA conducts oral and operating examinations on the request of management of nuclear installation for the award of licences to the operating personnel. The licence once issued is renewed annually in the light of assessment of operators' technical and professional competencies. PNRA also verifies the requirements regarding completion of necessary retraining and medical fitness recommendation from a qualified medical practitioner.

Figure 10 represents the details of new licences issued to C-1, C-2, C-3 and C-4 operating personnel and Figure 11 represents information regarding renewed licences issued to C-1, C-2 and K-1 operating personnel. Figure 12 provides the data of issuance and renewal of licences to operating personnel of PARR-1 and PARR-2 during the year 2016.

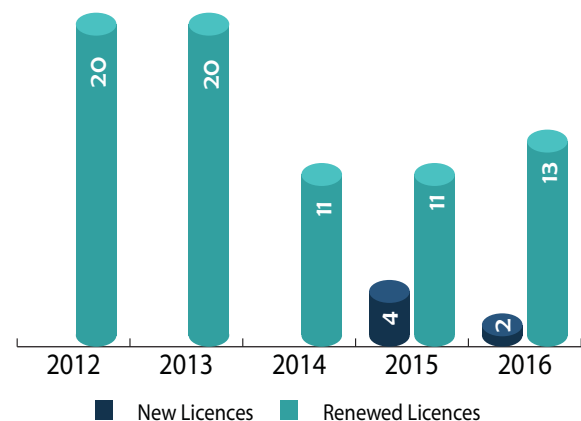


Figure 12: Issuance and Renewal of Licences to Operating Personnel of PARR-1 & PARR-2

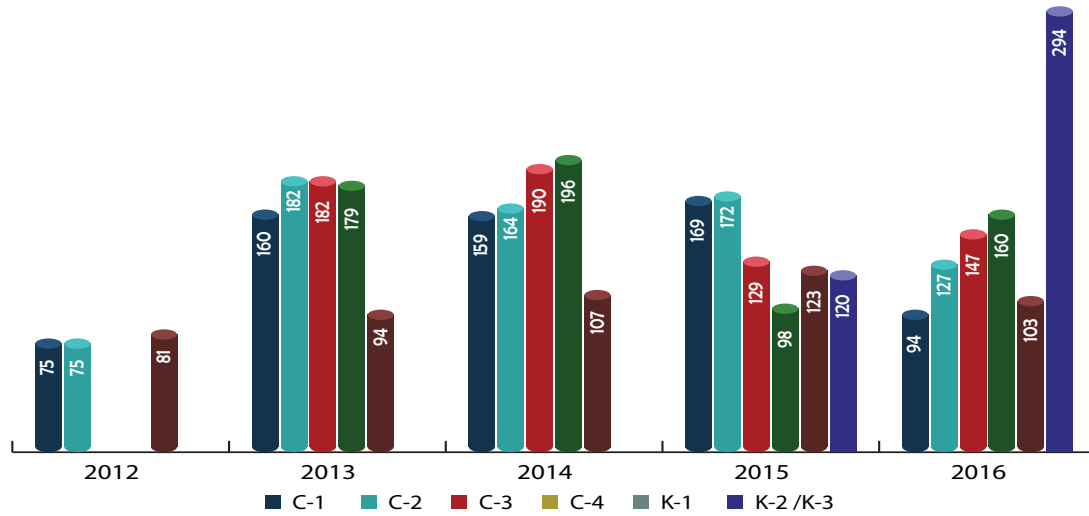


Figure 13: Regulatory Inspections Conducted at Nuclear Power Plants

Regulatory Inspections of Nuclear Installations

PNRA conducts regulatory inspections at all nuclear installations in order to verify that the activities conducted by the licensees are in accordance with PNRA regulations, licence conditions and the directives issued by the Authority from time to time. Inspections also play a significant role to determine that the licensees are acting appropriately to promote safety culture within their organizations.

PNRA has established three Regional Nuclear Safety Directorates (RNSDs) for the conduct of regulatory inspections – namely RNSD-I, RNSD-II and RNSD-III located in Islamabad, Kundian and Karachi respectively. The regulatory inspections are conducted by resident inspectors in their respective regions. The departments at PNRA Headquarters also provide technical support during the regulatory inspections to the regional directorates, whenever needed.

Inspections are conducted in all phases of a nuclear installation’s life cycle, i.e. construction, installation,

commissioning, operation, etc. PNRA performs planned and reactive inspections which may be announced or unannounced. The inspections are conducted according to an approved inspection programme, annual inspection plan, procedures and checklists. Subsequently, PNRA issues directives to communicate the deficiencies observed during inspections to the licensees in the form of inspection reports along with necessary requirements for initiating corrective actions. A follow-up process is in place to ensure satisfactory implementation of corrective actions.

PNRA’s resident inspectors undertake a variety of routine and planned inspections of nuclear installations in their respective regions according to their annual inspection plans. Unplanned and reactive inspections are carried out as and when required. Resident inspectors conduct general surveillance of various plant areas on a daily basis and also perform control point inspections of selected activities. Figure 13 presents number of inspections conducted at NPPs in 2016.

In addition to inspections at plant sites, PNRA also conducts control point inspections during manufacturing

Table 5: Summary of Inspections of Safety Class Equipment Manufacturing for K-2/K-3

Plant	Inspection Area
K-2/K-3	Type Tests and Factory Tests of Hydro Test Pump Motors of K-2/K-3
	Inspection of Welding of Inlet Nozzle of Reactor Pressure Vessel of K-2
	Welding of Circular Seam of Upper and Middle Shell of K-2 Pressurizer
	Type Test and Routine Test of Containment Spray Pump Motor and Low Head Safety Injection Pump Motor of K-2 Project
	QA Administrative Inspection of CZEC Design Office, CNPE (Designer) & HQC(Manufacturer)

of nuclear safety class equipment for nuclear power plants. During the reporting period, PNRA conducted a number of inspections of K-2 and K-3 at equipment manufacturing sites in China, which are summarized in Table 5. Furthermore, PNRA inspectors also participated in regulatory inspection during manufacturing of C-1/C-2 fuel assemblies in China during the reporting period.

During the year 2016, PNRA conducted a number of regulatory inspections at PARR-1 and PARR-2 in the areas of reactor utilization, operating policies & procedures, surveillance, safety systems, emergency preparedness, fire fighting, radiation safety, physical protection, etc. Figure 14 represents an overview of inspections conducted by PNRA inspectors at PARR-1 and PARR-2 in 2016.

Equipment Manufacturer in Pakistan

Heavy Mechanical Complex-3 (HMC-3)

PNRA issued manufacturing licence to Heavy Mechanical Complex-3 (HMC-3) for manufacturing of Nuclear Safety Class (NSC) Equipment as per ASME B&PV code. Subsequently, PNRA granted permission to HMC-3 for manufacturing of equipment as per RCCM code.

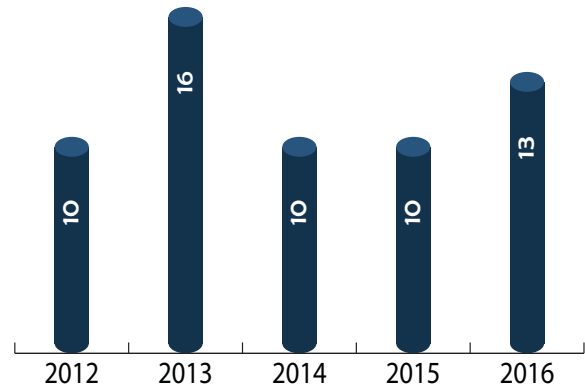


Figure 14: Regulatory Inspections of PARR-1 & PARR-2

Consequently, HMC-3 started manufacturing of NSC equipment for K-2 & K-3 projects which include Diesel Fuel Storage Tank, Volume Control Tank, Decay Tank, Boric Acid Storage Tank, Surge Tank, Head Storage Tank, Buffer Tank, etc.

PNRA's inspectors perform regulatory inspections in order to verify compliance with the regulatory requirements. During the year 2016, PNRA performed 15 control point inspections at HMC-3 in this regard.



PNRA Management During Site Visit of C-3



4. OVERSIGHT OF RADIATION FACILITIES

Radioactive materials are used in a variety of applications for the benefit of mankind. Their most prominent use includes medicine, industry, agriculture, academics, generation of electricity, archaeology (carbon dating), space exploration, law enforcement, geology (including mining), etc. Since all radiation sources have the potential to be harmful to workers, public and the environment, therefore, these sources need to be adequately regulated. PNRA regulates all such activities which involve radiation sources, radioactive material or radiation generating devices by promulgating and enforcing the regulations necessary for radiation protection in the country. It is mandatory for all radiation facilities in Pakistan to obtain licence or authorization from PNRA.

PNRA follows graded approach in carrying out its regulatory responsibilities which is based on safety significance and hazards associated with the facilities and activities under consideration. Furthermore, the licensing requirements for different radiation facilities and activities are defined in accordance with the graded approach. Accordingly, during various stages of licensing, PNRA requires submission of specific documents from applicants with regard to the hazards associated with their facility or activity. These documents include, for instance, radiation protection programme; radiation emergency plan; physical protection programme; qualification and experience credentials; dosimetry arrangements; and exposure records to verify compliance with the regulatory requirements, thereby ensuring protection of workers, public and the environment.

Review and assessment of licensing submissions and regulatory inspections of radiation facilities and activities

are basic processes utilized by PNRA for verifying compliance with the regulatory requirements. In case of a non-compliance, PNRA uses the enforcement process for its rectification.

Radiation Facilities in Pakistan

A complete spectrum of radiation facilities and practices exists in Pakistan which consists of diagnostic radiology centers; radiotherapy centers; nuclear medicine centers; industrial radiography facilities; blood, food and material irradiators; oil well logging units; educational and research institutes using radioactive sources including agricultural research centers, etc. Table 6 depicts the number of various types of radiation facilities operating under the licensing network of PNRA and registered radiation workers in Pakistan.

Radiation Safety at Radiation Facilities

PNRA has developed an effective mechanism for fulfillment of its mandate and achieving its mission of protecting workers, public and the environment from harmful effects of ionizing radiation. The mechanism encompasses a strong regulatory regime comprising of regulations for licensing / authorization, radiation protection, radioactive waste management, transport of radioactive material, management of radiological emergencies and enforcement; which are legally binding on all the users of radiation sources in Pakistan. These regulations document various regulatory requirements for different radiation facilities and activities in accordance with the graded approach. PNRA personnel conduct review and assessment of various licensing submissions

Table 6: Radiation Facilities under PNRA's Purview

Sr. No.	Type of Radiation Facility	Licensed Facilities	Registered Radiation Workers
1.	Nuclear Medicine and Radiotherapy Centers	77	1883
2.	Diagnostic and Dental Radiology Facilities	4192	6158
3.	Industrial Radiography Facilities	45	920
4.	Nuclear Gauges, Oil Well Logging and other Industrial Facilities	126	773
5.	Educational and Research Institutes	62	433
6.	Others (Importers, Scanners, Calibrations, Isotope Production, etc.)	251	654

required from the applicant / licensee which serve to ensure safety at radiation facilities and activities. During this process, PNRA verifies, using the graded approach, arrangements for personal protective measures; personal and area monitoring equipment; radiation dosimetry; health surveillance; and physical protection measures, prior to grant of licence / authorization.

Some of the major activities regarding safety at radiation facilities and activities conducted during the reporting year included:

- Review of the request of a radiotherapy center regarding treatment of cancer patients on Co-60 tele-therapy machine at low dose which was not allowed in lieu of applicable regulatory requirements.
- Review of the requests of two nuclear medicine centers regarding waiving off the requirement of delay tanks for I-131 therapy patient's isolation rooms which have been denied considering the potential implications and regulatory requirements.
- Review of the request regarding exemption from requirement of individual dosimetry for X-ray baggage scanners at public places and detailed assessment based on field inspections. Regulatory decision for conditional exemption remained under consideration by the end of reporting period.
- Review and approval of radiation protection programmes of various radiation facilities and activities with recommendations for improvement in the programmes.
- Initiation of a pilot project on assessment of patient exposure in selected medical centers for nuclear cardiology. These hospitals / medical centers were requested to provide dosimetry information on pre-designed forms for obtaining synchronized and harmonized input.
- Review of a request of medical center about the

possible re-use of sealed room due to high exposure and provision of recommendations and guidance for redesign of the facility.

Licensing of Radiation Facilities

Under the Ordinance, all the radiation facilities and activities in Pakistan require a licence from PNRA prior to start operation. Such licences are issued after detailed review and assessment of the applicants' submissions followed by inspections of the actual site and equipment. The licences issued to radiation facilities are renewed annually. PNRA has licensed all the radiation facilities in Pakistan including radiotherapy centers, nuclear medicine centers, irradiators and activities involving use of radiation sources in industry except for diagnostic X-ray facilities, several of which still remain outside the licensing net.

However, during the last few years, PNRA has strived to enhance its licensing net by bringing a number of unregistered facilities under licensing purview. More than 300 new facilities were licensed during the reporting period, thereby enabling PNRA to expand its licensing net for diagnostic radiation facilities by about 8 percent. By the end of 2016, licensed radiation facilities and activities numbered in excess of 4,700.

Occupational Exposure at Radiation Facilities

PNRA is maintaining occupational exposure record of radiation workers at national level. This record is important to evaluate variations in occupational exposures and ensure implementation of radiation protection programme and effectiveness of ALARA in routine work practices. Currently, the database includes dose records of more than 10500 radiation workers of different types of radiation facilities and activities. The distribution of radiation workers in various types of radiation facilities is shown in Figure 15.

