



REPORT
2008

PAKISTAN NUCLEAR REGULATORY AUTHORITY

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MESSAGE FROM THE CHAIRMAN



It is a pleasure to address you through this report, which is my last as the Chairman of PNRA. On the completion of my tenure of eight (08) years, I would like to thank all of my colleagues and stakeholders who have helped me in effectively performing my duties as the chief nuclear regulator of the country.

I must say that PNRA has faced many challenges—of resources, of independence and of competency building—but our team has responded ably to meet these challenges. I would like to take this opportunity to point out that many challenges still remain to be addressed. There is a need for continuous vigilance about our performance as a regulator. We also need to address the issue of resource management and career planning of our younger officers, whose number has increased from a few to around 200 in the last eight years.

The ability to make competent regulatory decisions based on sound technical grounds and free from the influence of politics, personal preference, or other interests that may conflict with safety requires leadership at all levels of the organization. Leaders are not born but are developed through careful grooming and planning, and this development needs to start early in the career of an employee. In 2008, PNRA has initiated a Leadership Development Program in collaboration with the Lahore University of Management Sciences. The program will help in identifying and grooming future leaders of PNRA. Our leadership development framework consists of 4Cs and 1P:

- *Competence – having the ability to make competent regulatory decisions based on safety from technically sound and objective position.*
- *Compassion – being caring, willing to motivate, and capable of counselling, coaching and mentoring.*
- *Credibility – being reliable, professional and authentic while dealing with licensees and stakeholders.*
- *Consistency – being consistent in decision making and achieving targets, and energetic for achieving objectives.*
- *Passion – having heartfelt, deep and authentic excitement about our stakeholders, the profession and PNRA.*

This leadership framework of PNRA has gained international recognition and appreciation and is expected to be adopted as the international model for leadership development within regulatory bodies. I sincerely believe that this program should continue with its current vigour as it will help PNRA in grooming its future leaders and equipping them with the technical as well as leadership competency to take up the regulatory challenges of the 21st century.

In the end, I will only emphasise that PNRA should continue to focus its efforts to: “Become a world class regulatory body with highly trained, competent and dedicated personnel working in unison with zeal to foster a positive safety culture in their licensee.”

ABBREVIATIONS AND ACRONYMS

ACIURI	Advisory Committee on Improving Utility-Regulatory Interface, PNRA
ALARA	As Low As Reasonably Achievable
C-1	Chashma Nuclear Power Plant Unit 1
C-2	Chashma Nuclear Power Plant Unit 2
C-3	Chashma Nuclear Power Plant Unit 3
C-4	Chashma Nuclear Power Plant Unit 4
CNPO	China Nuclear Power Operation Technology Corporation
CNS	Centre for Nuclear Safety, PNRA
COMTEX	Communication Test Exercise
ConvEx	Conventional Exercise
DNSRP	Directorate of Nuclear Safety and Radiation Protection
HMC	Heavy Mechanical Complex
IAEA	International Atomic Energy Agency
JTS	PNRA-PAEC Joint Technical Study Program
K-1	Karachi Nuclear Power Plant, Unit 1
K-2	Karachi Nuclear Power Project, Unit 2
KINPOE	Karachi Nuclear Power Plant Institute of Nuclear Power Engineering
LUMS	Lahore University of Management Sciences
MRML	Mobile Radiological Monitoring Laboratory
MWe	Megawatt-electric
NDPCL	National Dosimetry and Protection Level Calibration Laboratory
NERS	Network of Regulators of Countries with Small Nuclear Programs
NERSP	National Environmental Radioactivity Surveillance Program
NNSA	National Nuclear Safety Administration, China
NOC	No Objection Certificate
NRECC	National Radiation Emergency Coordination Centre, PNRA
NuSECC	Nuclear Security Emergency Coordination Centre, PNRA
PAEC	Pakistan Atomic Energy Commission
PARR	Pakistan Atomic Research Reactor
PHWR	Pressurized-heavy-water Reactor
PIEAS	Pakistan Institute of Engineering and Applied Sciences
PINSTECH	Pakistan Institute of Nuclear Science and Technology
PNRA	Pakistan Nuclear Regulatory Authority
PSDP	Public Sector Development Programme
PWR	Pressurized-water Reactor
RANET	Response Assistance Network, IAEA
RNSD	Regional Nuclear Safety Directorate, PNRA
RSD	Directorate for Radiation Safety, PNRA
SNRS	School of Nuclear and Radiation Safety, PNRA
SRS	Sealed Radiation Sources
TRANSSC	Transport Safety Standards Committee
UNSCEAR	United Nations Scientific Committee on Effects of Atomic Radiations
WSD	Waste Safety Directorate, PNRA

CONTENTS

1.	INTRODUCTION AND BACKGROUND	01
	RESPONSIBILITIES, FUNCTIONS AND ORGANIZATIONAL STRUCTURE.....	01
	HIGHLIGHTS OF PREVIOUS REPORT	01
	MAJOR ACTIVITIES IN 2008.....	02
2.	REGULATORY FRAMEWORK	05
	REGULATIONS	05
	REGULATORY GUIDES	05
3.	NUCLEAR SAFETY.....	06
	REVIEW AND ASSESSMENT.....	06
	LICENSING OF OPERATING PERSONNEL.....	07
	INSPECTION OF NUCLEAR INSTALLATIONS.....	08
4.	RADIATION SAFETY.....	10
	REVIEW AND ASSESSMENT.....	10
	LICENSING OF RADIATION FACILITIES	11
	AUTHORIZATION FOR IMPORT AND EXPORT OF RADIATION SOURCES AND EQUIPMENT... ..	11
	NATIONAL DOSIMETRY AND PROTECTION LEVEL CALIBRATION LABORATORY	11
	INSPECTION ACTIVITIES	12
5.	RADIOACTIVE WASTE AND TRANSPORT SAFETY.....	13
	NATIONAL POLICY ON RADIOACTIVE WASTE	13
	REVIEW AND ASSESSMENT.....	13
	INSPECTION OF WASTE MANAGEMENT AND DISPOSAL	13
	SAFE TRANSPORT OF RADIOACTIVE MATERIALS	13
6.	EMERGENCY PREPAREDNESS	14
	REGULATORY ASPECT.....	14
	PLANS AND DRILLS	14
	NATIONAL RADIATION EMERGENCY COORDINATION CENTRE	14
	PROGRESS UNDER THE NUCLEAR SECURITY ACTION PLAN	15
	REGISTRATION WITH RANET.....	15
	TRAINING OF MEDICAL PROFESSIONALS IN HANDLING OF RADIATION INJURIES.....	15
7.	NATIONAL AND INTERNATIONAL COOPERATION	17
	NATIONAL LINKAGES	17
	INTERNATIONAL COOPERATION	19
8.	STRIVING FOR CONTINUOUS IMPROVEMENT.....	21
	PROGRESS AT THE CENTRE FOR NUCLEAR SAFETY.....	21
	DEVELOPING THE NEXT GENERATION OF REGULATORS.....	22
	RESEARCH AND DEVELOPMENT	22
	MONITORING, EVALUATION AND IMPROVEMENT.....	22

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 and 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*

1 INTRODUCTION AND BACKGROUND

The Pakistan Nuclear Regulatory Authority (PNRA) came into existence in 2001 as an independent body to regulate nuclear safety and radiation protection matters in Pakistan.

The role that PNRA plays was previously performed by the Directorate of Nuclear Safety and Radiation Protection (DNSRP), a part of the Pakistan Atomic Energy Commission (PAEC). In this arrangement, PAEC was performing the functions of both promoter and regulator of nuclear energy in the country. In 1994, Pakistan signed the Convention on Nuclear Safety. One of the obligations under this Convention is that regulatory functions be institutionally separated from promotional and utilization activities involving nuclear energy in the country. Fulfilling this obligation, the Government of Pakistan promulgated the Pakistan Nuclear Regulatory Authority Ordinance in 2001, whereby DNSRP was transformed into a separate and independent institution: the Pakistan Nuclear Regulatory Authority.

PNRA is emerging as a progressive public sector organization committed to ensuring that the safety and security of nuclear and radiation facilities are maintained at all times. Transparency in functioning is a core value of the organization, while maintaining public confidence is integral to our mission. These commitments are manifested in, among other things, issuance of the PNRA Annual Report since 2006. The current report is the fourth in this series and outlines the activities carried out by PNRA during 2008. Readers interested in our past work can access the first three reports, covering the periods 2001-05, 2006 and 2007, at our website, <http://www.pnra.org>.

RESPONSIBILITIES, FUNCTIONS AND ORGANIZATIONAL STRUCTURE

Under the Pakistan Nuclear Regulatory Authority Ordinance, PNRA is entrusted with the responsibility of regulating nuclear installations, radiation generators and facilities using ionising radiation, which include:

- Nuclear power plants;
- Nuclear research reactors;
- Medical applications of radiation, including therapeutic and diagnostic radiography and irradiators for sterilization of medical

equipment;

- Industrial applications of radiation, including industrial radiography, irradiators and scanners, oil well logging and nuclear gauges;
- Transport of radioactive material; and
- Radioactive waste facilities.

PNRA is fully aware of its responsibility to ensure safe operation of nuclear and radiation facilities and to protect radiation workers, the general public and the environment from the harmful effects of ionizing radiation. This is achieved by formulating and implementing effective regulations, building a relationship of trust with the licensees, and maintaining transparency in regulatory actions and decisions.