The database contains records of radiation exposures

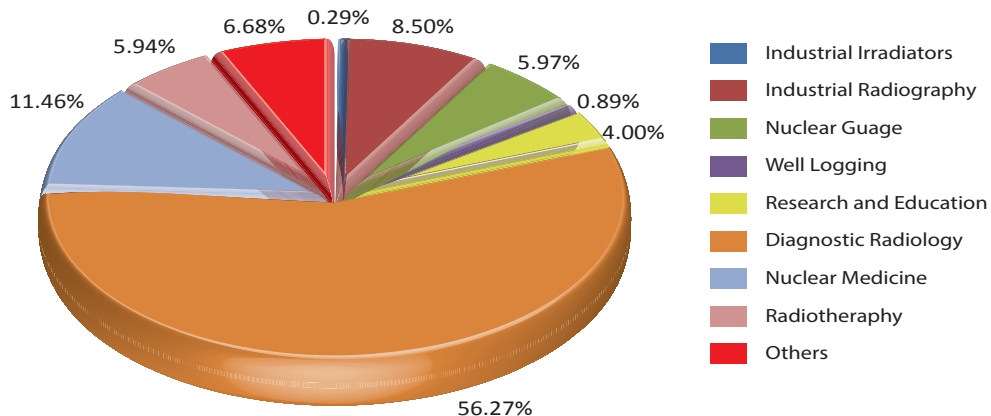


Figure 15: Radiation Workers in Different Radiation Facilities

since 1998. As per available dose record to date, doses to 95.81 percent of radiation workers remained less than 5 mSv in a year while 3.58 percent of the workers received doses between 5-20 mSv in a year. A small fraction (0.61 percent) of the workers received doses above 20 mSv in a year. The reason for such higher doses was thoroughly investigated and it was ensured that whenever such exposures are reported, the five year average annual dose of such workers remains within the prescribed regulatory dose limit. The investigation reports on overexposure submitted by radiation facilities and activities are reviewed and the licensees are advised to take corrective actions accordingly. A representation of radiation workers in different dose ranges is given in Figure 16.

Inspections of Radiation Facilities

Regulatory inspection is one of the core processes of a regulatory body and is a vital instrument of the regulatory oversight. PNRA conducts inspections of all facilities and activities using ionizing radiation. The objective of these regulatory inspections is to ensure that radiation sources - either radioactive materials or radiation generators - are used safely without posing any undue risk to the workers, public or the environment; and that the radiation workers possess required skills, qualification and experience, as necessary.

Regulatory inspections of radiation facilities and activities are carried out by PNRA to verify compliance of the provisions of the Ordinance, regulations made there-under and other terms and conditions imposed by the Authority from time to time. PNRA's inspection programme, that is aimed at fulfilling the Authority's commitment towards its Vision and Mission, comprises various types of inspections including planned and special reactive inspections which could be announced or unannounced. Accordingly, every year, PNRA chalks out an annual inspection plan incorporating planned inspections of radiation facilities as per defined frequency, utilizing graded approach, with the provisions for special inspections, where required. The licensing process of a radiation facility includes a

mandatory initial inspection for verification of pre-licensing requirements which is subsequently followed by planned inspections to keep an eye on a sustainable conformity to applicable regulatory requirements.

PNRA has established regional nuclear safety directorates and inspectorates in various parts of the country for effective implementation of its mandate and inspection programme. At present, PNRA has three regional directorates at Islamabad, Kundian and Karachi; and three regional inspectorates at Peshawar, Multan and Quetta under the administrative control of the regional directorates respectively.

In accordance with the annual inspection plan for the year 2016, regional directorates and inspectorates of PNRA have conducted around 3000 inspections of all types of radiation facilities and activities including medical, industrial, educational and research centers. These inspections specifically focused on verification of shielding design; facility layout; inventory of radiation sources; qualification and experience of radiation workers / radiation protection officers, etc. In addition, functioning, work practices, ALARA implementation, adequacy of security measures during use, transportation and storage of the sources were also assessed during these inspections.

The significant findings and compliance gaps observed during these inspections along with the directives for improvement were communicated to the inspected facilities through inspection reports which were appropriately followed. This regulatory surveillance has led to notable improvements in the safety of radiation practices. Figure 17 reflects an overview of regulatory inspections conducted during last five years.

Authorization of Import and Export of Radiation Sources and Generators

Maintaining cradle-to-grave track of all the radioactive sources and radiation generators in the country is another obligation of PNRA under the Ordinance. PNRA maintains

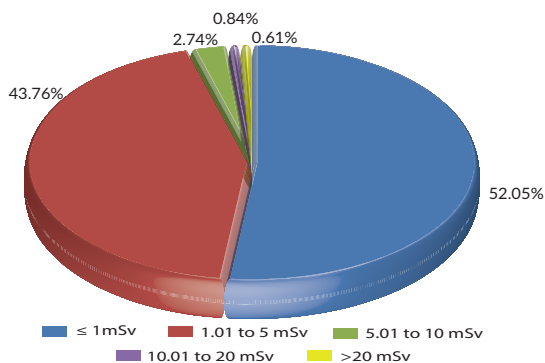


Figure 16: Radiation Workers in Different Dose Ranges

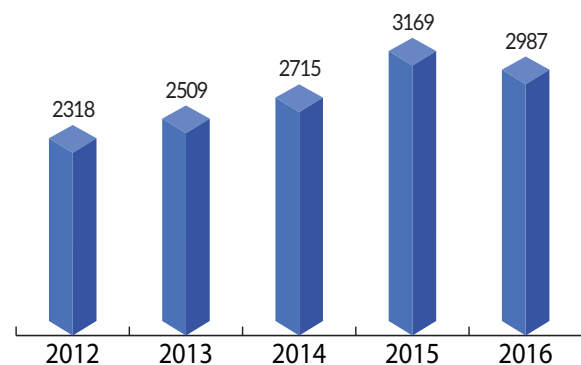


Figure 17: Regulatory Inspections of Radiation Facilities



PNRA Inspectors Conducting Radiation Survey at Industry

an inventory of sealed radioactive sources used in all types of radiation facilities and activities in Pakistan. Figure 18 presents an overview of sealed radioactive sources as per the inventory maintained at PNRA.

PNRA regulations require that import and export of radioactive sources or generators are to be authorized by PNRA. In this regard, PNRA has established a close liaison with the relevant law enforcement agencies and a mechanism is in place at international entry / exit points throughout the country for control of import / export. PNRA ensures this mechanism through issuance of “No Objection Certificate” (NOC) for import / export of radioactive sources or generators in the country.

The NOC is issued after verification of the intended end use, the user and the technical specifications of the radiation source or generator being imported / exported. According to the regulations, only licensed entities are authorized to import or export radioactive sources and radiation generators for the licensed / authorized end use. Furthermore, as a prerequisite for issuance of NOC, it is ensured that a high activity radioactive source can only be acquired / imported upon provision of undertaking by the supplier / manufacturer to accept its return at the end of its

useful design life as part of the purchase contract.

Some countries of origin require a special permit from regulatory body of the country of destination for placement of order for procurement of radioactive sources or generators. When such requests are received, PNRA issues permits to its licensees for facilitation in the process of procurement after necessary verifications.

During the reporting period, PNRA issued 1290 NOCs for the import of new radiation sources / radiation generators and 107 NOCs for the export of empty containers and radiation sources / radiation generators. Figure 19 reflects number of NOC's issued during past five years.

Furthermore, with regard to export of some food and other items, countries of destination may require exporters to furnish a radiation free certificate from the national nuclear regulatory authority. On such requests from exporters, PNRA performs radiometric analysis of food and other samples for provision of radiation-free certification for the purposes of export. During the reporting year, around 40 such samples were analyzed at PNRA laboratories located at Islamabad, Chashma and Karachi and certificates were issued accordingly.

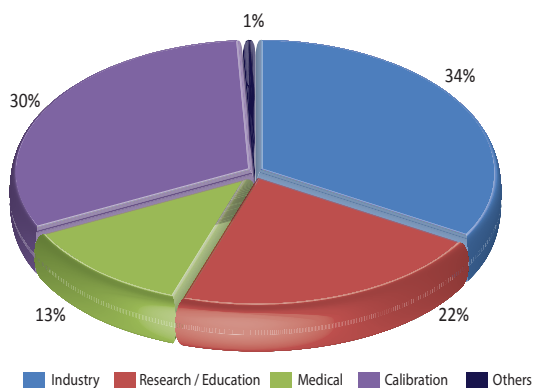


Figure 18: Sealed Radiation Sources by Usage

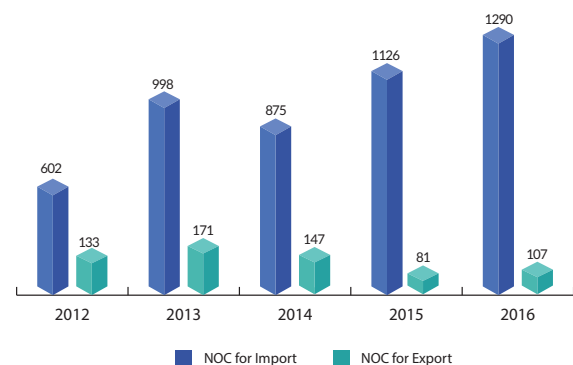


Figure 19: Issuance of NOC for Import-Export of Radiation Sources



5. RADIOACTIVE WASTE & TRANSPORT SAFETY

PNRA develops and implements regulatory framework for the safe management of radioactive waste generated from the operation of nuclear installations; and radiation facilities and associated activities in the country. PNRA makes every effort to ensure that radioactive waste generated in the country is managed in accordance with the National Policy on Control & Safe Management of Radioactive Waste; and National Regulations on Radioactive Waste Management for the Protection of Human Health and the Environment.

PNRA pays utmost importance to cater for the challenge of managing radioactive waste generated during the operation of nuclear installations and radiation facilities. It requires every user to keep the volume of radioactive waste as well as the activity to the minimum practicable level by means of suitable design and operation of the licensed facilities. These requirements are stipulated in PNRA Regulations on Radioactive Waste Management (PAK/915).

PNRA also regulates transport of radioactive material at the national level and has established “Regulations on Safe Transport of Radioactive Material” (PAK/916) for regulating transportation of radioactive material in the country.

In order to effectively implement the regulatory requirements, PNRA reviews and assesses licensees’ submissions, grants certification of packaging, authorizes shipments and conducts regulatory inspections for the verification of compliance with regulatory requirements during transportation phase.

Radioactive Waste Safety at Nuclear Installations

PNRA ensures safety of radioactive waste at nuclear installations through its regulatory oversight. Currently, seven nuclear installations including four Nuclear Power Plants (K-1, C-1, C-2 and C-3), two Research Reactors (PARR-1 & PARR-2) and one Isotope Production Unit (Molybdenum Production Facility - MPF) are in operation that generate low, intermediate and high level radioactive waste.

PNRA maintains a comprehensive inventory of radioactive waste generated at these nuclear installations and ensures that all licensees are managing radioactive

waste appropriately by taking suitable measures for its classification, segregation, treatment, conditioning and storage.

Solid Radioactive Waste at Nuclear Power Plants

PNRA oversees solid radioactive waste generation at nuclear power plants in order to ensure that the generation of radioactive waste is kept at minimum possible level and its management is in accordance with the approved Radioactive Waste Management Programme (RWMP).

The solid radioactive waste generated at NPPs mostly comprises contaminated materials such as spent resins, filters, tools, wooden and metal pieces, dungarees, rubber gloves and shoes, plastic overshoes, cotton, papers, etc.

The solid radioactive waste at K-1 is compacted in Mild Steel (MS) drums and stored at Radioactive Waste Storage Area (RAWSA). Furthermore, waste comprising of spent resin is collected in portable tanks and stored in trenches at RAWSA. Figure 20 shows the graphical representation of the compacted solid waste MS drums at K-1.

The solid radioactive waste generated at C-1 and C-2 is processed and categorized into two forms, namely compacted waste and solidified waste. The waste comprising tissue papers, dungarees, rubber shoes, gloves, etc., is compacted whereas the waste comprising resins and concentrates is solidified.

The compacted and solidified waste is stored in MS drums in the radioactive waste storage building at the plant site. During 2016, C-1 expanded its storage capacity by establishing an extended waste storage facility at its site.

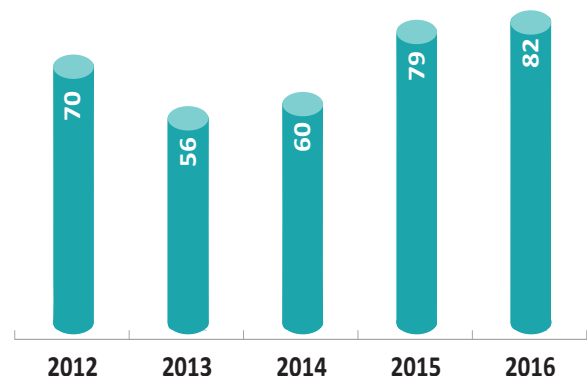


Figure 20: Number of Solid Waste Drums Generated at K-1

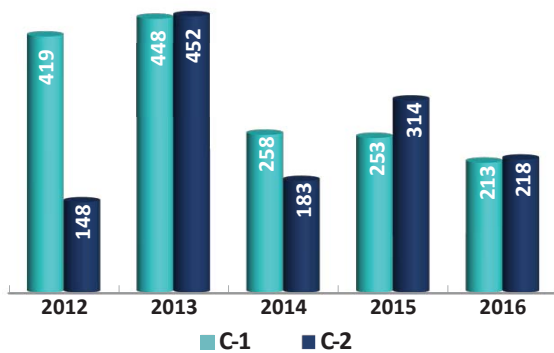


Figure 21: Number of Waste Drums Generated at C-1 and C-2

Figure 21 shows the number of compacted and solidified waste drums at C-1 and C-2.

Radioactive Effluents Discharge From Nuclear Power Plants

PNRA has a stringent regulatory mechanism to regulate and control radioactive effluents discharged from NPPs, ensuring that the releases to the environment are kept within the permissible level and as low as reasonably achievable. During the year 2016, the gaseous and liquid radioactive effluents from K-1 remained well below the Derived Release Limits (DRLs) as shown in Figure 22 and Figure 23 respectively. The total activity released in gaseous and liquid effluents from C-1 & C-2 during the reporting year, also remained well below the technical specification limits. The radioactive gaseous effluents released from C-1 and C-2 are shown in Figure 24 whereas the radioactive liquid effluents released from C-1 and C-2 are shown in Figure 25.