As its key activities, PNRA prepares regulations, licenses nuclear and radiation facilities, reviews and assesses safety submissions and cases, inspects facilities, and takes enforcement actions where needed. PNRA also ensures that adequate emergency preparedness programs exist at all nuclear and radiation facilities to respond to radiological emergencies. It moreover ensures that the safety and security of nuclear material/facilities is maintained at an acceptable level. All regulatory activities are carried out according to well established regimes based on national regulations as well as international practices. A system of self-assessment enables PNRA to continually assess its own performance.

In order to ensure that the nuclear and radiation facilities are being operated safely and in accordance with the national regulations, PNRA performs various types of inspections according to the annual inspection plan. For this purpose, PNRA has established three Regional Nuclear Safety Directorates (RNSDs) in Islamabad, Kundian and Karachi. Resident inspectors have been posted at all the nuclear power plants.

The organizational structure of PNRA is presented in Figure 1.

HIGHLIGHTS OF PREVIOUS REPORT

The following major activities were detailed in the previous report:

1. An Operating License was issued to Karachi Nuclear Power Plant Unit1 (K-1) for two years after it had completed re-licensing activities.

INTRODUCTION AND BACKGROUND

2. The licensing net for diagnostic radiation facilities was enhanced by 10 percent.
3. Three regulations were finalized for approval from the Authority.
4. A Self-assessment of PNRA's performance, conducted in collaboration with the Lahore University of Management Sciences (LUMS), was completed.
5. A Nuclear Security Training Centre and a Nuclear Security Emergency Co-ordination Centre were established.
6. The fifth recruitment drive was completed, increasing the total number of technical professionals in the PNRA team to 180.
7. A media campaign was conducted to create awareness in the general public about orphan radioactive sources.

MAJOR ACTIVITIES IN 2008

PNRA maintained its close monitoring of the two operational nuclear power plants in the country, Karachi Nuclear Power Plant, Unit 1 (K-1) and Chashma Nuclear Power Plant, Unit 1 (C-1). Through 2008, releases to the environment and radiation doses to workers remained well below regulatory limits at both plants.

Notably, K-1 is an older plant that completed its 30-year design life in 2002. After it had carried out the necessary safety upgradations and improvements, it was re-licensed to operate for two years at 90 megawatt-electric (MWe) in December 2007.

C-1 remained operational from January to August 2008. In August, the plant was shut down for refuelling. This was the fifth refuelling outage since the plant started commercial operation. C-1

is expected to restart in January 2009. The plant's maintenance performance remained satisfactory.

PNRA also kept a vigilant eye on the construction work under way for the Chashma Nuclear Power Project, Unit 2 (C-2). Civil construction has almost been completed and installation of the equipment is in progress.

In addition, PNRA completed its review of the Site Evaluation Report for Chashma Nuclear Power Plant, Unit 3 (C-3). A number of actions were identified; once the licensee has completed these, the site will be registered for construction.

The year saw further growth in the regulatory framework for nuclear safety in the country. PNRA formally notified the following regulations:

- Regulations for Licensing of Nuclear Safety Class Equipment and Components Manufacturers (PAK/907);
- Regulations on the Safety of Nuclear Installations – Site Evaluation (PAK/910); and
- Regulations on Management of a Nuclear or Radiological Emergency (PAK/914).

The National Radiation Emergency Coordination Centre (NRECC) remained functional as the focal point for round-the-clock reporting and monitoring of nuclear and radiological emergencies in Pakistan. It coordinated with other national and international response organizations and participated in the International Atomic Energy Agency (IAEA) Conventional Exercises (ConvEx) during 2008.

The Centre for Nuclear Safety (CNS), a technical support organization established within PNRA for institutional strengthening and capacity building, provided valuable technical support to its line directorates in the following activities:

History of Nuclear Safety Regime in Pakistan

1956	<i>Pakistan Atomic Energy Council established</i>
1964	<i>Pakistan Nuclear Safety Committee (PNSC) established.</i>
1965	<i>Pakistan Atomic Energy Ordinance promulgated.</i>
1970	<i>Nuclear Safety and Licensing Division (NSLD) established.</i>
1984	<i>Pakistan Nuclear Safety and Radiation Protection (PNSRP) Ordinance promulgated under which Directorate of Nuclear Safety and Radiation Protection (DNSRP) established.</i>
1990	<i>Pakistan Nuclear Safety and Radiation Protection (PNSRP) Regulations promulgated.</i>
1994	<i>Pakistan signs the Convention on Nuclear Safety.</i>
1994	<i>Pakistan Nuclear Regulatory Board (PNRB) established as a quasi-independent body</i>
2001	<i>Pakistan Nuclear Regulatory Authority Ordinance, 2001 promulgated thereby creating an independent regulatory body.</i>

- Review and inspection of refuelling activities at C-1;
- Follow-up of review of the Preliminary Safety Analysis Report for C-2;
- Inspection of C-2 equipments at manufacturer sites in China and Pakistan;
- Review of the Site Evaluation Report for C-3;
- Review of fuel channel integrity of K-1; and
- Licensing of Mo-99 isotope production plant at the Pakistan Institute of Nuclear Science and Technology (PINSTECH).

The PNRA School for Nuclear and Radiation Safety, established under the Public Sector Development Programme (PSDP), conducted eleven (11) courses in which 186 officers from PNRA as well as PAEC participated. In addition, PNRA arranged thirteen (13) training courses at external organizations in which twenty-four (24) PNRA officials received training in various disciplines.

The Nuclear Security Action Plan project continued in 2008. PNRA set up regional offices at Peshawar and Quetta to assist the law enforcement agencies in combating illicit trafficking of radioactive sources and material across international borders.

In addition, the following new projects were initiated by PNRA under the PSDP:

- i. Establishment of a National Dosimetry and Protection Level Calibration Laboratory (NDPCL); and
- ii. Establishment of National Environmental

Radioactivity Surveillance Program (NERSP).

Finally, PNRA continued to fulfil Pakistan's international obligations under the four conventions related to nuclear and radiation safety. PNRA submitted the country's National Report on Nuclear Safety and led the Pakistan delegation in the Fourth Review Meeting of the Convention on Nuclear Safety held in Vienna, Austria, in April 2008. The report was widely appreciated by the contracting parties. The rapporteur report issued by the Fourth Review Committee identified a number of good practices in Pakistan.

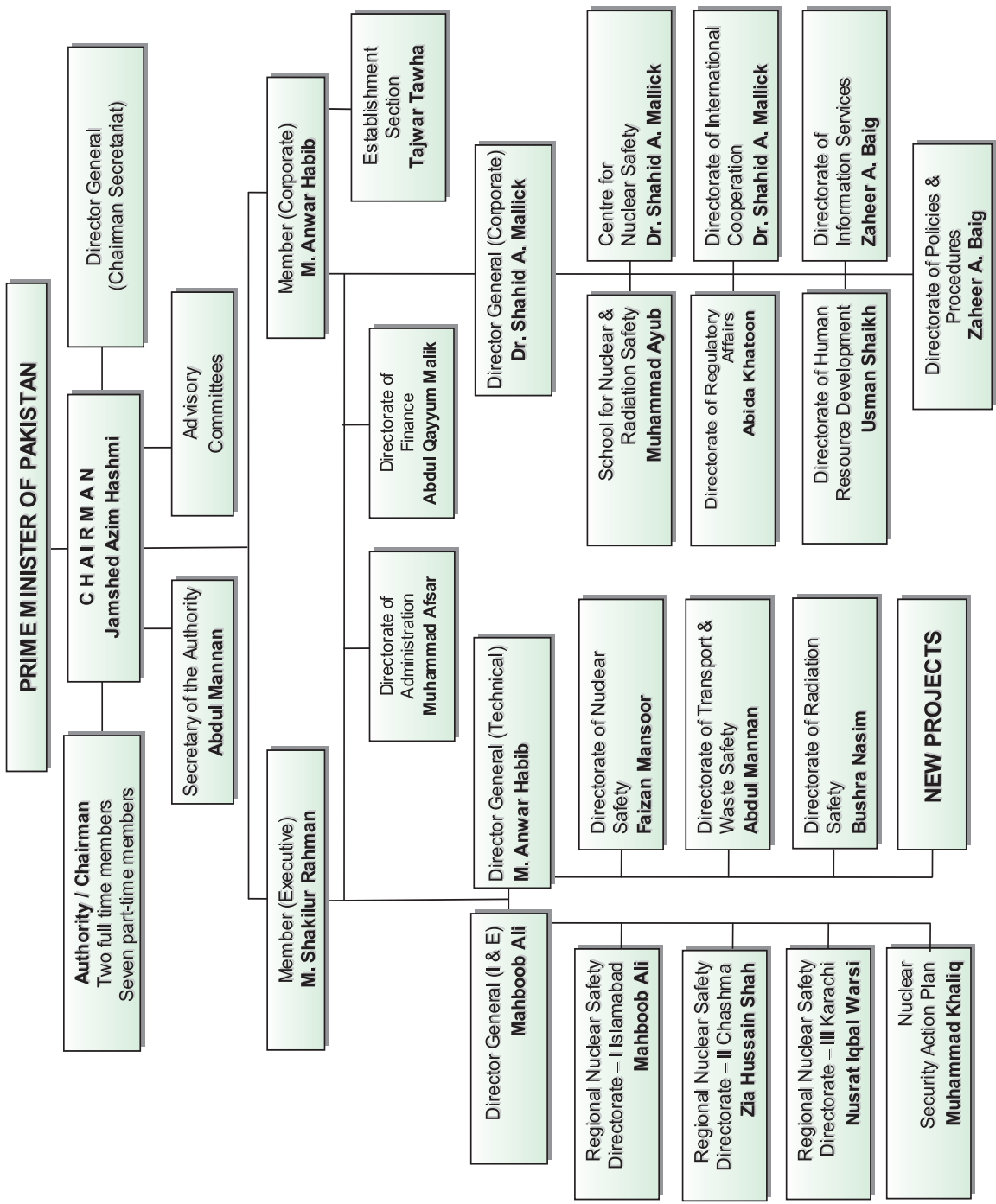
In summary, the key milestones achieved by PNRA in 2008 included the following:

- i. Monitoring of the fifth refuelling outage of C-1, which progressed satisfactorily;
- ii. Monitoring of construction work at C-2;
- iii. Review of the Site Evaluation Report for C-3;
- iv. Issuance of three national regulations related to the siting of nuclear installations, manufacturing of safety class equipment, and management of radiological emergencies;
- v. Initiation of two new PSDP-funded projects;
- vi. Submittal of the Fourth National Report on Nuclear Safety in Pakistan in the Fourth Review Meeting of the Convention on Nuclear Safety; and
- vii. Establishment of regional offices at Peshawar and Quetta to assist law enforcement agencies in combating illicit trafficking of radioactive sources and material.



PNRA Team Searching for a Radiation Source During an Exercise

FIGURE 1: ORGANIZATION STRUCTURE OF PNRA



2 REGULATORY FRAMEWORK

The Pakistan Nuclear Regulatory Authority Ordinance 2001 provides the statutory basis for PNRA. Under the Ordinance, the prime responsibility for formulating national regulations on nuclear and radiation safety lies with PNRA. These regulations are notified by PNRA in the official Gazette of Pakistan for implementation throughout the country.

The PNRA Ordinance, national regulations and non-mandatory guides form the basis of the nuclear regulatory framework in Pakistan. The highest level document in this framework is the Ordinance. The next tier consists of the mandatory national regulations carefully developed and notified by PNRA, which are based on internationally acceptable requirements. The bottom tier is comprised of non-mandatory guides that describe methods acceptable to PNRA to meet the requirements of its regulations; other methods may be adopted, provided it can be demonstrated to the Authority that they achieve the same or a better level of safety and quality.

REGULATIONS

The national regulations are binding upon licensees and are formulated to fulfil regulatory requirements for the nuclear and radiation safety of facilities and activities in the country. They set requirements for the protection of the public, workers and the environment from the harmful effects of ionising radiation. Existing regulations may be revised in the light of current safety requirements and international practices, licensees' feedback, national experiences and operating experience feedback.

During 2008, the "Regulations on Licensing Fee by PNRA (PAK/900)" were revised and formally

notified. An amendment was also issued in the "Regulations on the Safety of Nuclear Power Plants Operations (PAK/913)".

The following three new regulations were formally notified in the Gazette of Pakistan:

- i. Regulations for Licensing of Nuclear Safety Class Equipment and Components Manufacturers (PAK/907);
- ii. Regulations on the Safety of Nuclear Installations – Site Evaluation (PAK/910); and
- iii. Regulations on Management of a Nuclear or Radiological Emergency (PAK/914).

In addition, the following draft regulations remained under review in 2008:

- i. Pakistan Nuclear Regulatory Authority Enforcement Regulations (PAK/950);
- ii. Regulations on Safety of Nuclear Research Reactor(s) Operation (PAK/923); and
- iii. Regulations on Decommissioning of Facilities using Radioactive Material (PAK/930).

REGULATORY GUIDES

PNRA issues regulatory guides to help its licensees better understand the nature and requirements of national regulations and provide guidance in implementing these requirements. During 2008, PNRA issued the following regulatory guides:

- i. Dosage and Distribution of Potassium Iodide Tablets (a Thyroid Blocking Agent) in Radiation Emergencies (PNRA-RG-914.01); and
- ii. Probabilistic Safety Assessment of Nuclear Power Plants (PNRA-RG-911.01).



Cordoning off Dangerous Area During an Exercise

3 NUCLEAR SAFETY

PNRA regulates all matters related to safety at nuclear installations in the country and ensures that an acceptable level of safety, as prescribed in national regulations, is being maintained by the licensee. PNRA performs review and assessment of licensees' submissions and grants licences, and conducts inspections to verify that there are no deviations from licensing conditions and the technical specifications that define the 'safe operating envelope' of their facilities. PNRA also ensures that the licensee takes necessary actions to prevent degradation of safety, promote safety improvements, and maintain emergency preparedness at nuclear installations.

This section focuses on the review and assessment, licensing and inspection work performed by PNRA for nuclear installations in the country. Further discussion about radiation safety at nuclear installations is presented in Section 4 of this report; waste management and transport aspects are outlined in Section 5, and emergency preparedness aspects are discussed in Section 6.

REVIEW AND ASSESSMENT

KARACHI NUCLEAR POWER PLANT UNIT 1

K-1 started commercial operation in 1972 and completed its design life of 30 years in 2002. PAEC applied for extension of the plant's Operating Licence beyond design life in 2002. After fulfilment of regulatory requirements in accordance with national regulations, K-1 was licensed, in December 2007, to operate for two years beyond its design life, i.e., until December 31, 2009, at 90 MWe.

K-1 operated up to 90 MWe during the reported period. The plant tripped fifteen (15) times during the year, out of which eleven (11) trips were due to grid transients. PNRA has taken notice of this problem and PAEC has been directed to rectify the problem in consultation with the concerned authorities. Some actions have been taken while others are being taken to improve plant response to grid instability and make the grid more reliable.

As part of its regulatory activities at K-1, PNRA conducted an annual safety review, a review of plant safety performance, as well as review of modifications, event reports, routine reports and other documents. The plant's follow-up to licence conditions was specifically monitored to ensure

that satisfactory actions were taken by the licensee. In all, PNRA issued nine (09) directives in 2008, and K-1 responded to all of these by taking the necessary actions.

PNRA's review and assessment regimen did not identify any condition requiring issuance of a violation notice in 2008.

The releases of radioactivity to the environment, as well as radiation doses received by the workers at K-1, remained well below the authorized limits.

CHASHMA NUCLEAR POWER PLANT UNIT 1

C-1 was issued an Operating Licence in 2004 by PNRA. The plant remained in operation in the first eight months of 2008 and tripped five (05) times during this period. Again, three (03) of these trips were due to grid transients. C-1 has been directed to resolve the issue with WAPDA.

In August 2008, C-1 completed its fifth cycle of operation and was shut down for refuelling. The plant will restart in January 2009 after completion of this fifth refuelling outage. Major review and assessment activities performed during the refuelling outage included review of submissions related to activities such as refuelling, in-service inspections, surveillance tests and modifications. During the previous refuelling outage, some degradation had been observed in the plant's irradiation surveillance capsule baskets. PAEC had proposed some modifications in these baskets, which were reviewed and approved by PNRA. These modifications were implemented during the fifth refuelling outage.

In addition, PNRA performed review and assessment of plant performance, routine reports, event reports, modifications, and conformance to conditions of the Operating Licence. PNRA issued thirty-seven (37) directives to C-1 out of which thirty-two (32) have been implemented by the licensee. The remaining issues will be resolved at the Final Safety Analysis Report stage. No violation notice was issued to the plant in 2008. Its radioactivity releases to the environment and doses to workers remained well below the authorized limits.

CHASHMA NUCLEAR POWER PLANT UNIT 2

Construction work of C-2 remained in progress during the reporting period. Almost all the civil

work at site has been completed and installation of equipment is in progress. Most of the equipment has already been shifted to the site; however, manufacturing of some equipment is in progress and near completion. It is envisaged that this remaining equipment will be shifted to the site in early 2009.

PNRA is monitoring, both, construction at site and equipment manufacturing in China and Pakistan, in accordance with an approved inspection program to verify compliance with national regulations and licence conditions. In 2005-6, PNRA had reviewed the Preliminary Safety Analysis Report for C-2 and identified certain actions to be taken by the licensee, some of which were pending at the end of 2007. In 2008, PNRA followed up to verify that these actions had been taken satisfactorily. Seventeen (17) directives were issued to C-2 during the year, out of which fifteen (15) were satisfactorily addressed. The remaining two are being followed up by PNRA. No significant non-conformance was observed.

NEW NUCLEAR POWER PLANTS

Under its National Energy Security Plan, the Government of Pakistan has tasked PAEC with increasing the country's nuclear electricity generation capacity from the current level of 425 MWe to 8,800 MWe by the year 2030. To meet this target, PAEC plans to install a number of new nuclear power plants.

As a first step, in 2008, PAEC submitted Site Evaluation Reports for the registration of sites for Chashma Nuclear Power Plant Unit-3 and Karachi Nuclear Power Plant Unit 2 (K-2). PNRA has completed the review of the report for C-3; some administrative requirements are pending. Review of the report for K-2 revealed the need for further investigation and additional data, and PAEC was requested to re-submit the report after fulfilling this requirement.