Radioactive Waste Management Facilities

Pakistan Atomic Energy Commission (PAEC) - the licensee of nuclear installations in the country - is conducting the site studies for establishment of a facility for disposal of

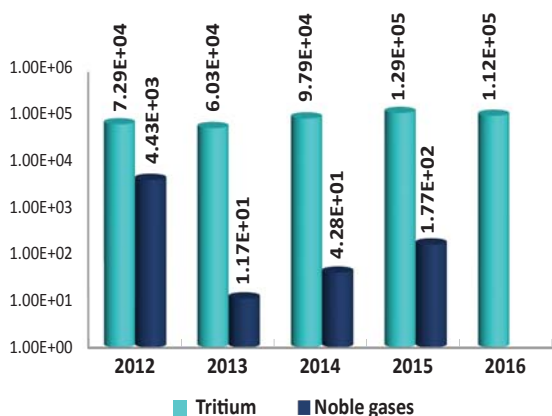


Figure 22: Gaseous Effluents (GBq/yr) from K-1

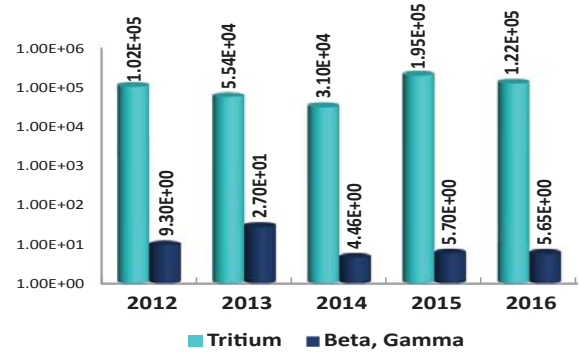


Figure 23: Liquid Effluents (GBq/yr) from K-1

radioactive waste. PAEC has submitted a letter of intention for the establishment of Near Surface Disposal Facility for Low and Intermediate Level Radioactive Waste which is under review at PNRA.

Currently, radioactive waste generated in the country is being stored in predisposal radioactive waste management facilities. The existing radioactive waste storage facilities include PINSTECH Predisposal Radioactive Waste Management Facility (PPRWMF) and K-1 Radioactive Waste Storage Area (RAWSA).

PINSTECH Predisposal Radioactive Waste Management Facility

PINSTECH Predisposal Radioactive Waste Management Facility (PPRWMF) is one of the designated radioactive waste storage facilities in the country as per the National Policy on Control and Safe Management of Radioactive Waste. Under this policy, PINSTECH is responsible to receive / store / dispose-off disused Sealed Radioactive Sources (SRS) from industrial, medical and research facilities located in the northern part of the country as well as orphan radioactive sources and ownerless waste. Previously, this facility was licensed under the licence of Pakistan Research Reactor (PARR-1) at PINSTECH. To

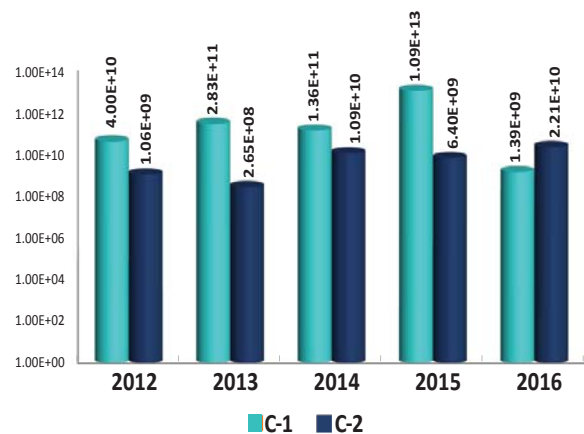


Figure 24: Gaseous Effluents (Bq/yr) from C-1 and C-2

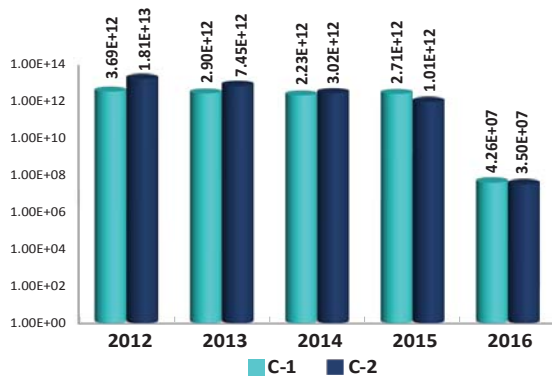


Figure 25: Liquid Effluents (Bq/yr) from C-1 and C-2

enhance the safety of this facility and to cover the safe management of radioactive waste received from other facilities such as PARR-2, MO-99 plant and disused SRS from private / public sector organizations; PNRA, upon request, awarded a separate licence to PPRWMF after thorough review of licensing submissions as an independent predisposal radioactive waste management facility under the Regulations for Licensing of Nuclear Installation(s) (PAK/909). This licence authorizes the facility for management of low and intermediate level radioactive waste including disused SRS generated from various nuclear installations and radiation facilities.

At this facility, radioactive waste is stored in Reinforced Cement Concrete (RCC) barrels and Mild Steel (MS) drums. The number of cementized and compacted containers of radioactive waste stored at PPRWMF during the last five years is shown in Figure 26.

KANUPP Radioactive Waste Storage Area

KANUPP Radioactive Waste Storage Area (RAWSA) located in Karachi, is licensed under the operating licence of Karachi Nuclear Power Plant Unit 1 (K-1). As per the National Policy on Control and Safe Management of Radioactive Waste, RAWSA is the second designated site



PINSTECH Predisposal Radioactive Waste Management Facility (PPRWMF)

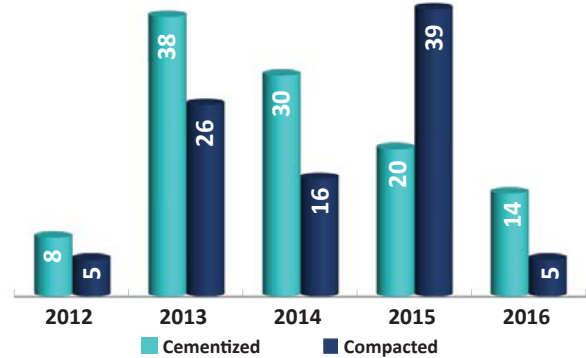


Figure 26: Number of Cementized and Compacted Radioactive Waste Containers at PPRWMF

for the collection of radioactive waste generated from K-1 and radiation facilities in the southern part of the country.

Inspections of Radioactive Waste Management

PNRA conducts regulatory inspections of nuclear installations to verify compliance of the licensees with regulatory requirements regarding management of radioactive waste and the implementation of radioactive waste management programmes and subsequent procedures. These inspections are carried out to physically observe the radioactive waste storage facilities and to assess the safety of radioactive waste collection, classification, treatment, conditioning and storage.

During the reporting period, PNRA conducted inspections at all nuclear installations in this regard and issued recommendations to further improve the implementation of regulatory requirements, radioactive waste management programmes and procedures.

Radioactive Waste Safety at Radiation Facilities

A wide variety of radioisotopes are being used extensively in nuclear medicine centers, agriculture, research & academic institutes, industries, etc. PNRA strives hard to ensure that the radioactive waste generated at radiation facilities is being managed and disposed off in a safe manner.

Radiation facilities such as nuclear medicine centers, industries, agriculture and research centres using radionuclides are required to ensure safe and secure storage of their radioactive waste as per regulatory requirements. PNRA ensures the implementation of regulatory requirements through inspections and record reviews.

During the reporting period, PNRA conducted a number of inspections of nuclear medicine centers and industrial facilities to further improve the implementation of

regulatory requirements, radioactive waste management programmes and procedures at radiation facilities.

Under the PNRA Regulations on Radioactive Waste Management (PAK/915), nuclear medical centers are required to develop and submit a radioactive waste management programme to PNRA for approval. During the reporting year, 18 radioactive waste management programmes of nuclear medical centers were reviewed and the regulatory position was communicated to the respective licensees for further improvement in their programmes.

Management of disused Sealed Radioactive Sources

PNRA Regulations on Radioactive Waste Management (PAK/915) also stipulate the requirements for safe management of disused SRS. According to these regulations, importers are required to return back those radioactive sources which have an initial activity greater than 100 GBq and half-life more than 1 year to the supplier / manufacturer when the sources are no longer useful. This is ensured by requiring an undertaking from the manufacturer / supplier, to accept the return of such sources, as a pre-requisite for issuance of NOC for import. Other disused SRS are stored at the designated predisposal sites.

As per the inventory of sealed radioactive sources maintained by PNRA, at the end of year 2016, around 32 percent of total SRS in the country are in use; 62 percent were safely stored at designated storage sites; and six percent were returned to suppliers in the respective countries of origin. The disused SRS deposited at designated storage sites mainly include Cobalt-60, Cesium-137, Iridium-192, and Radium-226. Figure 27 shows the graphical representation of the status of SRS in use in the country and disused SRS.

PNRA issues a clearance certificate for radioactive sources

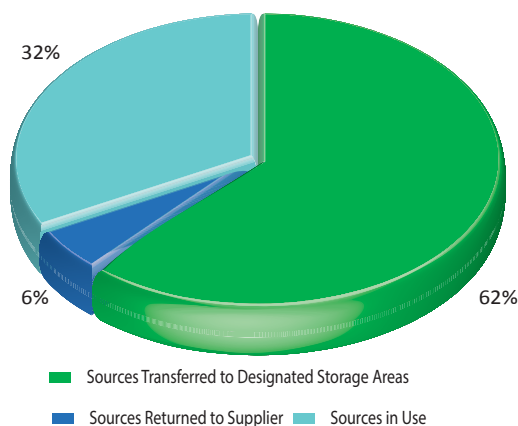


Figure 27: Status of Sealed Radioactive Sources

having activity below the exemption limit. During the reporting year, PNRA removed around 4800 disused SRS from regulatory control. The inventory of irretrievable radioactive sources stuck during oil well logging operations is also being maintained at PNRA.

Safe Transport of Radioactive Material

In Pakistan, transport of radioactive material is regulated through Regulations on the Safe Transport of Radioactive Material - PAK/916. PNRA performs review and assessment of consignor's submissions; conducts regulatory inspections; and issues certification of packaging to ensure compliance with these regulations.

During the reporting year, more than 300 shipments of radioactive material, radiopharmaceuticals and SRS were recorded. PNRA thoroughly reviewed key elements of compliance assurance programme and relevant shipping documents for safe transport of radioactive material. The objective of this review was to assess the existing measures in the light of regulatory framework to further strengthen the control.

PNRA also maintains stringent control over package design, manufacturing and maintenance to ensure safe transport of radioactive material. In addition, PNRA maintains the record of Type B(U) packages being used in the country.

During 2016, PNRA conducted inspections of designers, manufacturers, users and consignors of transport packages.

Certification of Type B(U) Packaging

The radioactive material is transported in well designed packages which are capable to withstand an accident and prevent damage to radioactive material. To achieve this, packages are designed and evaluated on four principal safety functions, namely protection of people from radiations, containment of the material, prevention of criticality and damage caused by heat. All such packages manufactured in Pakistan require the design approval certification from PNRA.

Pakistan Institute of Nuclear Science and Technology - PINSTECH - applied for the design certification of Type B(U) Packaging from PNRA. PNRA conducted thorough review of applicant's submissions including safety analysis report and quality assurance programme; and witnessed functional tests for normal and accident conditions in accordance with requirements of Regulations on the Safe Transport of Radioactive Material (PAK/916).

Upon successful demonstration of tests and satisfactory resolution of queries in the review meeting, PNRA issued

design certificate to PINSTECH during the year 2016 for manufacturing Type B(U) packaging for the transport of radiopharmaceuticals.

Safe Management of Spent Nuclear Fuel

Spent nuclear fuel is the fuel that is considered no longer useful for further utilization in nuclear reactors. Currently, the spent nuclear fuel generated by the operation of Nuclear Power Plants is stored on-site in spent fuel pools with continuous cooling.

It is supposed to remain there for a certain period of time and finally to be shifted to a dry storage facility. PAEC, the operator of nuclear installations in the country, approached PNRA for execution of the project for establishment of dry storage facility in Pakistan.

Licensing of Spent Fuel Dry Storage Facility in Pakistan

During the reporting period, PAEC submitted its intention for establishment of spent fuel dry storage facility at Chashma site. A number of meetings were held between PNRA and PAEC to establish the interface for licensing and to apprise PNRA about the execution of the project; its organizational structure; and design and manufacturing capabilities for spent fuel dry storage facility at Chashma Nuclear Power Generating Station (CNPGS).

Furthermore, the licensing process and applicable codes and standards for preparation of Safety Analysis Report (SAR) were also discussed during these meetings. Currently, PAEC is in the stage of identification of applicable



Schematic Design of Spent Nuclear Fuel Dry Storage Cask

industrial codes and standards for preparation of SAR for its spent fuel dry storage facility.

Certification of Spent Nuclear Fuel (SNF) Dry Storage Cask

PAEC submitted its intent for certification of design of spent nuclear fuel dry storage cask of K-1 to PNRA. In this regard, PNRA established an interim regulatory process for design certification of spent nuclear fuel dry storage cask during the year 2016.

Accordingly, PAEC submitted Safety Analysis Report (SAR) for certification of spent fuel dry storage cask of K-1. During the reporting period, the review of Safety Analysis Report (SAR) of spent nuclear fuel dry storage cask remained in progress.



Chairman PNRA Awarding Certificate to Chairman PAEC for PINSTECH Type B(U) Transport Package

6. EMERGENCY PREPAREDNESS & RESPONSE

Nuclear power plants are designed and constructed with a number of inherent safety features which prevent the occurrence of an accident and mitigate its consequences if it occurs. However, the possibility of nuclear accidents cannot be completely ruled out, no matter how safe a nuclear power plant is designed or operated.

Therefore, there is a need for availability of robust emergency measures and appropriate preparedness to effectively respond to nuclear accidents and radiological emergencies at national level. Existence and functionality of such measures are ensured through stringent regulatory oversight in order to protect the public, property and environment from the harmful effects of ionizing radiation.

The Government of Pakistan has vested in PNRA the responsibility to ensure, coordinate and enforce preparation of emergency plans for actions to be taken by the relevant onsite and offsite authorities in case of foreseeable nuclear or radiological accidents.

In order to fulfill this obligation, PNRA has established detailed regulatory requirements in the document titled "Regulations on Management of a Nuclear or Radiological Emergency" (PAK/914). These regulations are in line with the international standards and require licensees to have in place emergency plans, necessary workforce, essential equipment and mechanisms for responding to such incidents and/or accidents.

Under these Regulations, the licensees are required to maintain close coordination with the offsite response organizations responsible for mitigating the consequences of nuclear or radiological emergency in case the consequences have the potential to exceed the plant boundary.

As per PNRA requirements, complete emergency preparedness and response arrangements are ensured before introducing nuclear fuel into the systems of a nuclear installation or, in case of radiation facility, before a radioactive material is brought into the facility with potential for significant radiation hazards requiring protective measures. The permission for commencement of operation is not granted until these arrangements are demonstrated through an emergency exercise to the entire satisfaction of the Authority.

PNRA is also responsible to advise the Federal Government

and other concerned authorities regarding implementation of necessary safety and protective measures to mitigate the consequences of such accidents.

National Radiation Emergency Coordination Centre (NRECC)

Pakistan is a State Party to the IAEA's 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 the state parties to designate a Competent Authority and make available a continuous point of contact, who is authorized to make and receive requests for and to accept offers of assistance in case of nuclear accidents or radiological emergencies.

In Pakistan, PNRA is the National Warning Point (NWP) and Chairman PNRA is the National Competent Authority (NCA) for notification and coordination with IAEA and /or with other State Parties under these Conventions.

For fulfillment of obligations of these Conventions and the Ordinance, PNRA has established National Radiation Emergency Coordination Centre (NRECC) at its Headquarters in Islamabad, which acts as NWP and remains available round the clock for receipt / dissemination of emergency notifications and initiation / coordination of necessary emergency response at national and international levels.

NRECC is equipped with redundant and diverse communication means, radiation detection instruments and personal protective equipment. It has a dedicated team possessing specialized capabilities augmented by designated technical support team comprising of experts from various PNRA departments.

PNRA has established a network of six field response teams which are composed of trained officials with Mobile Radiological Monitoring Laboratories (MRMLs) and are geographically located in major cities across the country including Islamabad, Kundian, Karachi, Peshawar, Multan and Quetta.

These teams have been established with the purpose of conducting independent assessment of any incident involving radiation exposure and provision of technical assistance to local and national response authorities, if needed.

Emergency Plans and Procedures

Submission of emergency response plans to the Authority is one of the major regulatory requirements for PNRA licensees. The Authority reviews and approves the onsite emergency plans of nuclear installations as well as radiation facilities to ensure that these plans are commensurate with the regulatory requirements and are executable.

Moreover, the offsite plans are reviewed for acceptance by PNRA and are approved by the Government at appropriate levels. In the year 2016, PNRA reviewed and approved a number of emergency response plans of nuclear installations. The detail is given in Table 7.

In addition to the above, the emergency plans of 36 radiation facilities and activities including hospitals, industries, irradiators, industrial radiography, etc. were reviewed during 2016.

Emergency Drills and Exercises

Emergency response drills and exercises are the key component of an effective emergency preparedness and response infrastructure and provide a basis for continued improvement of the overall emergency response arrangements.

These drills / exercises are conducted to demonstrate that emergency plans are effective and implementable. PNRA officials - at following levels - participate in and / or evaluate different types of emergency drills and exercises:

1. PNRA Level - to verify the availability of communication channels and test the capability of field response and technical teams;
2. National Level - to ensure the effectiveness and implementation of emergency plans of various

nuclear installations and radiation facilities / activities; and

3. International Level - to verify the international emergency response arrangements including communication channels and response capabilities during different emergency situations.

Emergency Exercises at PNRA Level

NRECC conducts various emergency exercises at PNRA level to test its own preparedness and response arrangements during different types of anticipated emergency scenarios. These exercises include Communication Test Exercise (COMTEX) and Mobile Radiological Monitoring Laboratory (MRML) Field Exercise.

COMTEX is conducted, thrice a year, to check the availability and reliability of modes; and means to communicate with the licensees and other relevant national response organizations. MRML Field Exercises are conducted biannually, to test the procedures and operation of field response teams during hypothetical emergency situations.

Such field exercises are conducted at various places and cities across Pakistan. When field exercises take place in cities other than Islamabad, these are organized in coordination with the respective regional directorate by involving their field response teams.

Emergency Exercises at National Level

PNRA requires its licensees to conduct emergency drills and exercises at regular intervals to test the adequacy and effectiveness of their emergency plans and necessary preparedness arrangements.

The frequency of emergency drills and exercises is agreed

Table 7: Status of Emergency Response Plans of Nuclear Installations

Sr.No.	Emergency Plan of Nuclear Installations	Status / Progress during 2016
1.	Onsite Emergency Plan of Chashma Nuclear Power Plant Unit 3 (C-3)	Approved
2.	Onsite Emergency Plan of Chashma Nuclear Power Plant Unit 4 (C-4)	Approved
3.	Revision of On-Site Radiological Emergency Plan of Karachi Nuclear Power Plant Unit 1 (K-1)	Reviewed and communicated the observations / recommendations.
4.	Revision of Off-Site Radiological Emergency Plan of Karachi Nuclear Power Plant Unit 1 (K-1)	Reviewed and communicated the observations / recommendations.
5.	Revision of Emergency Plan of Pakistan Research Reactor-1 (PARR-1)	Reviewed and communicated the observations / recommendations.
6.	Revision of Emergency Plan of Pakistan Research Reactor-2 (PARR-2)	Approved



Field Exercise of First Responders and Paramedics at PNRA Headquarters

upon by the Authority in the approved emergency plans. PNRA witnesses some of these drills / exercises to assess the licensee’s capabilities for executing the emergency plans, as and when required.

There are two types of emergency exercises which are conducted at nuclear installations namely partial and integrated emergency exercises. In the partial emergency exercise, either onsite or offsite emergency response plans are tested; while in the integrated emergency exercise, both the onsite and offsite plans are tested simultaneously.

During the year 2016, PNRA witnessed and evaluated integrated emergency exercise of CNPGS (also termed as C-3 First Fuel Load Emergency Exercise), KANUPP integrated emergency exercise, PARR-1 general emergency exercise and onsite emergency exercise of Chashma Nuclear Power Project Unit 4.

Emergency Exercises at International Level

PNRA also participates in the exercises conducted by IAEA under Early Notification and Assistance Conventions - called ConvEx Exercises. These exercises are regularly conducted by the Incident and Emergency Centre of IAEA, as ConvEx-1, ConvEx-2 and ConvEx-3 with varying scope and objectives.

The objective of these exercises is to test the emergency notification and communication arrangements; response capabilities during various emergency situations; and the mechanisms in place to offer and receive international assistance in case of nuclear and radiological emergencies.

In 2016, PNRA participated in five ConvEx exercises including ConvEx-2b, which lasted for about three days. A summary of all these exercises conducted / participated by PNRA during the year 2016 is given in Table 8.

Training on Emergency Preparedness and Response

NRECC conducts various types of training courses for the



Field Exercise during Training Course on Emergency Response for Paramedical Staff at Peshawar

licensees of nuclear installations and radiation facilities as well as for the first responders to a nuclear accident or a radiological emergency.

Most of these courses are organized at the National Institute of Safety and Security (NISAS) which is the training institute of PNRA based at PNRA Headquarters, Islamabad, while some of the courses are conducted with the support of IAEA. In 2016, PNRA organized three training courses on nuclear and radiological emergency preparedness and response.

The aspects covered during these training courses included regulatory oversight, emergency management

Table 8: Emergency Exercises Conducted During 2016

Sr. No	Type of Exercise	Conducted
Exercises at PNRA Level		
1	COMTEX	February
2	COMTEX	June
3	MRML	October
4	COMTEX	October
5	MRML	December
Exercises at National Level		
1	C-3 First Fuel Load / CNPGS 8 th Integrated Emergency Exercise	April
2	KANUPP Integrated Emergency Exercise	September
3	PARR-1 General Emergency Exercise	August
4	C-4 First Fuel Load Emergency Exercise (Onsite)	December
Exercises at International Level		
1	ConvEx-2a	February
2	ConvEx-1a	March
3	ConvEx-1c	April
4	ConvEx-2b	June
5	ConvEx-1b	September

system, hazard assessment, public communication, medical response, response to malicious acts, etc. About 100 participants from various organizations including users of SRS from industries; hospitals and research institutions; personnel from NPPs, rescue services and police; and doctors & paramedical staff were provided training on various aspects of preparedness and response to nuclear and radiological emergencies.

IAEA's Response and Assistance Network (RANET)

A Response and Assistance Network (RANET) has been established by IAEA's Incident and Emergency Centre (IEC) to provide international assistance upon request from a member state in case of a nuclear or radiological emergency. This network consists of resources and capabilities registered by Member States to support the implementation of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

Pakistan is member of RANET since 2008 and PNRA is the National Assistance Coordinator for RANET activities in Pakistan. Pakistan has registered its national assistance

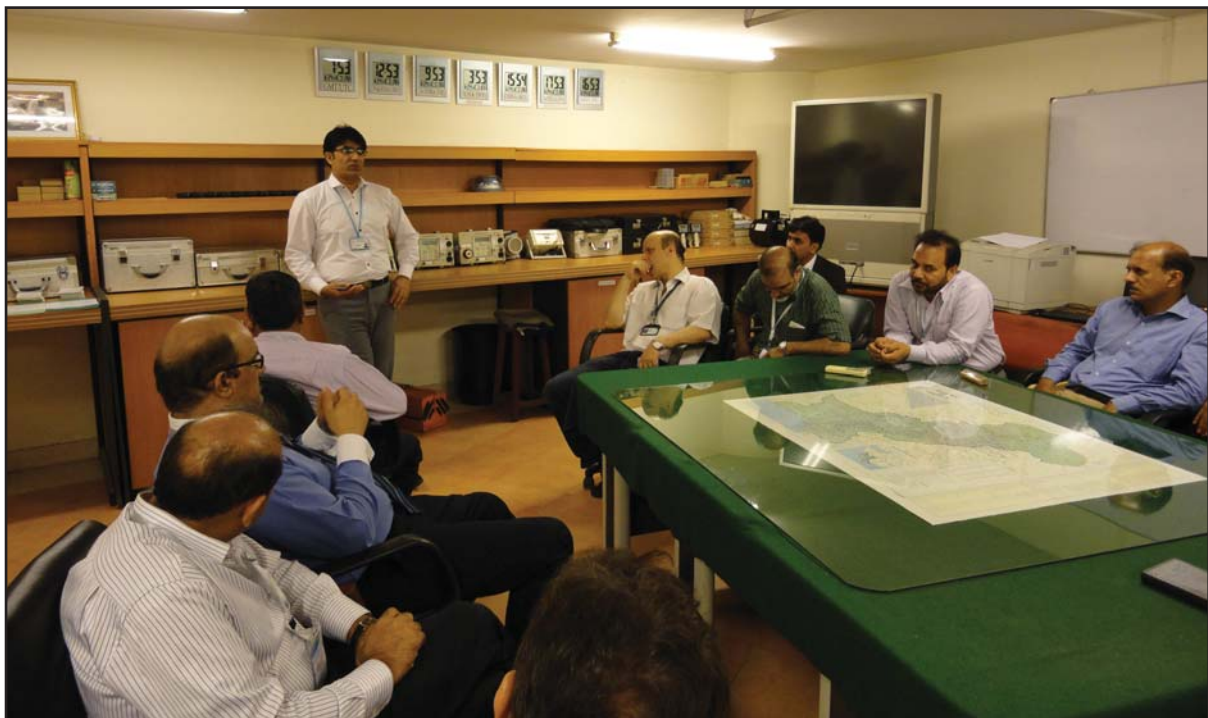
capabilities with RANET in four areas, namely: Radiological Assessment and Advice; Source Search and Recovery; Radiation Monitoring; and Environmental Sampling and Analysis.

NRECC coordinates all the activities related to RANET with other stakeholders in Pakistan as well as with the IAEA. In 2016, PNRA activated national arrangements for the provision of assistance under IAEA emergency exercise ConvEx-2b.

Sharing of Information Related to Radiation Incidents and Emergencies

PNRA receives information on radiation incidents and emergencies occurring worldwide through IAEA NEWS / USIE website.

PNRA analyzes the received information, identifies the lessons learnt and disseminates these lessons among relevant licensees and stakeholders for improvement of radiation safety in the country. During this year, information about 45 events was shared.



Briefing to Participants of Senior Officers Management Course (SOMC) on Emergency Preparedness and Response



7. CAPACITY BUILDING AT PNRA

Capacity building of manpower in regulatory disciplines is an essential element for regulating nuclear installations and radioactive facilities effectively and efficiently. The manpower in PNRA is augmented keeping in view the increase in use of nuclear and radioactive materials in Pakistan. The newly inducted manpower is selected on the basis of their excellent academic record which is knowledgeable enough in basic & applied sciences and engineering; however, their specific expertise in different regulatory areas is enhanced through capacity building initiatives.

These initiatives include in-house education, training and expertise development; training and skill development through national institutions; and competence building through international organizations.

Competency Development Programme of PNRA

Preserving and continuously enhancing knowledge is important for sustained growth of any organization and therefore, PNRA focused its efforts on the enhancement of knowledge and skills of junior officials as well as senior professionals. PNRA has adopted following processes for the competency development of its staff:

- In-House Capacity Building
- Competency Through Fellowship Scheme
- Trainings Arranged at National Organizations
- Competency Development Through IAEA Support
- Competency Development Through Higher Education at International Universities
- Knowledge Sharing and Mentoring Programme
- Leadership Development Programme

In-House Capacity Building

PNRA performs in-house capacity building of its regulatory professionals through its training institute - National Institute of Safety and Security (NISAS). In order to transform NISAS into a world class training institute, capable of providing high quality training consistent with international standards, it was considered necessary to accredit NISAS as an ISO certified training institute.