PAKISTAN RESEARCH REACTORS (PARR-I AND PARR-II)

Pakistan Research Reactors PARR-I and PARR-II, located at the Pakistan Institute of Nuclear Science and Technology (PINSTECH), Islamabad, are mainly used for research and training purposes. In 2008, PNRA carried out inspections of annual maintenance activities at PARR-I and issued recommendations for improvement.

During the year, a total of seven (7) regulatory inspections were carried out at PARR-I and PARR-II in the areas of operation, radiation protection, environmental protection and radioactive waste management. PNRA renewed 26 Operator's Licences at the two reactors.

HEAVY MECHANICAL COMPLEX-3

Heavy Mechanical Complex-3 (HMC-3) has been licensed by PNRA to manufacture nuclear safety class 2 and 3 equipment for nuclear power plants in Pakistan. Accordingly, HMC-3 submitted its quality plans for manufacturing of equipment under the licence, which were reviewed by PNRA and a number of control points were selected for inspections.

HEAVY MECHANICAL COMPLEX

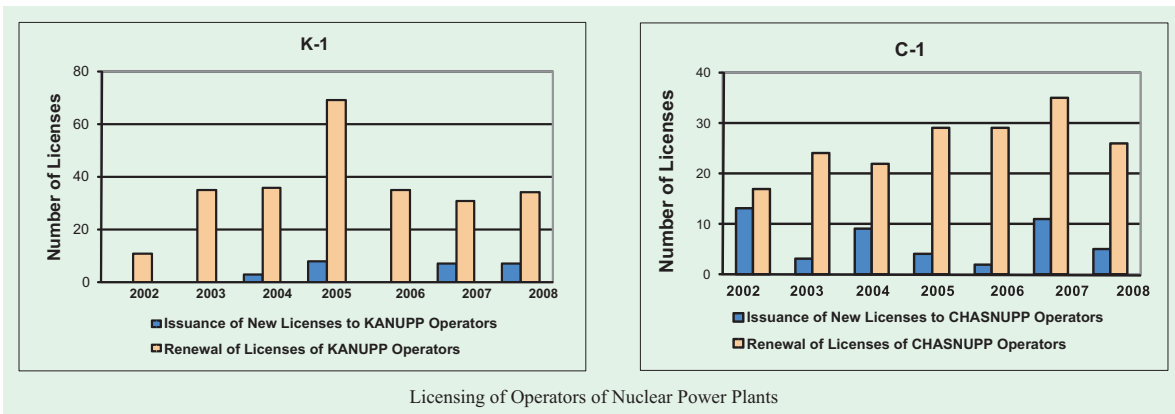
The Heavy Mechanical Complex applied to PNRA for obtaining a licence to manufacture nuclear safety class equipment. A thorough review of licensing submissions and inspections of HMC identified various areas that needed improvement to meet the qualification criteria. Accordingly, PNRA advised HMC to complete a number of actions. However, since HMC was unable to complete the required actions, the licensing process was terminated.

LICENSING OF OPERATING PERSONNEL

An important concern at PNRA is to ensure that sufficient number of qualified staff, i.e., staff with appropriate education, training and retraining, are available to conduct all safety-related activities at each nuclear installation throughout its life. Therefore, PNRA requires licensees of nuclear installations to obtain Operator's Licences for their operating personnel. Before issuing an Operator's Licence, PNRA verifies basic engineering qualifications and training as well as the medical and psychological fitness of the operator. The renewal of Operator's Licences also entails a rigorous procedure of oral, written and practical examinations.

During the reported period, Operator's Licences were granted to five (5) new personnel at C-1 and seven (7) new personnel at K-1. Several licences of existing plant operating personnel were also renewed, including twenty-six (26) at C-1, thirty-four (34) at K-1, and twenty-six (26) at PARR-I and PARR-II.

NUCLEAR SAFETY



INSPECTION OF NUCLEAR INSTALLATIONS

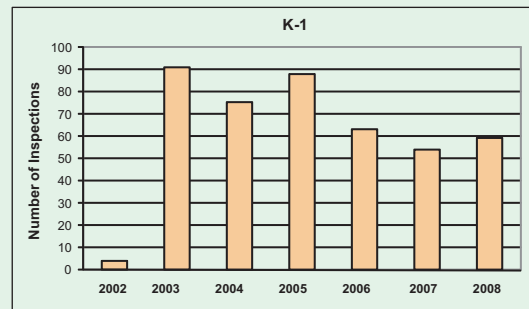
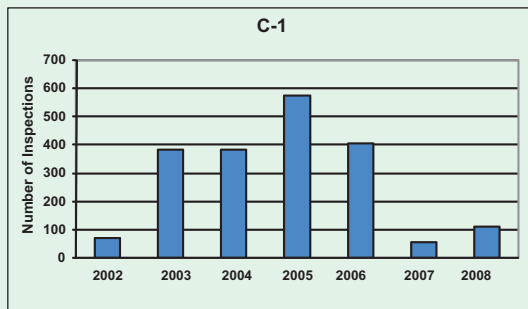
The main purpose of regulatory inspections at nuclear installations is to verify that licensees take appropriate measures to promote safety and also prevent degradation of safety at these facilities. Various types of routine as well as unplanned and reactive inspections are carried out in accordance with the "PNRA Inspection Program".

To carry out inspection activities, PNRA has established three Regional Nuclear Safety Directorates (RNSDs) in Islamabad, Kundian and Karachi, namely RNSD-I, RNSD-II and RNSD-III, respectively. Resident inspectors have also been posted at the two nuclear power plants, K-1 and C-1. The RNSDs conduct regulatory inspections of nuclear installations in their respective regions to ensure that provisions of the PNRA Ordinance, related national regulatory requirements, and

Status of Existing Nuclear Installations

	K-1	K-2	C-1	C-2	C-3 and C-4
Status	Licensed to operate until 2009	Site study ongoing	Licensed to operate until 2010	Construction to be completed by 2010	Site study ongoing
Location	Karachi, Sindh	Karachi, Sindh	Chashma, Punjab	Chashma, Punjab	Chashma, Punjab
Type	CANDU (PHWR)	PWR	PWR	PWR	PWR
Capacity (Gross)	137 MWe	340 MWe	325 MWe	325 MWe	340 MWe
First Fuel Loading	July 1971	–	November 1999	September 2010 (expected)	–
First Criticality	August 1971	–	May 2000	April 2011 (expected)	–
Date of Commercial Operation	December 1972	–	September 2000	2011 (expected)	–

PHWR: pressurized-heavy-water reactor; PWR: pressurized-water reactor.



Regulatory Inspections of Nuclear Power Plants

terms and conditions of the licence are being complied with, and that the facility operates according to approved technical specifications.

In 2008, RNSD-II performed periodic inspections in addition to routine and daily inspections of C-1. Main Control Room inspections were also performed as part of daily inspections. In all, RNSD-II performed one hundred and ten (110) inspections, including sixty-nine (69) inspections as part of the plant's fifth refuelling outage, and issued thirty-seven (37) directives to C-1 requiring various actions for safety improvement. RNSD-II, along with PNRA Headquarters staff, performed inspections and observed maintenance, testing and refuelling activities during the refuelling outage, which remained in progress during the last quarter of 2008. The findings and observations of these inspections were communicated to C-1 and will be followed-up in subsequent inspections. Aspects of C-1's safety culture were also monitored during the refuelling outage; the observations indicated that the plant's safety culture has improved.

At the site of C-2, a new nuclear power plant under construction, PNRA carried out Control Point and Hold Point Inspections. PNRA also

conducted 20 inspections at manufacturing sites in China to verify that the equipment for C-2 is being manufactured as per approved design and quality assurance requirements. Inspection reports were issued requiring various actions from the licensee, its contractor and sub-contractors. In all, PNRA conducted three hundred and eighty-five (385) inspections and surveillance activities for C-2 during the reported period.

RNSD-III performed regulatory inspections of various safety related structures, systems and components at K-1. In addition, many inspections related to re-licensing activities were also conducted; actions necessary for improvement in safety were communicated to K-1 and were followed up. PNRA conducted a total of fifty-seven (57) inspections and issued nine (09) directives to K-1 requiring various actions to be taken to enhance the plant safety.

RNSD-I performed seven (7) inspections of PARR-I and PARR-II in 2008. Recommendations were issued identifying deficiencies and requiring the licensee to take necessary actions for improvements in safety.



Mobile Radiological Monitoring Laboratory of PNRA

4 RADIATION SAFETY

Radiation safety is a core concern in overall nuclear safety, and the main concern at other types of radiation facilities, such as medical radiology centres, agricultural research centres, irradiators, etc. The Directorate for Radiation Safety (RSD) at PNRA oversees all matters related to radiation safety at nuclear installations and radiation facilities in Pakistan. In addition to leading the radiation aspects of all regulatory activities at nuclear power plants, RSD conducts similar review and assessment, licensing, inspection and other regulatory activities at the various smaller radiation facilities in the country.