After successful completion of all requirements, formalities



Director NISAS Receiving ISO 9001:2008 Certificate from Mr. Shafqat Iqbal CEO, CeSP

and audits, the institute was awarded ISO 9001:2008 certificate by the Certification Services of Pakistan (CeSP) in January 2016. The ISO certification has been renewed for the year 2017, as well, on the basis of surveillance audit.

PNRA conducts a variety of in-house training courses for fresh, intermediate and senior level professionals. Basic Professional Training Course Level-I is one of these training courses which is designed for the newly recruited scientists and engineers and covers areas like regulatory perspective, fundamentals of nuclear safety and security, radiation protection, regulatory practices and control, etc. Professional Training Course Level-II is designed for providing training to intermediate level officers in the areas of NPP systems, operation & components; radiation safety; radioactive waste management; and nuclear security & physical protection.

In 2016, PNRA conducted 19 training courses / workshops in nuclear and radiation safety and provided trainings to 432 personnel from PNRA, licensees, and other stakeholders. Figure 28 reflects the number of training

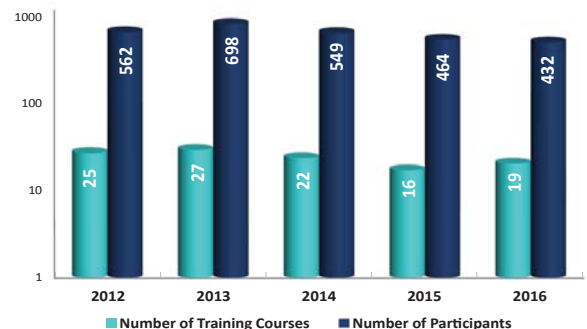


Figure 28: Overview of Nuclear & Radiation Safety Training Courses and Participants

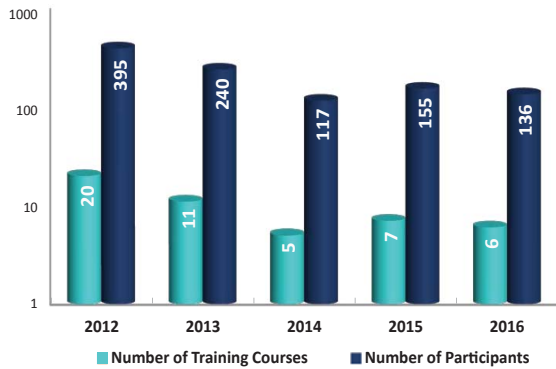


Figure 29: Overview of Nuclear Security Training Courses and Participants

courses conducted and personnel trained since 2012.

Furthermore, during the reporting year, PNRA conducted 06 training courses in the area of nuclear security in which more than 136 professionals from the regulatory body as well as representatives from various stakeholders participated. Figure 29 shows the number of nuclear security training courses conducted from 2012 to 2016 along with number of course participants.

A unique feature of these trainings has been the participation of PNRA, licensees and other stakeholders to establish a common understanding of nuclear safety and security requirements. It was recognized that by means of short training courses, a common platform could be utilized for disseminating knowledge of the regulatory perspectives and the significance of nuclear safety and security among all those who have a role in nuclear safety and security in the country. The percentage of participants of the training courses from PNRA and other organizations is shown in Figure 30.

Competency Development Through Fellowship Scheme

PNRA considers it necessary to induct professionals having a broad nuclear background knowledge. For this purpose, PNRA has agreements with Pakistan Institute of Engineering and Applied Sciences (PIEAS) and Karachi Institute of Nuclear Power Engineering (KINPOE) which offer masters degree programmes in nuclear / systems / power engineering and medical physics disciplines.

In 2016, PNRA awarded fellowships to 10 candidates for Masters degree programmes in nuclear / systems / power engineering at PIEAS and KINPOE. During the reporting period, 11 fellows from the batch of 2014-16 joined PNRA after successful completion of MS programmes at their respective institutes. So far, around 109 graduates have joined PNRA while 23 more candidates are currently pursuing their Masters studies at these Institutions.

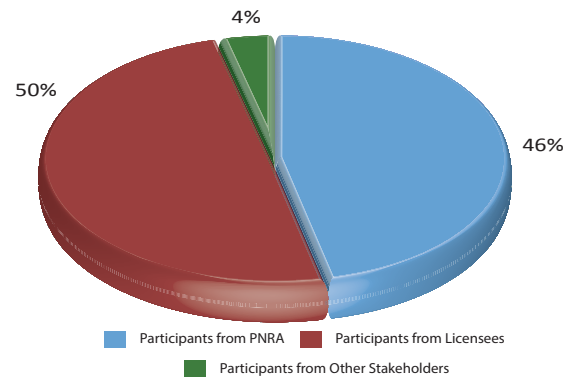


Figure 30: Distribution of Training Participants from Various Organizations

Trainings Arranged at National Organizations

PNRA collaborates with various national institutes for knowledge enhancement of its regulatory staff in technical areas of interest and to keep abreast with latest national and international research and development. Prominent among these are Pakistan Welding Institute (PWI), National Center for Non-Destructive Testing (NCNDT), Pakistan Institute of Management (PIM), Secretariat Training Institute (STI), PAEC, etc. A number of PNRA officials have participated in different courses in these institutes.

In order to enhance competency of PNRA inspectors in specialized areas related to mechanical components of NPPs such as welding, fracture mechanics and non-destructive examination, a number of engineers participated in training courses at PWI and NCNDT.

PNRA also has an active collaboration with PIEAS for providing training opportunities to its mid career officers by sending them for Senior Officers Management Course - SOMC. During 2016, four PNRA officers successfully completed SOMC at PIEAS. So far, 21 officers from PNRA have successfully completed SOMC at PIEAS. PNRA representatives also participate in short term training courses and seminars arranged at these institutions.

During the reporting period, around 73 PNRA personnel



Briefing to OIC Delegates on NPP Simulator

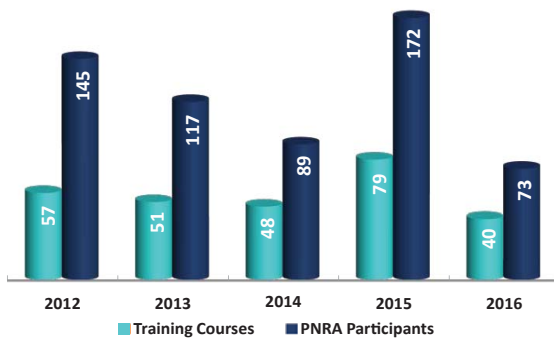


Figure 31: Training Courses / Participants at National Institutes

participated and benefited from 40 training opportunities arranged at national organizations. Figure 31 shows the trend of participation of PNRA officials in various training courses arranged at national institutes from 2012 to 2016.

Competency Development Through IAEA Support

PNRA takes benefit from IAEA's efforts to promote nuclear safety and security internationally. IAEA has been assisting Pakistan in capacity building and technical support through Technical Cooperation (TC) and Regional Asia (RAS) projects; and nuclear security cooperation programme.

Activities under these projects and programme include capacity building through missions, workshops, scientific visits, fellowships and training of PNRA personnel in nuclear safety and security areas. Under these programmes, the Agency has arranged professional and technical trainings for a number of PNRA's young engineers and scientists at various regulatory bodies and research organizations to enhance their competence.

During the year 2016, a number of PNRA officials benefited from various international workshops, training courses, fellowships, etc. As a whole, during the reporting

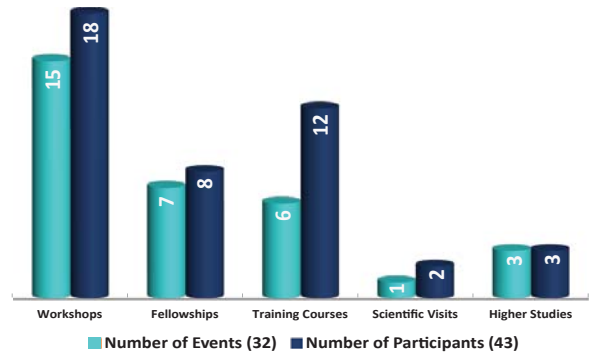


Figure 32: Capacity Building Through International Institutions

year, more than 40 PNRA officials participated in around 30 international events under IAEA programmes designed for enhancing capacity of Member States.

Competency Development Through Higher Education at International Universities

PNRA also promotes higher education opportunities for its officials in post-graduate, masters and doctorate degree programmes at various international institutions in relevant areas.

During the reporting year, one PNRA official was sent for "Post Graduate Training Course in Radiation Protection and Safety of Radiation Sources" in Malaysia. Furthermore, in 2016, one PNRA official was sent for International Nuclear and Radiation Safety Master's Degree Programme at KINS-KAIST University, Korea while two officers were sent for PhD studies at KINS-KAIST and Seoul National University, Korea. Moreover, during 2016, one official completed Master's Degree and one official completed PhD Programme at KINS-KAIST, Korea.

Graphical representation of competency development through international organizations, during the reporting year, is reflected in Figure 32.



Regional Workshop on Planning Integrated Management System Development Projects for Regulatory Bodies



Glimpses of PNRA Knowledge Sharing Programme

Knowledge Sharing and Mentoring Programme

Knowledge Management has worldwide received attention so that tacit knowledge of senior and retiring officials can be preserved and transferred to the next generation. Considering its relevance, PNRA has developed and implemented a comprehensive knowledge management programme and formally incorporated it as an integral component of management system and its strategic plan. Furthermore, this programme also encompasses knowledge domains of prominent luminaries from other technical and scientific organizations.

PNRA, under this programme, invites senior officials of PNRA and other relevant organizations to share their vast experience with young scientists and engineers from PNRA and other scientific establishments of the country.

In 2016, PNRA invited Mr. Ansar Hussain Shamsi - a former UN official and current advisor to the Chairman PNRA - and Mr. Zia Hussain Shah - former Director General of

PNRA who joined the UN on deputation - for talks to share their life time experiences with the young professionals.

Leadership Development Programme

PNRA understands the importance of leadership and considers it a crucial element for organizational progression and success. Since 2007 PNRA is working on a structured programme for leadership development which was initiated with the assistance of a leading business school in Pakistan. It is worth mentioning that volunteers working under this programme have so far contributed in very innovative ways by launching new programmes and developing valuable processes and platforms which became regular part of routine working of PNRA.

During the reporting period, competence development of the third batch of this programme was initiated as per the leadership framework of PNRA. A 360-degree feedback analysis of all the participants was conducted and participants prepared project proposals for polishing their leadership competencies.



Third Batch of PNRA Leadership Development Programme

8. NATIONAL & INTERNATIONAL COOPERATION

Cooperation with national and international organizations is very important for continuous advancement of a regulatory body. Such cooperation greatly helps in keeping abreast with the latest technical developments and enhancing the knowledge-base of regulatory officials through sharing of knowledge and experience; thereby augmenting the effectiveness of regulatory oversight of nuclear installations and radiation facilities.

Further, it is essential for the nuclear regulator to establish relationship with other concerned state entities while being aligned with internationally accepted standards and latest developments for the discharge of its responsibilities competently, timely, cost-effectively and in a manner that wins the confidence of all stakeholders. PNRA is cognizant of this importance of collaboration with national and international stakeholders.

At national level, PNRA has strived to establish a three-fold paradigm of cooperation. One dimension of this cooperation is with the relevant Governmental departments, divisions, agencies, authorities and ministries for effective regulatory control. The other facet of this collaboration is with its licensees in diverse domains of nuclear and radiation safety. Equally crucial is the third aspect, which is coordination with the general public with the aim of enhancing awareness about the use of ionizing radiation in common man's life, their potential health effects and necessary means of protection.

At international level, PNRA has a wide spectrum of bilateral and multilateral cooperation with international community. On one hand, PNRA utilizes these platforms for capacity building of its personnel and development of infrastructure; and on the other, PNRA provides expert technical support to the countries embarking on nuclear power in the assessment of their regulatory processes and implementation of human resource training under the auspices of International Atomic Energy Agency (IAEA). PNRA also functions as the national contact point for various international conventions signed by Pakistan for nuclear safety, physical protection and nuclear and radiological emergencies.

National Cooperation

PNRA maintains close cooperation with all the national stakeholders to enhance the safety of nuclear installations and radiation facilities in the country.

Coordination with Government Organizations

PNRA maintains effective reporting and communication channels with other Government organizations for the provision of information about regulatory decisions and for support in fulfillment of national obligations relevant to nuclear safety.

PNRA continuously reports the status of NPPs safety to concerned Government departments on quarterly basis. During the reporting period, PNRA prepared and disseminated status reports to relevant Governmental agencies including Prime Minister Secretariat, Planning Commission, etc. These reports contain information about different aspects of nuclear power plants in Pakistan, such as plant performance, radiation protection, significant events and regulatory oversight, etc.

PNRA also provided input and support to various Governmental organizations and ministries including Strategic Plans Division (SPD), Planning Commission, Ministry of Finance and other related Governmental departments.

PNRA maintains a National Radiation Emergency Coordination Center (NRECC) equipped with communication and radiation detection equipment along with a network of field response teams in six cities across the country. Among other assigned tasks, this center also provides, upon request, technical assistance and advice to local and national response authorities and federal and provincial governments.

Furthermore, PNRA also maintains Radiological Assistance Groups (RAG) in order to provide technical support to national stakeholders for response to a radiological emergency or nuclear security event.

Interaction with Licensees

PNRA believes that close liaison with its licensees is indispensable for the assurance of nuclear safety and radiation protection in Pakistan. In order to build and enhance strong interaction, PNRA conducts periodic coordination meetings with the licensees of nuclear installations at various levels with different frequencies. During the reporting period, PNRA hosted two corporate level meetings with the top management representatives of its major licensee - the Pakistan Atomic Energy

Commission - to discuss the progress of safety related activities.

During the year under review, six coordination meetings (three each with C-3 / C-4 and K-2 / K-3) were conducted with the management of under-construction nuclear power projects. Furthermore, two coordination meetings were conducted each with the management of operational nuclear power plants, research reactors, service providers, equipment manufacturer and radioisotope production facility (i.e. C-1, C-2, K-1, PINSTECH, NCNDT and HMC-3) during 2016.