REVIEW AND ASSESSMENT

PAK/904 and PAK/908 are the key regulations governing radiation safety issues. PNRA ensures that nuclear installations and radiation facilities are complying with the radiation protection requirements set out in these regulations through its review and assessment of licensing documents; periodic inspections of the facility and work practices; and monitoring of radioactive releases from nuclear installations. Every nuclear installation is required by the regulations to have in place a Radiation Protection Program approved by PNRA. PNRA ensures that the facilities are properly designed for their intended work, with provisions for minimizing radiation exposure to workers, the public and the environment in accordance with their radiation protection programs.

NUCLEAR INSTALLATIONS

KARACHI NUCLEAR POWER PLANT, UNIT 1

As mentioned earlier, after a major refurbishment in 2007, K-1 was re-licensed for operation beyond design life until December 2009. PNRA is closely monitoring the plant's operation. Several major activities involving high radiation exposures were performed during the reported period, during

which PNRA ensured that radiation doses and exposure were minimized with the application of the 'As Low As Reasonably Achievable' (ALARA) principle through review, assessment and inspection of activities. Individual doses to the workers and plant effluents were found to be within regulatory limits, and K-1 made no significant contribution to the ambient radiation level.

CHASHMA NUCLEAR POWER PLANT, UNIT 1

As mentioned earlier, C-1 operated routinely until August 2008, when it was shut down for refuelling. PNRA ensured that the ALARA principle was applied at the plant in letter and spirit by reviewing the ALARA plans and assessing dose estimates. It was ensured that C-1 keeps the individual doses to the workers and plant effluents within regulatory limits and makes no significant contribution in the ambient radiation level.

Notably, PNRA maintains a radiation exposure record of occupational workers at nuclear installations and radiation facilities to review and evaluate the safety of workers, effectiveness of radiation protection, and application of the ALARA management program by the licensee. At present, the record includes information about 7,000 occupational radiation workers employed at K-1, C-1 and other nuclear installations and radiation facilities in the country.

RADIATION FACILITIES

PNRA also ensures safe use of X-ray machines and radioactive sources at facilities such as nuclear medical centres, agricultural centres, research establishments, radiography and industrial units, etc., through regulatory inspections and surveillance.

The use of X-ray machines and radioactive sources requires a valid licence from PNRA. After

Types Of Radiation Facilities In Pakistan

Nuclear installations
Medical therapeutic and diagnostic radiology centres
Nuclear medicine centres
Educational and Agricultural research centres
Industrial radiography units
Irradiators and Scanners
Oil Well Logging and Nuclear Gauges

conducting a thorough review and assessment of safety provisions, PNRA issues a licence to the user for a specified period and for a specific purpose. The three RNSDs are designated to perform regulatory inspections of licensed facilities to verify compliance with regulatory requirements. Strict regulatory control is maintained over all radioactive sources being employed by various types of radiation facilities. PNRA keeps an inventory of all sealed sources and physically verifies it at the premises of facilities. At the end of the reported period, 2,994 sources were in use at the licensed facilities.

PNRA has developed a centralized personal dosimetry database for radiation facilities to facilitate independent analysis and control doses of itinerant radiation workers. During the reported period, the occupational exposure of workers at almost all radiation and nuclear facilities remained within regulatory limits.

LICENSING OF RADIATION FACILITIES

PNRA is striving to enhance its licensing net to bring all radiation facilities, especially diagnostic facilities, under effective regulatory control. To meet this objective, PNRA has adopted a strategy of persuasion. Inspectors from the PNRA regional directorates regularly visit radiation facilities, discuss the potential hazards of radiation and the ways and means for addressing them with the owners and operators, and convince them to get licensed. By the end of 2008, the total number of X-ray units and radiation facilities licensed by PNRA had increased by six (6) percent.

AUTHORIZATION FOR IMPORT AND EXPORT OF RADIATION SOURCES AND EQUIPMENT

With modernization in industry, the use of sealed and unsealed radiation sources and radiation generating equipment is on the rise. In order to maintain effective regulatory control over these sources of radiation, PNRA follows the concept of 'monitoring from cradle to grave'. The import and export of radiation sources and equipment requires a No Objection Certificate (NOC) from PNRA, which is mandatory for customs clearance. NOCs are issued only to those facilities that have valid registration or licence from PNRA. Moreover, PNRA maintains a central registry to keep track of such sources and apparatus, and periodically verifies that they are being kept and used as specified in the NOC.

In addition, PNRA trains Pakistan Customs personnel in handling, inspection, clearance, etc. of radiation sources and equipment.

These activities were carried out in routine and no significant safety issue arose through the reporting period.

NATIONAL DOSIMETRY AND PROTECTION LEVEL CALIBRATION LABORATORY

The Government of Pakistan approved a PC-1 for the project "Establishment of National Dosimetry and Protection Level Calibration Laboratory (NDCL)" under the Public Sector Development Programme in 2007. This national laboratory will



National Training Course on Radiation Detection Equipment at SOST Border

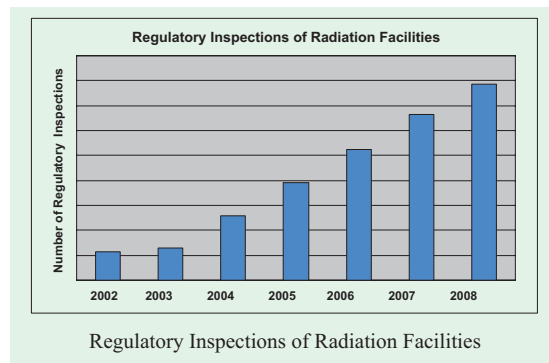
RADIATION SAFETY

be established by PNRA in Islamabad and Karachi. It will provide personal dosimetry services to radiation workers at the national level and to the first responders in any radiological emergency situation. The laboratory will also perform a quality check on other dosimetry service providers in the country through independent verification.

Different project activities remained in progress during 2008. Land has been acquired in Karachi and Islamabad for the laboratories and construction is expected to start in 2009.

INSPECTION ACTIVITIES

During 2008, PNRA's three regional nuclear safety directorates conducted a large number of inspections to verify radiation safety at nuclear installations and radiation facilities in their jurisdiction. Details of such inspections at nuclear power plants have been presented in earlier sections of this report.



In addition, PNRA conducted 1,570 regulatory inspections of radiation facilities in the country. These led to improved measures at radiation facilities for minimizing radiation exposure of the general public, workers and the environment. The number of such inspections is rising steadily every year with the increase in the number of licensed radiation facilities (Figure 4).



Tabletop Exercise on "Malicious Act to Contaminate Drinking Water with Radioactivity"
Conducted by PNRA in Lahore



Training Course on Radiation Protection and Regulatory Requirements

PNRA is responsible for regulating and controlling licensees' activities related to safety in radioactive waste management and transportation of radioactive materials. Within PNRA, the Directorate of Transport and Waste Safety (WSD) leads efforts in this area by developing necessary regulations and policies and verifying that they are followed by licensees through reviews, assessments and inspections undertaken jointly with PNRA's RNSDs. WSD also ensures that waste from nuclear and radiation facilities have a minimal impact on the environment from the time that these facilities are designed until their decommissioning.

NATIONAL POLICY ON RADIOACTIVE WASTE

In 2008, PNRA collaborated with the concerned governmental organizations for the finalization and approval of a "National Policy on Radioactive Waste", aimed at further minimizing the generation of radioactive waste and improving its management so it does not impose undue burden on future generations.

REVIEW AND ASSESSMENT

NUCLEAR INSTALLATIONS

PNRA performs review and assessment of the waste management programs of nuclear installations in accordance with national regulations and closely monitors their waste generation and treatment activities. During 2008, the average gaseous releases from K-1 remained less than 1 percent of annual release limits and the liquid effluents released to the sea remained in the order of 0.15 percent of the annual release limit for Tritium.

Likewise, all the liquid and gaseous effluents released to the environment from C-1 also remained well within the annual safety limits: the gaseous releases were less than 1.2 percent of the release limit while liquid effluent releases were less than 0.1 percent of the annual release limit for the plant.

PNRA monitored the establishment of a dry storage facility for the spent fuel of K-1. This work started in 2007 and is aimed at increasing the plant's spent fuel storage capacity to cater to its extended operational life. The facility will store spent fuel generated from K-1 up to 2017.

RADIATION FACILITIES

PNRA gives particular consideration to the safe

and secure management of disused sealed radioactive sources (SRS) in the country and maintains a detailed inventory of sources. Guidance is provided to licensees regarding the safety and security of radioactive sources and the importance of their safe disposal after expiry of their useful life.

PNRA continuously updates the national inventory of sealed radiation sources (SRS). At the end of the reporting period, more than 5,000 disused radioactive sources had been transferred to interim storage facilities at PINSTECH and K-1 as radioactive waste.

INSPECTION OF WASTE MANAGEMENT AND DISPOSAL

The Regulations on Radioactive Waste Management (PAK/915) set strict requirements for the safe management of radioactive waste in the country. During 2008, PNRA's regional nuclear safety directorates conducted numerous inspections of nuclear and radiation facilities to verify compliance with the regulatory requirements. The inspections focused on storage facilities and radioactive waste management programs to assess the safety of waste collection, classification, treatment, storage and disposal practices.

SAFE TRANSPORT OF RADIOACTIVE MATERIALS

PNRA ensures safety in transportation of radioactive materials in the country and conducts regulatory inspections of the radioactive materials transported in and out of the country in accordance with the Regulations for the Safe Transport of Radioactive Material (PAK/916). These regulations were promulgated in 2007 in order to harmonize national transportation practices with international requirements.

PNRA has been participating in activities of the Transport Safety Standards Committee (TRANSSC) of IAEA with a view to keeping at par with international safety standards for radioactive material transportation.

PNRA regularly receives information on transport events that occur in IAEA member states that have joined the IAEA database system on Events in the Transport of Radioactive Material (EVTRAM). This database system provides useful information for improving transport practices in member states.

6 EMERGENCY PREPAREDNESS

PNRA is responsible for ensuring that the licensees have in place emergency plans, necessary facilities and instruments, and mechanisms for coordination with offsite response organizations for actions to be taken following foreseeable types of nuclear or radiological emergencies. PNRA's National Radiation Emergency Coordination Centre (NRECC) plays the key role in such efforts. Apart from working closely with licensees and developing the capacity of its own team in this regard, PNRA also works with other national and international organizations to ensure that key stakeholders are prepared for the roles they may be called upon to play in the event of a nuclear or radiological accident.

REGULATORY ASPECT

In order to prepare the licensee for mitigating the consequences of any untoward incident, the "Regulations on Management of Nuclear Accidents or Radiological Emergency (PAK/914)" were promulgated in 2008. These regulations formally establish the requirement to maintain an adequate level of preparedness and response during a nuclear or radiological emergency. The implementation of these regulations will minimize the consequences of any nuclear or radiological emergency to the public, property, and the environment.

PLANS AND DRILLS

PNRA ensures that the emergency planning and preparedness plans of the facilities, having potential radiation hazard, are in place. The PNRA's licensees conduct regular exercises to verify the effectiveness of their emergency plans and procedures. These are witnessed by PNRA to confirm that the plans are sound, and the facility is well-prepared to execute them should the need arise.

In 2008, K-1 and PINSTECH conducted such exercises to evaluate their effectiveness with regard to the newly notified Regulations on Management of a Nuclear or Radiological Emergency (PAK/914). PNRA witnessed these

exercises and issued recommendations for improvement in their emergency preparedness programs.

The C-1 emergency exercise was re-scheduled to January 2009 as the plant's refuelling outage remained in progress until the end of 2008.

NATIONAL RADIATION EMERGENCY COORDINATION CENTRE

PNRA maintains a National Radiation Emergency Coordination Centre (NRECC) to function as the focal point for round-the-clock reporting, monitoring and coordinating of the national response to nuclear and radiological accidents in Pakistan. Established in 1988, NRECC is also the focal point for fulfilment of national and international responsibilities accruing from the obligations of international conventions to which Pakistan is a party.

During the reported year, NRECC participated in an international emergency exercise (ConvEx) arranged by IAEA, during which the Centre's Emergency Response System was comprehensively tested for performance in a nuclear emergency with trans-boundary consequences. The exercise also served to identify the actions that the National Disaster Management Authority, Strategic Plans Division, Ministry of Foreign Affairs, and Pakistan Atomic Energy Commission should take in such an event, and these were communicated to the respective organizations.

NRECC also participated in three (03) other IAEA exercises conducted to test its capacity for timely and accurate information exchange in nuclear or radiological emergencies at the international level. In addition, PNRA performed three (03) Communication Test Exercises (COMTEX) to test NRECC's response capability to PNRA's regional offices and the licensee concerned.

Until December 2007, NRECC had only one Mobile Radiological Monitoring Laboratory (MRML) equipped with radiation monitoring equipment, personnel safety equipment and a system of communication with PNRA and other

National Radiation Emergency Coordination Centre (NRECC)

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Email: nrecc@pnra.org, <http://www.pnra.org>

relevant organizations. In 2008, NRECC was strengthened with another MRML with advanced radiation monitoring equipment. The Centre's team was also bolstered with the designation and training of an additional team of standby personnel.

PROGRESS UNDER THE NUCLEAR SECURITY ACTION PLAN

With the establishment of the Nuclear Security Emergency Coordination Centre (NuSECC) under the Nuclear Security Action Plan in 2006, PNRA has broadened its base for the implementation of applicable clauses of the IAEA Code of Conduct on Safety and Security of Radioactive Sources and UN Security Council Resolution 1540.

During the reporting period, regional offices of NuSECC were set up in Peshawar and Quetta for the assessment of security levels, up-gradation of security measures, and propagation of security culture at nuclear and radiation facilities in the country.

Under the Nuclear Security Action Plan, the PNRA Nuclear Security Training Centre conducted various training courses, workshops, seminars and table-top exercises for the staff of PNRA, as well as officials of public organizations, such as Pakistan Customs, Inter Services Intelligence, Frontier Corps, medical and industrial workers, and the PAEC. Some of these events were conducted in collaboration with IAEA. Key events were:

- Courses on "Radiation Detection Equipment to Detect Nuclear and other Radioactive Materials at International Borders" for officials of Pakistan Customs posted at the Torkhum and Sost borders;
- Course on "Radiation Protection and Safety and Security of Sealed Radioactive Sources" in Multan for users of SRS at medical and industrial facilities; and
- Joint PNRA-IAEA training workshop in Beijing on "Physical Protection of Nuclear Material and Facilities" for PNRA and PAEC officials.

A state-of-the-art Radiation Detection Equipment Laboratory was established in collaboration with IAEA. In addition, radiation detection equipment was provided to Pakistan Customs officials at the Sost and Torkhum borders to facilitate the control of illicit trafficking of nuclear or radioactive materials.

REGISTRATION WITH RANET

Pakistan is a party to the international Convention on Assistance in Case of a Nuclear or Radiological Accident. Availing a provision of this convention, PNRA registered Pakistan's National Assistance Capabilities with the IAEA Response Assistance Network (RANET). RANET is based on a registry of national assistance capabilities of IAEA member states that can be called upon by a country under the above-mentioned convention. The integrated system is designed to provide international assistance to Member States to minimize the radiological consequences of accidents.

TRAINING OF MEDICAL PROFESSIONALS IN HANDLING OF RADIATION INJURIES

A nuclear or radiological accident may result in radiation injuries through overexposure or contamination. Medical professionals are therefore among the first responders in such accidents. To ensure that capabilities exist for providing people the best possible care under such circumstances, PNRA pays special attention to the continued training of the medical community in handling radiation injuries.

In this regard, during the reported period, a two-day seminar was arranged at Rawalpindi General Hospital, Rawalpindi, to train physicians to recognize a possible radiation injury and safely manage contaminated patients. The seminar was attended by medical doctors, mainly general practitioners, from all the major hospitals of Islamabad and Rawalpindi, as well as resident medical students of the Rawalpindi Medical College.

Speakers from PNRA, the Pakistan Institute of

Nuclear Security Emergency Coordination Centre (NuSECC)

Pakistan Nuclear Regulatory Authority

Mauve Area, G-8/1, Islamabad. Toll-free 24-hour Helpline: 0800 777 66

EMERGENCY PREPAREDNESS

Engineering and Applied Sciences (PIEAS), PAEC, Kahuta Research Laboratories and the Armed Forces Institute of Pathology made detailed state-of-the-art presentations at the event. The

programme also included practical demonstration of a Mobile Radiological Monitoring Laboratory and other detection equipment.



Arrival of Reactor Pressure Vessel at C-2 Site



PNRA Engineers Inspecting Reactor Pressure Vessel of C-2

Cooperation with national and international organizations is essential for PNRA's effectiveness as a regulatory body. Recognizing this, the Authority maintains and develops productive professional linkages and collaborations with its licensees, especially the national nuclear energy utility, PAEC; other government bodies that have a role to play along with PNRA in protecting the people and environment from potential radiation hazards; national academic institutions; and the general public. At the international level, PNRA maintains sound cooperative and technical ties with IAEA, and exchanges expertise under bilateral and multilateral agreements with other countries.

NATIONAL LINKAGES

RELATIONS WITH LICENSEES

PNRA maintains a relationship of mutual respect and trust with its licensees. An Advisory Committee for Improving Utility Regulatory Interface (ACIURI) was constituted by PNRA in 2005 to provide a platform for resolving any dispute that arises between a licensee and PNRA in an amicable manner and without compromising safety. ACIURI ensures that an atmosphere of understanding, harmonization and consensus is maintained between the regulatory body and its licensees on all nuclear and radiation safety issues.

PNRA is working closely with PAEC to prepare for the heightened regulatory challenges entailed in the enhancement of the present installed nuclear capacity of 425 MWe to 8,800 MWe by the year 2030 as envisaged in the National Energy Security Plan.

In 2008, work remained in progress under the PNRA-PAEC Joint Technical Study Program (JTS) to develop capabilities for preparation and review

of safety analysis reports, performing independent safety analyses, and enhancing skills on the use of safety codes and standards for the design, operation and licensing of future nuclear power plants in Pakistan.

In this regard, a joint study was carried out to develop database and engineering handbook documents and perform accident analysis of selected event sequences for C-1. Following this activity, a three-day seminar was organized at PNRA for sharing of technical information and safety analysis experience gathered during the JTS program. Another significant activity under the JTS program was a review of international safety codes, guidelines and standards to identify and compile a list of those applicable to future nuclear power plants in Pakistan.