PNRA promotes the involvement of its licensees in the development of regulations and gives due consideration to their feedback. PNRA also invites licensees, radiation workers and other stakeholders for participation in various training courses and seminars to enhance their understanding of the regulatory framework and of the importance of regulatory requirements and their effective implementation for maintaining safety.

Public Awareness Programme

PNRA understands that public needs to be made aware about the applications of ionizing radiations in everyday life; their potential harmful effects on human health and the environment; and various methodologies that could be adopted in case of incidents or accidents at installations and facilities using radioactive material.

PNRA has initiated a public awareness campaign to disseminate necessary information through lectures, seminars and printed leaflets targeting the youth in educational institutions all over the country. The participants are also made aware of the regulatory framework for nuclear power plants and radiation facilities.

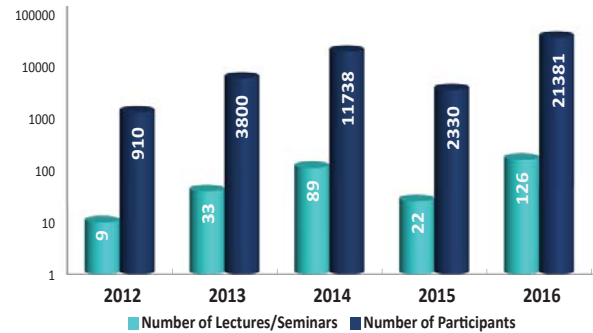


Figure 33: Overview of Public Awareness Programme

In 2016, PNRA conducted around 126 such lectures and seminars in various cities in the country at Government and private organisations, schools, colleges, universities, law enforcement agencies, hospitals and industries. These seminars addressed the benefits and risks associated with the use of ionizing radiation in everyday life and means of protection against these risks and were attended by more than 21,000 participants. Figure 33 represents the number of lectures / seminars conducted and participants of the PNRA public awareness programme during last five years.

International Cooperation

PNRA maintains cooperation at international level for fulfilling its responsibilities as national contact point for various international conventions; for capacity building of its officials and infrastructure; and also for sharing its expertise with partner organizations and institutions in other countries.

Meeting International Obligations

Pakistan is a Contracting Party to five major international



Public Awareness Seminar at a Postgraduate College in Rawalpindi

legal instruments under the auspices of International Atomic Energy Agency (IAEA). These conventions are related to nuclear safety, physical protection, and nuclear and radiological emergencies. PNRA is assisting the Government of Pakistan in execution of national obligations under these conventions.

With regard to nuclear and radiological emergencies, Pakistan acceded to two conventions, "Early Notification of a Nuclear Accident" and "Assistance in the Case of a Nuclear Accident or Radiological Emergency", on 11th September, 1989. In order to fulfil the obligations arising from these Conventions, PNRA has established National Radiation Emergency Coordination Centre (NRECC). During the reporting year, PNRA participated in Eighth Meeting of the Representatives of Competent Authorities designated under these conventions.

Pakistan ratified the Convention on Nuclear Safety in 1997. In accordance with the obligations of this instrument, Pakistan regularly submits the National Report of Pakistan for peer review at the International Atomic Energy Agency. During this year, PNRA contributed in the preparation of 7th National Report of Convention on Nuclear Safety (CNS) which was submitted to IAEA.

PNRA also serves as the national point of contact for the Convention on Physical Protection of Nuclear Materials to which Pakistan acceded in September 2000. During the reporting period, PNRA remained involved in the national process leading to the ratification of the amendment to the Convention on 24th March, 2016.

In addition, Pakistan follows the Code of Conduct on Safety and Security of Radioactive Sources. During the current year, PNRA representative attended a meeting held at the IAEA to share information related to its implementation by Pakistan.

Bilateral & Multilateral Cooperation

Bilateral and multilateral cooperation play an important role in strengthening and promoting efforts for nuclear safety and security worldwide. PNRA understands that establishment of a robust and effective collaboration among nuclear regulatory bodies is necessary for sharing experience and improving regulatory oversight of nuclear safety and security.

Pakistan has a strong liaison under working protocols with National Nuclear Safety Administration (NNSA) and China Nuclear Power Operation Technology Corporation (CNPO) for cooperation in the field of nuclear safety. PNRA and NNSA have set up a joint Steering Committee to discuss issues of mutual interest and evaluate progress on agreed actions. During the reporting year, 9th meeting of this Steering Committee was held at Qinshan, China. Furthermore, a PNRA delegation visited China for meetings with CNPO to discuss areas of cooperation related to safety assessment and long-term safety considerations of NPPs.

During the year 2016, PNRA in collaboration with the Ministerial Standing Committee on Scientific and Technological Cooperation of the Organization of Islamic Cooperation - COMSTECH - and the Pakistan Atomic Energy Commission - PAEC - organized an international workshop on "Application of Nuclear Radiation in the Field of Agriculture, Medical, Non-Destructive Testing and Nuclear Regulatory Practices" in Islamabad; 40 participants from Organization of Islamic Cooperation - OIC - countries attended this workshop.

Collaboration with the IAEA

Pakistan is a Member State of IAEA. PNRA, in its capacity as national nuclear regulator, contributes to and collaborates



Participants of the International Workshop on "Application of Nuclear Radiation in the Field of Agriculture, Medical, Non-Destructive Testing and Nuclear Regulatory Practices"

with IAEA in a range of activities. These include sharing of experience and good practices through various IAEA committees and networks; and provision of expert support and consultancy services by its professionals in various fields of nuclear safety and security. PNRA also participates in various technical cooperation and regional projects; and is collaborating with IAEA for nuclear security cooperation programme.

This year, PNRA participated and contributed – as part of Pakistan’s delegation – in the proceedings and activities of the 60th Regular Session of the IAEA General Conference.

During the reporting year, PNRA collaborated with other national stakeholders to host the Annual Meeting of the International Network for Nuclear Security Training and Support Centres (NSSC) in Islamabad, Pakistan. Since the establishment of NSSC Network in 2012, this meeting was held for the first time outside the IAEA headquarters in Vienna. The five-day meeting was attended by 56 participants from 30 Member States.

a. Participation in IAEA Safety and Security Standards Committees and Other Forums

Experts from PNRA actively contribute in a wide range of activities conducted through various IAEA committees and related forums and networks. PNRA experts represent Pakistan as designated members in various IAEA committees including Commission on Safety Standards (CSS), Nuclear Safety Standards Committee (NUSSC), Transport Safety Standards Committee (TRANSSC), Waste Safety Standards Committee (WASSC), Radiation Safety Standards Committee (RASSC), Nuclear Security Guidance Committee (NSGC), Emergency Preparedness and Response Standards Committee (EPReSC), Advisory Group on Nuclear Security (AdSec) and Global Nuclear Safety and Security Network (GNSSN). During the reporting year, PNRA officials participated in 39th Meeting of CSS ; 10th meeting of NSGC; 33rd Meeting of the TRANSSC; and 28th Meeting of AdSec. PNRA is also the designated national coordinator for activities and reporting under the International Nuclear Event Scale (INES) and Incident Reporting System (IRS).

Furthermore, PNRA represents Pakistan as a permanent member of the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). During the reporting period, PNRA participated in its 63rd session.

b. Expert Missions and Consultancy

PNRA supports IAEA’s motto - Atoms for Peace - and has a dynamic collaboration with IAEA. PNRA’s professionals assist IAEA in the fields of nuclear safety and security through expert support, consultancy and training for embarking countries.



Briefing to NSSC Network Meeting Delegates on NPP Physical Models

During 2016, PNRA’s experts participated and contributed in the IAEA Integrated Regulatory Review Services (IRRS) Missions to Bulgaria, Lithuania, Sweden, and China. In addition, PNRA’s experts also contributed in National Needs Assessment Missions to Sudan, Cuba and Mauritania.

Besides above, during this year, PNRA’s experts provided technical support and shared experiences in a number of conferences, seminars, workshops, meetings, trainings, etc. held at international level. Figure 34 represents the graphical detail of expert support provided by PNRA to IAEA during 2016.

c. IAEA Technical Cooperation Projects

Presently, PNRA is implementing two IAEA Technical Cooperation (TC) Projects for the Cycle 2016 & 17, “TC Project PAK9/040: Strengthening of Infrastructure for Radiation, Transport and Waste Safety” and “PAK/9/041: Enhancing Nuclear Safety and Expansion/Sustainability of Regulatory Framework.” Through these Projects, IAEA conducts workshops, training courses and offers fellowships in the relevant areas.

In 2016, 14 international experts visited Pakistan to conduct workshops and training courses in the field of nuclear safety and radiation protection. In addition, representatives of IAEA Technical Cooperation Division of Asia and Pacific visited PNRA for reviewing the outcome

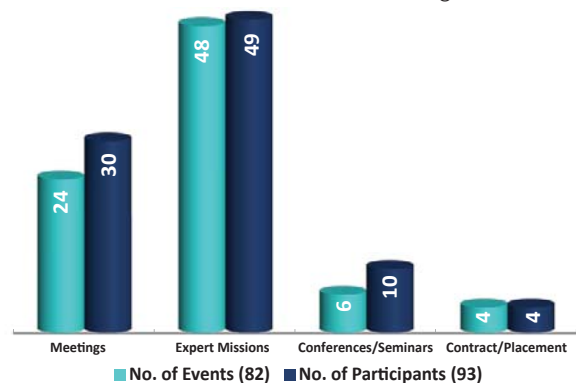


Figure 34: Expert Support in International Events



Mr. Juan Carlos Lentijo - DDG IAEA Unveiling the Plaque of Physical Protection Exterior Laboratory at Chakri

of technical cooperation while project counterparts from PNRA visited IAEA to discuss future course of action for implementation of activities agreed with IAEA.

During the reporting period, IAEA approved the TC Project Concept Note for the Cycle 2018-19, "Strengthening and Enhancing Sustainability of Regulatory Infrastructure in the Field of Nuclear, Radiation, Transport & Waste Safety; and Emergency Preparedness & Response in Pakistan".

d. IAEA Regional Asia (RAS) Projects

PNRA benefits from participation in IAEA projects on the development in Asia region in different areas related to nuclear and radiation safety. These IAEA projects are termed as IAEA Regional Asia (RAS) projects. Under these projects, 22 international delegates visited Pakistan in 2016 to participate in regional meetings.

e. IAEA-Pakistan Nuclear Security Cooperation Programme

Pakistan and IAEA have been working together on a nuclear security cooperation programme for more than a decade. This cooperation is aimed to further enhance the nuclear security regime in Pakistan. PNRA, being the designated focal point under this cooperation programme, coordinates with all stakeholders (IAEA, PAEC and SPD)

for planning and implementation of various activities under this programme.

The programme supports Pakistan's capacity-building through training of its personnel in nuclear security and establishment of nuclear security laboratories. It also focuses on enhancing physical security systems and measures at nuclear power plants and facilities using high-activity (Category-1) radioactive sources for which the IAEA Code of Conduct on Safety and Security of Radioactive Sources is applicable.

During the year 2016, five project coordination meetings were held among the stakeholders under IAEA-Pakistan Nuclear Security Cooperation Programme to discuss the progress of ongoing up-gradation projects. In this period, 25 experts visited PNRA under this programme for project coordination meetings and trainings related to physical protection and nuclear security.

During the reporting year Deputy Director General and Head of IAEA's Department of Nuclear Safety and Security Mr. Juan Carlos Lentijo unveiled the plaque of PNRA's state-of-the-art Physical Protection Exterior Laboratory (PPEL) at Chakri in March 2016. The operational functioning of this laboratory was inaugurated by the Chairman of Joint Chiefs of Staff Committee, Pakistan in April 2016.



Inauguration of PPEL by General Rashad Mahmood NI (M), Chairman Joint Chiefs of Staff Committee

9. TSOs, LABs & DEVELOPMENT PROJECTS

Safety review and assessment during the licensing of nuclear installations and radiation facilities by the regulatory body is a tedious and highly complex process wherein a bulk of scientific and technical information, design data and emerging safety issues are analyzed for regulatory decision-making.

Due to this reason, sufficient manpower with specialized technical knowledge, expertise, skills and research capabilities in different areas is needed to assess tricky and diverse safety issues. It is always difficult for an organization to make available specialists in all technical domains for evaluation of complicated phenomena.

In this context, the concept of Technical Support Organization - TSO - evolves in organizations with responsibilities to conduct safety research and evaluation to support the critical licensing and regulatory decisions. Such TSOs are comprised of specialists in specific areas having in-depth understanding of new scientific and technical developments; advance knowledge of latest NPP designs; application of relevant computer codes; experience of research and development; and capable to provide technical and scientific bases / input for regulatory decisions.

Furthermore, regulatory bodies in the world, utilize advanced laboratories for benchmarking and independent verification / assessment of reported data and results.

The development projects are also used for appropriately enhancing regulatory infrastructure and acquisition of state-of-the-art technology for strengthening nuclear regulatory regime.

PNRA has two TSOs namely Centre for Nuclear Safety (CNS) and Safety Analysis Centre (SAC). CNS mainly performs review and assessment of safety analysis reports and other licensing submissions related to nuclear installations; and audit calculations by using available computer codes. SAC provides technical support in safety and design analysis for verification of submissions by the licensees.

PNRA has two laboratories namely National Dosimetry and Protection Level Calibration Laboratory (NDCL) for monitoring personnel radiation dose and cross-verification of data reported by licensees; and National Environmental

Monitoring Programme (NEMP) to monitor environmental radioactivity level and verify environmental monitoring data provided by NPPs.

PNRA has three ongoing Public Sector Development Programme (PSDP) projects namely National Radiation Emergency Coordination Centre (NRECC) to improve the technical capabilities of PNRA and for effectively assessing a nuclear accident or radiological emergency; PNRA Residential Colony Chashma (PRC) to resolve residential problems of PNRA officials by providing safe and secure accommodation facilities in the vicinity of Chashma Nuclear Power Complex; and Design Assessment and Analysis of NPPs (DAAP) to further strengthen design assessment and analysis capability.