PNRA also conducted several courses for licensed radiation facilities in Lahore, Peshawar, Multan, Karachi and Islamabad to develop an understanding on the implementation of relevant regulatory requirements. Various trainings were also organized to help licensees to further improve their nuclear/radiation security arrangements, as detailed in Section 6.

Notably, before finalizing and gazette notifying national regulations, PNRA routinely shares their drafts with the concerned licensees for feedback. The draft regulations are also placed on the PNRA website to inform and receive comments from the general public.

LINKAGES WITH THE GOVERNMENT

PNRA strives to maintain and further develop effective liaison with other governmental bodies to enable them to play their roles in maintaining and improving nuclear and radiation safety in the country. In this regard, PNRA invited officials from various government ministries to observe

National Regulators

Civil Aviation Authority (CAA) (<http://www.caaapakistan.com.pk>)

National Electric Power Regulatory Authority (NEPRA) (<http://www.nepra.org.pk>)

Oil and Gas Regulatory Authority (OGRA) (<http://www.ogra.org.pk>)

Pakistan Electronic Media Regulatory Authority (PEMRA) (<http://www.pemra.gov.pk>)

Pakistan Nuclear Regulatory Authority (PNRA) (<http://www.pnra.org>)

Public Procurement Regulatory Authority (PPRA) (<http://www.ppra.org.pk>)

Pakistan Telecommunication Authority (PTA) (<http://www.pta.gov.pk>)

NATIONAL AND INTERNATIONAL COOPERATION

the communication set-up of the National Radiation Emergency Coordination Centre at PNRA Headquarters while it was activated during an integrated emergency exercise conducted at K-1 in December 2008.

PNRA also conducted a meeting of the major national regulators to share information and experience regarding regulatory independence and inspection techniques. This is going to be a regular practice and will serve as a national forum for discussion on thematic areas of interest for all national regulators.

PNRA has adopted the IAEA Safety Fundamentals to bring its performance further in line with international standards. In this context, a Safety Fundamentals Committee comprising of officials from various governmental departments and ministries has been constituted for the implementation of the ten safety fundamental principles within the country.

Among other technical activities, PNRA hosted courses for Pakistan Customs personnel on "Radiation Detection Equipment to Detect Nuclear and Other Radioactive Materials at International Borders" at the Torkhum and Sost borders in 2008. On these occasions, radiation detection equipment was also handed over to Customs officials to aid in the control of illicit trafficking of nuclear or radioactive materials at these borders. The establishment of NuSECC offices in Quetta and Peshawar during the year was another step towards control of such trafficking.

In addition, PNRA pays special attention on the training of the medical community on the management of overexposed & contaminated individuals in order to respond to radiological emergencies in an effective manner. In this regard a two-day seminar was organized at the Rawalpindi General Hospital where medical doctors from all the major hospitals in Islamabad and Rawalpindi and resident medical students of the Rawalpindi Medical College were provided training in recognizing a possible radiation injury and managing contaminated individuals. More details are provided in Section 6.

PNRA regularly submits an annual report to the Government of Pakistan at the end of each calendar year. These submissions, among which the current report is the seventh, are important tools in maintaining transparency and enabling

the Government to keep abreast of PNRA's efforts for ensuring safety of the people and the environment from ionizing radiation.

Apart from arranging its own initiatives to forge linkages with other government organizations, PNRA actively participates in similar activities of other organizations. On 16-17 December 2008, PNRA participated in the "Pakistan Disaster Management Exhibition" organized by the National Disaster Management Authority.

COLLABORATION WITH NATIONAL ACADEMIC INSTITUTIONS

PNRA strives for continuous improvement of its regulatory performance and is committed to evolving into a world class nuclear regulator. As a proactive approach, PNRA has in place a number of measures to improve its own regulatory performance, some of which are based on collaboration with prestigious national academic institutions.

In 2008, PNRA initiated a Leadership Development Program in collaboration with the Lahore University of Management Sciences for the purpose of identifying and grooming its future leaders. The program will help in identifying and grooming future leaders of PNRA. The leadership development framework of PNRA, consisting of 4Cs and 1P (Competence, Compassion, Credibility, Consistency and Passion), was appreciated at international forum of regulators and is expected to be adopted as the international model for leadership development within regulatory bodies.

PNRA annually awards fellowships to promising candidates for masters programs in the nuclear and power engineering disciplines at the Pakistan Institute of Engineering and Applied Sciences (PIEAS) and the KANUPP Institute of Nuclear Power Engineering (KINPOE). Ten (10) such fellows have joined PNRA after completion of their studies. Six candidates were awarded fellowships during 2008. These fellows will join PNRA in 2010 after successful completion of studies.

During the year, PNRA also worked on a technical assistance program with PINSTECH for provision of assistance in dosimetry and environmental radioactivity surveillance.

RELATIONS WITH THE PUBLIC

PNRA keeps the general public informed about its activities through a frequently updated website and a regularly published annual report. Special activities and any event at radiation facilities are also reported through timely press releases. Because of this openness and transparency, the print and electronic media routinely contact PNRA with queries and provide space promptly in prominent locations whenever PNRA issues public statements.

In 2008, PNRA's annual report for the public was issued well in time and widely distributed. A number of brochures and pamphlets were also prepared and are expected to be published in 2009.

PNRA has set up a dedicated toll-free line (0800 777 66) at which the general public can report events and obtain information related to radioactive sources and radiation exposure. This line is accessible and manned round the clock.

INTERNATIONAL COOPERATION**FULFILMENT OF OBLIGATIONS**

PNRA continued to fulfil Pakistan's international obligations under the following four conventions related to nuclear and radiation safety:

- Convention on Nuclear Safety;
- Convention on Early Notification of a Nuclear Accident;
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; and
- Convention on Physical Protection and Safety and Security of Nuclear Material.

The Fourth National Report of Pakistan was prepared by PNRA for submittal at the Review Meeting of the Convention on Nuclear Safety held in Vienna, Austria, in April 2008. PNRA led the Pakistan delegation at this event. Pakistan's report was widely appreciated by the contracting parties and the rapporteurs' report issued by the fourth review committee identified a number of good practices in Pakistan. .

BILATERAL AND MULTILATERAL COOPERATION**COOPERATION WITH INTERNATIONAL NUCLEAR REGULATORS**

The Network of Regulators of Countries with Small Nuclear Programs (NERS) is an international forum intended to facilitate communication between nuclear regulators and inspectors of countries with small nuclear programs. PNRA is an active member of NERS and maintains and updates its website (www.ners.info). In 2008, PNRA participated in the annual meeting of NERS in Prague, Czech Republic.

COOPERATION WITH CHINA

PNRA has bilateral cooperation agreements with the National Nuclear Safety Administration (NNSA), China; China Nuclear Power Operation Technology Corporation (CNPO); and Nuclear Safety Centre (NSC), NNSA, to provide training to PNRA staff in regulatory review and assessment. These agreements also provide an effective mechanism for exchange of safety related information between Pakistan and China.

In 2008, training remained in progress under these agreements. PNRA also signed a new agreement with CNPO for development of physical models of C-1 for the training of PNRA officials.

TECHNICAL COOPERATION WITH THE IAEA

The two ongoing IAEA-assisted technical cooperation projects, namely, "Further Improvement of Regulatory Infrastructure in Pakistan (PAK/9/028)" and "Applicability of IAEA Safety Standards in Licensing of NPP in Pakistan (PAK/9/030)", made satisfactory progress during 2008. A new technical cooperation project, "Strengthening Infrastructure for Radiation, Transport and Waste Safety (PAK/9/034)" was also approved by IAEA.

PNRA continued to actively participate in the IAEA program of development of Safety Analysis Report Review Plan (SARRP).

In addition, PNRA participated in a number of activities organized by IAEA in the areas of education and training, knowledge management, and safety review and assessment. Experts from PNRA were part of an Integrated Regulatory Review Service (IRRS) mission to Ukraine. PNRA also contributed its expertise to various activities of the Committee on Safety Standards (CSS), Nuclear Safety Standards Committee (NUCSSC), Transport Safety Standards Committee

NATIONAL AND INTERNATIONAL COOPERATION

(TRANSSC) and the Radiation Safety Standards Committee (RASSC).

From the year 2001 to 2008, seventy five (75) expert missions have visited PNRA and delivered lectures on various topics. During the same period, twenty seven (27) experts from PNRA have participated in various international activities organized by IAEA. The number of expert missions conducted to and from PNRA in 2001-08 is shown in the opposite figure. During 2008, twelve (12) experts from PNRA participated in various activities organized by IAEA.

In collaboration with IAEA, PNRA organized a number of training courses pertaining to nuclear



security as part of the Nuclear Security Action Plan. A state-of-the-art "Radiation Detection Equipment Laboratory" was also established in collaboration with IAEA under this project.



Signing of Agreement between China Nuclear Power Operation Technology Corporation (CNPO) and PNRA School (SNRS) for development of Physical Models of Nuclear Power Plant's Main Components

PNRA's vision statement reflects the importance it accords to improving its own capabilities so that workers, the public and the environment are better protected from any potential damage from nuclear and radiation facilities. Committed to meeting the highest standards of performance as a nuclear regulatory body, PNRA proactively seizes national and international opportunities to enhance its institutional capabilities, and to impart to its team the necessary knowledge, skills, tools and international exposure for keeping pace with international practices and state-of-the-art technologies.