Technical Support Organizations

Centre for Nuclear Safety

Centre for Nuclear Safety (CNS) comprises of experts who provide technical and scientific services to various departments of PNRA and assist in ensuring high levels of safety for nuclear installations and radiation facilities.

CNS provides support in review and assessment of assignments pertaining to regulatory decisions on issuance of permits, authorizations and grant of licences to the applicants. During the reporting period, some major tasks carried out by CNS to support the regulatory decision-making included:

- Review of C-3 / C-4 Final Safety Analysis Report (FSAR) for issuance of fuel load permit;
- Review of Design Evaluation Report of Pumping Station Building Raft of K-2 / K-3;
- Review of submissions for licensing of Nuclear Safety Class-1 Equipment Manufacturer;
- Review of revised KFSAR and KPSA Level-1 Report (Rev. 03); and
- Review of SAR of Spent Nuclear Fuel Dry Storage Cask of K-1 for design certification.

Furthermore, research studies on radiological impacts of coal-fired power plants; and contents of uranium, thorium and potassium-40 in coal to be used as fuel in these plants were also performed.

Safety Analysis Centre

During the reporting year, PNRA concluded its five year development project for establishment of Safety Analysis Centre - SAC. SAC provides enhanced regulatory support to PNRA in NPP safety analyses. It specifically provides improved expertise to PNRA in deterministic and probabilistic safety analyses.

SAC performed substantial work in development of 1000 MWe PWR desktop simulator and NPP design assessment and modeling. During the year under review, some major tasks conducted for supporting the regulatory decision-making included:

- Analyses of different design basis accident sequences presented in K-2 / K-3 PSAR;
- Assessment of Severe Accident and Radiological Consequences of K-2;
- Analysis of C-2 emergency diesel generator loading sequence; and
- Assessment of decay and irradiation of PARR-1 fuel.

In addition, an analysis to validate the ultimate stress integrity of C-2 containment building and a study of emergency planning zones of K-2 and C-2 based on atmospheric release fractions in the case of loss of coolant accident were conducted.

PNRA Laboratories

National Environmental Monitoring Programme

PNRA has three environmental monitoring laboratories in the south, central and north regions of the country i.e. Karachi, Kundian and Islamabad. These laboratories, established under the National Environmental Monitoring Programme (NEMP), are capable of conducting effective



PNRA Officials Collecting Environmental Samples Around PARR-1 and PARR-2

and comprehensive environmental radiological monitoring throughout the country.

These laboratories are working on establishing background radiation levels all over the country. PNRA also utilizes these laboratories to conduct independent environmental radiological monitoring around the nuclear installations to verify data provided by licensees to ensure that the radioactive discharges from NPPs to the environment are within the specified acceptable limits and do not pose any harm to the public or environment.

During the year 2016, independent environmental radiological monitoring around K-1 was conducted and found that its results were in concurrence with licensee's results. Pre-operational study around K-2 / K-3 and C-3 / C-4 and its detailed analysis were also conducted to serve as a baseline for verification of licensee's data and to compare the impact on environment from the operation of these plants.

During the year 2016, verification of environmental monitoring data reported by research reactors was also conducted through independent collection and analysis of



Collection of NORM Samples from Phosphate and Fertilizer Industry

environmental samples.

PNRA has been working on establishment of national background radiation levels. For this purpose, the whole country has been divided into a mesh grid for sample collection. However, implementation of this study is pending due to limited financial recourses.

Moreover, PNRA is conducting survey of Naturally Occurring Radioactive Materials (NORM). During the reporting year, samples from six oil and gas fields were analyzed for the assessment of NORM.

Furthermore, in 2016, coordination with other NORM producers including mineral, coal, power and fertilizer production industries was also initiated.

National Dosimetry and Protection Level Calibration Laboratory

National Dosimetry and Protection Level Calibration Laboratory (NDCL) is equipped with sophisticated and state-of-the-art equipment for external and internal dosimetry and protection level calibration.

Currently, three laboratories at Islamabad, Kundian and Karachi, are providing such services. In addition to provision of dosimetry and calibration services to licensees, these laboratories also offer dose monitoring services for the personnel of first-response organizations and law enforcement agencies that may be involved in response actions in case of any radiological emergency.

These laboratories are also intended to conduct independent verification of personnel radiation dose record submitted by the licensees and to study the implementation of guidance levels for medical exposure.

External dosimetry setup comprising thermo-luminescent and film badge dosimetry offers dose monitoring service to licensed installations and facilities throughout the country.



Briefing to Maj. Gen. Tariq Javed HI (M), DG ESA SPD on PNRA Dosimetry and Calibration Laboratories

During 2016, services were provided to a number of radiation workers of some nuclear medicine facilities, radiotherapy centres, diagnostic radiology facilities, industrial radiography facilities, cargo monitors and participants of exercises / courses / workshops. External dosimetry services are also being provided to licensed nuclear installations. External dosimetry service could not be further extended considering the limited number of TLD and film badges.

Internal dosimetry setup of NDCL comprises Whole Body Counting System for direct measurement; and Liquid Scintillation Analyzer, Gamma Spectroscope and Alpha Spectroscope for indirect measurements of internal contamination. It provides internal dosimetry services to radiation workers of licensed nuclear installations on a routine basis.

During the reporting period, around 1700 personnel of licensed nuclear installations, foreign contractors and IAEA inspectors were monitored by this setup.

Calibration of Gamma Irradiation Equipment was performed using secondary standards reference



Calibration of Gamma Beam at NDCL, PNRA



Demonstration of WBC Operation to OIC Delegates

dosimetry system. A reference dosimetry system was also procured through IAEA during the reporting period which will be used for future calibrations. This setup is expected to initiate provision of calibration services during 2017.

Public Sector Development Programme (PSDP) Projects

National Radiological Emergency Coordination Centre - NRECC

PNRA is executing a project, initiated in 2015, for upgrading its National Radiation Emergency Coordination Centre (NRECC) with the objective to improve the technical capabilities of PNRA for effectively advising the Government and relevant organizations to implement protective measures in case of a nuclear accident or radiological emergency.

This project aims to enhance the capabilities of PNRA by making available real time access to safety parameters of nuclear power plants, metrological data and environmental radiation levels during NPP normal operation as well as emergency situation.

In this regard, work on development of detailed building

design was initiated during the reporting period.

PNRA Residential Colony Chashma - PRC

PNRA is developing a residential colony to facilitate / ensure continuous on - site presence of regulatory staff at Chashma which is emerging as a major hub of nuclear power production in the country.

Construction of several buildings containing family suites, hostel and security barracks along with necessary amenities has been completed and handed over for occupancy. Further work on other structures and facilities is scheduled to be completed in 2018.

Design Assessment and Analysis of NPPs - DAAP

PNRA also launched Design Assessment and Analysis of Nuclear Power Plants (DAAP) project under Public Sector Development Programme with an objective to further strengthen its design assessment and analysis capability for ensuring safety of nuclear power plants in the country.

The Specific focus of this project is to augment existing assessment and analysis capabilities; identify and acquire new tools; identify and fulfil future training needs and maintain / update the available tools.



Chairman PNRA Inaugurating Block-A of PNRA Residential Colony Chashma



10. PERFORMANCE REVIEW

PNRA has established a process of performance evaluation to assess the efficacy of its regulatory business against defined criteria comprised 12 Strategic Performance Indicators (SPIs).

For effective evaluation, PNRA has established downstream indicators - Specific Performance Elements (SPEs) - against each indicator. The progress of activities against these SPEs is used to depict the overall integrated performance of PNRA during annual performance assessment.

The outcome of annual performance review of PNRA is presented on a ranking scale of five levels – Satisfactory, Minimally Acceptable, Needs Improvement, Unsatisfactory and Not Acceptable.

This Chapter highlights the discussion on evaluation of these indicators based on the accomplishments and shortcomings noted during 2016.

Strategic Performance Indicators

Indicator 1

“Ensures that acceptable level of safety is being maintained by licensees”

The defined elements for evaluation of this indicator include two core functions of PNRA, i.e. “Review and Assessment” and “Inspection and Enforcement”; and Reporting of Events.

The performance element “Review and Assessment” corresponds to the review of licensees’ submissions including safety analysis reports, emergency plans, physical protection plans, etc.

During 2016, PNRA successfully completed review of Final Safety Analysis Report (FSAR) of C-3/C-4 as planned and issued its evaluation report. In addition, PNRA performed comprehensive review of initial decommissioning plans of C-3, C-4, PARR-1, MPF and PPRWMF which were approved after satisfactory resolution of all the review queries.

During the reporting period, PNRA also performed review of submissions and granted design approval certificate for Type B(U) transport container and operating licence of Pre-disposal Radioactive Waste Management Facility to PINSTECH upon satisfactory resolution of all the safety

issues raised during the review process.

Licensed radiation facilities, as per the requirements of PNRA regulations, submit a number of documents for review and approval of PNRA such as radiation protection programmes, ALARA plans, annual safety reports, annual dose reports, emergency response plans, physical protection programmes, decommissioning plans, environmental reports, etc. In 2016, PNRA reviewed these submissions and issued recommendations / directives, where necessary.

The performance element “Inspection and Enforcement” corresponds to regulatory inspections of nuclear installations and radiation facilities in order to ascertain the adequate level of safety at licensed installations and facilities.

During 2016, PNRA conducted a number of regulatory inspections of nuclear installations (operational, under commissioning and under construction), equipment manufacturing industry and radiation facilities. During these inspections, a number of deficiencies were observed and reported in the inspection reports issued by PNRA. Consequently, several directives were issued in lieu of non-compliances by the licensees which were continuously followed-up by PNRA inspectors. PNRA also monitored the conduct of emergency exercises at C-1, C-2, C-3, K-1 and PARR-1 for the evaluation of preparedness of nuclear installations for various emergency scenarios.

During the reporting period, the reportable events notified by the licensees were analyzed and PNRA ensured timely implementation of all corrective actions.

Chapter 3 to Chapter 6 of this report encompass the details of these activities and the corresponding efforts of PNRA.

Keeping in view all the above activities, PNRA has maintained its performance as “Satisfactory” against this indicator.

Indicator 2

“Ensures that regulations and guides are in position and understood by licensees”

This indicator is assessed on the basis of one of the core functions of PNRA, i.e. Development of Regulatory Framework and its understanding among the licensees.

A comprehensive process exists in the PNRA management system for the development and maintenance of regulations and regulatory guides. PNRA has so far issued 18 regulations and eight regulatory guides related to all relevant domains of PNRA jurisdiction. During the reporting period, PNRA remained involved in development of five new regulations and nine regulatory guides and revision of seven existing regulations and one regulatory guide.

PNRA gives due consideration to the involvement of all stakeholders in the process of development of regulations. In addition, PNRA organized a number of training courses / lectures for developing the awareness and understanding of regulatory framework among the officials of nuclear installations and radiation facilities during the reporting period.

Chapter 2, Chapter 7 and Chapter 8 of this report present detail of these activities. However, the development / revision of regulations and regulatory guides was observed to be lagging behind the schedule.

Keeping in view the above, the performance rating of this indicator is retained as **"Minimally Acceptable"**.

Indicator 3

"Strives for continuous improvement of its performance"

This indicator is assessed against the efforts of PNRA for the improvement in regulatory effectiveness on the basis of monitoring, self assessment, independent assessments, feedback from interested parties and international experience feedback.

Under its management system, PNRA has developed a detailed mechanism for monitoring and assessment of all the regulatory processes, with pre-defined frequencies, in order to evaluate their effectiveness.

During the reporting period, PNRA performed annual monitoring of the status of and progress on its Strategic Plan 2015-18 and issued a report in this regard. PNRA also performed quarterly performance evaluation of all departments and issued reports to reflect the progress and implementation status of their annual work plans. In addition, PNRA conducted weekly performance reviews and prepared a summary report on implementation of the weekly work plans.

Under the PNRA management system, all departments are required to conduct their self assessment according to a pre-defined frequency. During the reporting period, a number of PNRA departments performed their self assessment on the basis of pre-defined criteria and procedures.

For independent assessment, PNRA conducts internal regulatory audit of all departments and also invites international organizations for the overall performance evaluation based on IAEA safety standards. During the reporting period, the outcome of the 3rd regulatory audit conducted in 2015 was documented in the form of an integrated audit report. Furthermore, a comprehensive action plan was prepared in the light of the recommendations and suggestions of International Regulatory Review Services Mission report issued by IAEA in 2016.

The international experience feedback and feedback from stakeholders / licensees are embedded elements of PNRA management system and are given due consideration for the improvement in regulatory processes / activities.

Keeping in view the above, the performance of PNRA is rated as **"Satisfactory"** as that of previous year.

Indicator 4

"Takes appropriate actions to prevent degradation of safety and to promote safety improvements"

Assessment of this indicator is based on PNRA performance against periodic safety assessment of licensees, implementation of relevant international experience feedback and implementation of necessary design modifications.

As a part of safety improvements, PNRA approved a number of design modifications of nuclear installations that met the regulatory requirements. In addition, PNRA reviewed various periodic submissions including technical reports, event reports and respective investigations conducted by licensees, dose reports, environmental monitoring reports, etc.

Evaluation of International Operating Experience Feedback (OEF) is essential to enhance nuclear safety. PNRA has a formal mechanism of evaluation of international OEF obtained from nuclear industry around the globe. During the reporting period, PNRA issued the 8th Report on Evaluation of OEF to apprise the regulatory staff and operating personnel of nuclear installations in Pakistan about international operating experience feedback.

PNRA also utilized the international feedback from Fukushima Response Action Plan (FRAP) during the review of K-1 revised FSAR to make it consistent with international safety standards.

Chapter 3, Chapter 4 and Chapter 5 provide the detail of these activities.

Considering the completion of all scheduled activities related to assessment of periodic submissions, approval

of design modifications and utilization of international operating experience feedback, the performance-rating of this indicator has been upgraded from “Minimally Acceptable” to **“Satisfactory”**.

Indicator 5

“Takes appropriate steps for human resource development and has competent and certified regulatory staff”

The evaluation of this indicator is based on defined performance elements pertaining to human resource development, training & certification of officials and evaluation / implementation of competence needs assessment.

During 2016, PNRA performed an analysis for the rationalization of human resources in comparison with the assigned tasks & functions of PNRA departments and submitted its detailed outcome to the PNRA management. Keeping in view the increasing scope of regulatory network, PNRA is developing an HR Strategic Plan-2025 to address the future regulatory challenges.

PNRA completed a pilot project on Competence Needs Assessment (CNA). Upon the success of pilot phase, the scope of assessment has been expanded to cover the rest of PNRA departments which is currently in progress. Furthermore, work remained in progress for development of Knowledge Management Policy and strategies to implement the Knowledge Management System.

In 2016, PNRA inducted a number of engineers, scientists, technicians, scientific assistants and other administrative personnel under its human resource development programme. During the reporting period, NISAS, which is the in-house training facility of PNRA, was awarded ISO 9001:2008 certification. PNRA arranged a number of training courses, both in-house and outside PNRA at different national organizations, during the reporting period, to enhance the competency of its officials through training and retraining in various disciplines including legal and regulatory framework; regulatory processes and practices; management system; personnel skills and behaviour, etc. In addition, a number of officials participated in training courses, workshops, fellowships, etc. organized at international platforms. Chapter 7 of this report provides the detail of these activities.

In view of the above, PNRA’s performance against this indicator is evaluated as **“Satisfactory”**.

Indicator 6

“Ensures legal actions are taken in case of violations of regulatory requirements”

This indicator is assessed based on the availability of enforcement regulations and relevant updated procedures

and their implementation against violators upon non compliance.

Under the Ordinance, PNRA has the legislative mandate to develop and enforce its regulations in the country and take action against violators. For the effective implementation of this mandate, PNRA has promulgated Enforcement Regulations - PAK/950 - and developed enforcement procedure which describes step-by-step approach for taking enforcement actions against the violators.

Currently, all practices involving use of radiation generators or sources in medical, agricultural, industrial, education & research sectors are under the licensing domain of PNRA. However, a number of medical diagnostic X-ray facilities are still outside the licensing network, in violation of the regulatory requirements. PNRA continued to exercise strong persuasions to get such facilities within the licensing net. PNRA served more than 370 violation notices and around 200 show cause notices to the violators and subsequently several hearings were conducted by PNRA. These efforts resulted in an appreciable increase in the number of licensed X-ray facilities during the current year. By the end of 2016, the total number of licensed radiation facilities and activities reached over 4700.

As all the diagnostic X-ray facilities have not yet been brought into the licensing net of PNRA, the performance of PNRA is retained as **“Minimally Acceptable”** against this indicator for the current year.

Indicator 7

“Performs its functions in a timely and cost-effective manner”

This indicator is assessed against the performance elements regarding meeting the defined targets and schedules; conducting planned and unplanned activities; and optimization of resources.

During the reporting period, PNRA continued to monitor the activities of the licensees in accordance with annual work plans as well as managed to participate in unplanned activities without affecting the scheduled ones. PNRA, in accordance with annual inspection plans, performed inspections at nuclear installations and radiation facilities. PNRA also conducted a number of special and unannounced inspections at various facilities.

In 2016, PNRA achieved most of its targets within estimated budget and schedule. These included award of operating licence to Pre-disposal Radioactive Waste Management Facility; issuance of design approval certificate for Type B(U) Transport Container; approval of initial decommissioning plans; operation of Physical Protection Exterior Laboratory; completion of security

barracks, hostel and family accommodation blocks in PNRA Colony Chashma; acquisition of land for NRECC project; revision of PNRA Management System Manual; monitoring of PNRA Strategic Plan 2015-2018; development of action plan against IRRS Mission report; HR rationalization study; ISO 9001:2008 certification of NISAS; gazette notification of regulations on decommissioning - PAK/930; etc.

Although, PNRA has achieved almost all major targets and milestones for the year 2016 within defined timeline and budget, however some exceptions are also noted such as delay in the development of regulation on physical protection of nuclear material and nuclear facilities (PAK/925); revision of regulations on equipment manufacturer (PAK/907); development and revision of regulatory guides; procurement of online radiation monitoring system for NRECC project; TLDs / film badges for dosimetry laboratories and postponement of some international workshops; etc.

Keeping in view the achievements and shortcomings of PNRA during the reporting period, the performance against this indicator is retained as **"Minimally Acceptable"**.

Indicator 8

"Ensures that a well established quality management system exists"

The assessment of this indicator is based on the availability of updated management system, its understanding among PNRA officials and its implementation within PNRA.

During the reporting period, PNRA revised its Management System Manual (MSM) in the light of feedback from implementation of its previous version, self assessment of PNRA, IRRS Mission report; and IAEA GSR Part 2: Leadership and Management for Safety and GS-R-3: The Management System for Facilities and Activities.

The revised PNRA MSM was presented to Senior and Top Management; and circulated to all PNRA departments for its awareness among PNRA officials and its implementation within PNRA.

During the reporting period, as per requirements of updated PNRA MSM, PNRA issued progress report of Long Term Strategic Plan 2015-2018; quarterly performance evaluation reports and integrated audit report of 3rd regulatory audit.

Furthermore, a number of PNRA departments conducted departmental level self assessments; all departments updated their organizational structure, issued annual work plans, weekly plans, monthly progress reports; and prepared several working documents including programmes, procedures, process flow charts, job descriptions, reports, etc.

The Directors' meeting & Chairman's meeting with PNRA departments were also conducted in accordance with management system.

Based on the above facts, the rating of PNRA against this indicator has been upgraded from "Minimally Acceptable" to **"Satisfactory"** for the reporting period.

Indicator 9

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

This indicator is assessed against the availability of appropriate resources and technical support to PNRA for carrying out its activities.

PNRA made a lot of efforts for ensuring the adequacy of financial and human resource planning to perform its functions smoothly. All regulatory functions continued to be executed appropriately while most of the planned activities for the year were adequately resourced. Annual budget of PNRA was approved and provided by the Federal Government and all efforts were made for its effective utilization to achieve most of the intended outcomes. Furthermore, PNRA inducted required manpower and conducted in-house trainings as scheduled.

PNRA has two technical support centres namely Centre for Nuclear Safety (CNS) and Safety Analysis Centre (SAC). CNS conducted review of safety analysis reports and other submissions related to nuclear installations to provide technical support in licensing and regulatory decision-making. In 2016, the PSDP project to establish Safety Analysis Centre (SAC) for providing technical support in safety and design analysis was successfully completed. SAC provided support in conducting different independent analyses and development of models for verification of licensees' submissions.

PNRA has also established two laboratories namely National Dosimetry and Protection Level Calibration Laboratory (NDCL) for monitoring personnel radiation dose and cross-verification of data reported by licensees; and the National Environmental Monitoring Programme (NEMP) to monitor environmental radioactivity and verify environmental monitoring data provided by NPPs. During the reporting period, PNRA also made operational the Physical Protection Exterior Laboratory (PPEL) for training at national and international levels, at Chakri, in collaboration with IAEA.

Currently, PNRA has three ongoing PSDP projects. One of them is PNRA Residential Colony (PRC) Chashma for providing safe and secure housing facilities to PNRA officials in the vicinity of Chashma Nuclear Power Complex. The other one is for upgrading the National

Radiation Emergency Coordination Centre (NRECC) to develop and enhance PNRA's capabilities to access technical information; and meteorological and environmental radiation levels around NPPs. During the reporting period, a new project namely Design Assessment and Analysis of Nuclear Power Plants (DAAP) was approved by Planning Commission to further strengthen PNRA's capability for design assessment and analysis.

During the reporting period, PNRA has accordingly, achieved most of its objectives and targets within available resources. However, some of the activities were affected due to scarcity of financial resources. These included execution of some elements of competence development programme, establishment of background radiation level through meshing and procurement of TLDs & film badge dosimeters for NDCL.

Keeping in view the above, PNRA has retained its performance against this indicator as **"Needs Improvement"** for the reporting year.

Indicator 10

"Performs its functions in a manner that ensures confidence of the operating organizations"

This indicator is assessed against the performance elements related to feedback of the licensees of nuclear installations and radiation facilities and collaboration with licensees in various activities.

PNRA believes to maintain a close liaison with interested parties all over the country. PNRA promotes the involvement of licensees and public in the process of development of regulations and gives due consideration to their feedback. Chapter 2 of this report reflects in detail the development process of PNRA regulations.

PNRA convenes training courses for the licensees, radiation workers and other stakeholders. In 2016, PNRA arranged various training courses for the licensees and radiation workers to enhance the understanding of regulatory framework, the importance of regulatory requirements and their implementation for maintaining safety. Chapter 7 of this report describes in detail these training activities.

In order to build and enhance strong interaction with the operating organizations, PNRA conducts periodic meetings, at various levels with different frequencies, with the licensees of nuclear power plants, research reactors, equipment manufacturer and molybdenum production facility to discuss the progress of safety related activities and resolution of issues and queries. Chapter 8 of this report presents details of these meetings conducted during the year 2016.

The direct feedback of licensees on various regulatory

oversight processes was planned to be obtained during the year 2016. In this regard, a questionnaire with a comprehensive set of questions was prepared during the reporting period and is currently under review at PNRA.

Considering the ongoing process of finalization of questionnaire to get licensees' feedback, the performance of this indicator for the reporting year is downgraded one step to **"Minimally Acceptable"**.

Indicator 11

"Performs its functions in a manner that ensures confidence of the general public"

This indicator is assessed against public awareness programme, dissemination of information among general public and involvement of public in the preparation of regulatory documents.

PNRA associates utmost importance to public awareness programme and annually develops a comprehensive plan for its implementation. During the year under review, PNRA conducted a number of lectures and seminars as a part of the implementation of public awareness programme. Chapter 8 presents detail of the activities on public awareness.

PNRA disseminates necessary information through a variety of platforms such as PNRA website (www.pnra.org), PNRA annual report, press releases to media, and through lectures & seminars delivered in different Government and private organisations all over the country.

PNRA has a National Radiation Emergency Coordination Centre (NRECC) to look into the matters related to emergency situation(s) and to enhance coordination with all the stakeholders including first responders and the general public in case of a nuclear or radiological emergency.

PNRA is continuously striving for the enhancement of public involvement in different regulatory processes/ activities. PNRA involves public in the development of regulatory documents by placing draft regulations at its website for feedback and comments. However, PNRA needs to enhance its outreach by developing a mechanism / process for the involvement of general public in the preparation of regulatory documents.

Based on these facts, the performance against this indicator is retained as **"Needs Improvement"**.

Indicator 12

"Performs its functions in a manner that ensures confidence of the Government"

This indicator is assessed on the basis of effectiveness

of reporting and communication channels for provision of necessary information to the Government about regulatory decisions and provision of support for fulfilment of international obligations.

PNRA continues to report status of the NPPs to the concerned Government departments on quarterly basis. PNRA also holds meetings at national level with Strategic Plans Division (SPD), Planning Commission, Ministry of Finance and other related Governmental departments to discuss the matters of mutual interest.

PNRA has adopted effective strategies and takes appropriate actions at national and international levels to fulfil the obligations of four international conventions

ratified by Pakistan. During the year under review, PNRA prepared 7th National Report under the Convention on Nuclear Safety (CNS).

During the reporting period, PNRA provided support to the Government of Pakistan for ratification of the amendment in the Convention on the Physical Protection of Nuclear Material (CPPNM) for extension of the scope of the Convention to cover nuclear facilities and nuclear material in peaceful use, storage and transportation at domestic as well as at international level.

Chapters 3 and 8 provide detail of all these activities.

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



Figure 35: Assessment of PNRA's Performance in 2016

Overall Performance

The overall performance of PNRA against all the Strategic Performance Indicators is reflected collectively in Figure 35. Keeping in view the evaluation of all the twelve

performance indicators, PNRA has rated its overall performance for the reporting period as **“Satisfactory”**. An overview of its overall performance during the last ten years is given in Figure 36.

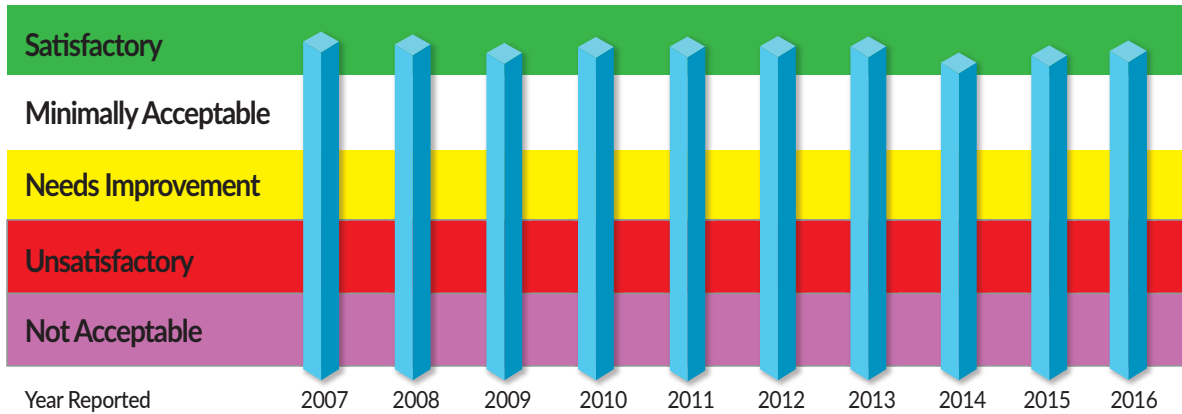
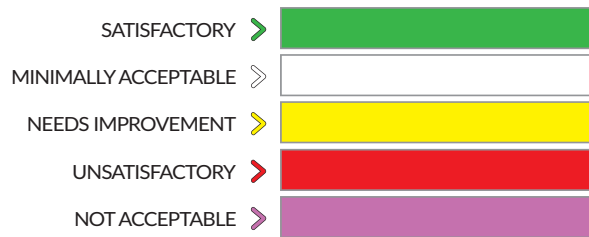


Figure 36: Annual Performance Review of PNRA for Last Ten Years



RATING SCALE AND COLOUR CODES



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