PROGRESS AT THE CENTRE FOR NUCLEAR SAFETY

The Centre for Nuclear Safety (CNS) is a technical support organization that was formally established within PNRA in 2005 for institutional strengthening and capacity building under a Government of Pakistan PSDP-funded project. The main purpose of CNS is to strengthen and enhance PNRA's regulatory capabilities for the licensing of Chashma Nuclear Power Plant, Unit 2 and other nuclear power plants to be set up in the country in future.

CNS completed the fourth year of its existence during the reporting period. In accordance with its plan, CNS recruited 55 professional scientists and engineers, most of them fresh graduates from universities in different engineering disciplines. The new officers were provided rigorous training in different areas of regulatory work through in-house courses as well as learning opportunities arranged by regulatory bodies of other countries under bilateral and multilateral agreements as well as IAEA.

Although the establishment of CNS is still in the project execution phase, the Centre has begun to demonstrate that it is capable of providing valuable technical support in different licensing

activities pertaining to nuclear power plants and nuclear research reactors. During 2008, CNS assisted different line directorates of PNRA in the following activities:

- Review and inspection of refuelling operation of C-1;
- Review of design of loose-part and vibration monitoring system of C-1;
- Review of modifications in the design of irradiation surveillance capsule of C-1;
- Follow-up of safety review of C-2 Preliminary Safety Analysis Report;
- Inspection of C-2 equipment at manufacturer sites in China and Pakistan;
- Review of C-3 Site Evaluation Report;
- Review of ageing management program of K-1;
- Review of fuel channel integrity of K-1; and
- Licensing of Mo-99 isotope production plant at PINSTECH.

The performance of CNS is continuously monitored by the Planning and Development Division, Government of Pakistan.

The Centre for Nuclear Safety remained an important hub for capacity building initiatives. Despite the prevailing financial crunch in the country, the training activities to impart state-of-the-art knowledge to PNRA professional staff continued during the reported year at national and international level. Six officers were sent on fellowships and scientific visits under IAEA-assisted technical cooperation projects to enhance their technical skills in safety review and safety analysis. In addition, 15 officers were sent to different institutes of China. In addition, various international and local workshops were organized to provide hands-on technical experience to CNS personnel.

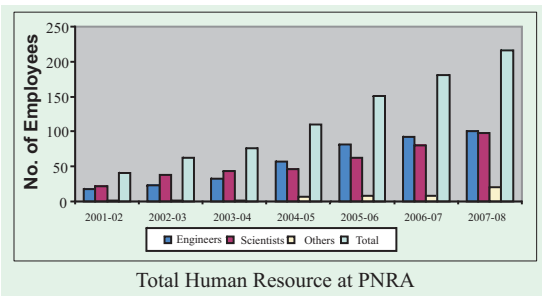
Training Courses Conducted by SNRS

1. *8th Level - I Training Course (August 25 to October 17);*
2. *1st Level-II Professional Training Course on Radiation Protection and Waste Safety (commenced April 7);*
3. *Training workshop on piping system analysis using peps computer code (**);*
4. *Mechanical Components of Nuclear Power Plants (January 21 to 25);*
5. *4th Level-II Professional Training Course on Pressurized-Water Reactor Systems (June 30 to August 1);*
6. *Workshop on "Inspection and Enforcement" (June 9 to 11).*

DEVELOPING THE NEXT GENERATION OF REGULATORS

PNRA has taken a number of initiatives to ensure continuous improvement in its regulatory performance. As a forward-looking, knowledge-based organization, it is committed to working proactively to develop and maintain the competency of its current and future human resources.

Presently, there are two hundred and fifteen (215) technical professionals on PNRA's team; by 2015,



this strength has to be increased to 415 through direct recruitment drives and fellowship schemes to cater for the country's expanding nuclear power generation capacity. The sixth recruitment drive was successfully completed during the reporting year and thirty-five (35) scientists and engineers were inducted. As mentioned earlier, PNRA awards fellowships to candidates for masters programs in nuclear and power engineering disciplines at PIEAS and KINPOE on an annual basis. Ten (10) such fellows have joined PNRA after completion of their postgraduate studies. Six candidates were awarded fellowships during 2008; they will join PNRA in 2010 after successful completion of their studies.

As per PNRA's training policy, newly appointed scientists and engineers are required to rotate in different directorates to enhance their competency level and enable them to acquire first-hand knowledge and practical experience in all regulatory activities. In addition to in-house training, newly recruited officers are also trained at national and international organizations.

The Leadership Development Program initiated at PNRA in collaboration with LUMS remained in progress during the reported period. The program will help in identifying and grooming future leaders of PNRA. The leadership development framework of PNRA, consisting of 4Cs and 1P—Competence, Compassion, Credibility, Consistency and Passion, was

appreciated by international regulators and is expected to be adopted as the international model for leadership development within regulatory bodies.

The PNRA School for Nuclear and Radiation Safety (SNRS) conducted/facilitated eleven (11) courses during 2008, in which 186 officers from PNRA and PAEC participated. In addition, PNRA arranged thirteen (13) training courses at external organizations in which twenty-four (24) PNRA officials received training in various disciplines.

During the reported year, the PNRA Nuclear Security Training Centre conducted various training courses, workshops, seminars and tabletop exercises for the staff of PNRA, as well as Pakistan Customs officials, and medical and industrial workers. Two of these courses were specifically conducted at Torkham and Sost borders for Pakistan Customs officials. Some of these were organized in collaboration with IAEA under the Nuclear Security Action Plan. Details are provided in Section 6.

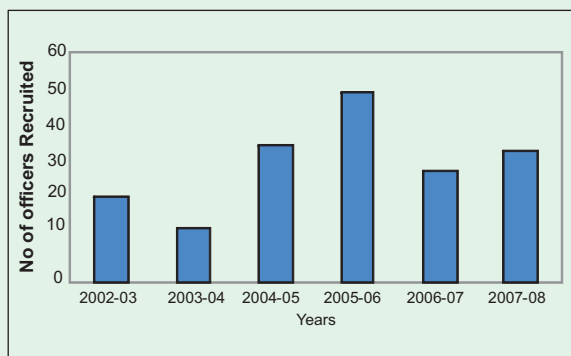
PNRA has also been utilizing other opportunities with IAEA for training and learning, such as regional (Asia) programs, technical cooperation projects, regional training courses, technical meetings, project workshops, and expert missions on nuclear and radiation safety.

RESEARCH AND DEVELOPMENT

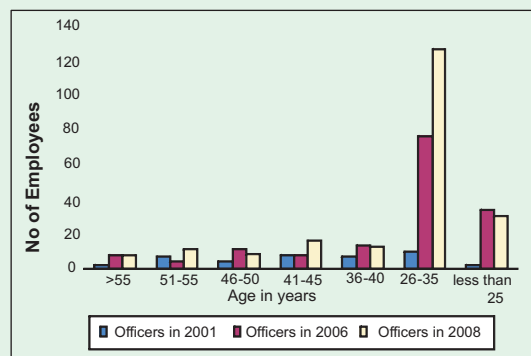
Research and development constitutes a critical component of PNRA's strategic plan. As mentioned earlier, PNRA is liaising with a wide range of national academic and research institutions including PIEAS, Ghulam Ishaq Khan Institute (GIKI), PINSTECH and the National Centre of Non-destructive Testing (NCNDT) for competency building and promotion of research on nuclear and radiation safety. Moreover, PNRA maintains bilateral relationships with international research institutions like the Nuclear Safety Centre, Beijing; China Nuclear Power Operation Technology Corporation; and the IAEA for exchange of safety related information and research.

MONITORING, EVALUATION AND IMPROVEMENT

As part of its Management System, PNRA has been performing annual monitoring and evaluation of its regulatory activities since its inception. In addition to regular self-evaluation



Recruitment of Technical Officers



Age Profile

and performance reporting to the Government and the public, PNRA frequently invites international experts for peer reviews. This process contributes to continuous improvement of regulatory effectiveness and efficiency and drives PNRA towards improved performance in all of its activities.

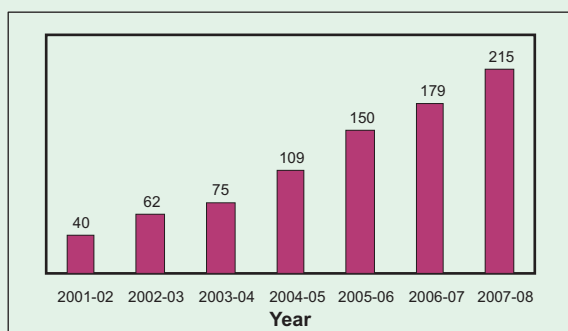
The monitoring of the regulatory performance of PNRA is based on 12 strategic performance indicators and a five-level rating scale. The results of the assessment for the year January-December 2008 are summarized in Figure 2. In September 2008, PNRA also published its third report, entitled "PNRA Report 2007", which was widely distributed and is also available on the PNRA website, <http://www.pnra.org>.

PNRA enjoys a relationship of mutual respect and trust with the Government, and ensures that this confidence of the government is maintained at all times. PNRA regularly submits its annual report to the Government at the end of each calendar year. Accordingly, the "Performance Review Report-2008" of PNRA was submitted to the Prime Minister of Pakistan in February 2009. These submissions have improved transparency and enabled the Government to keep abreast of

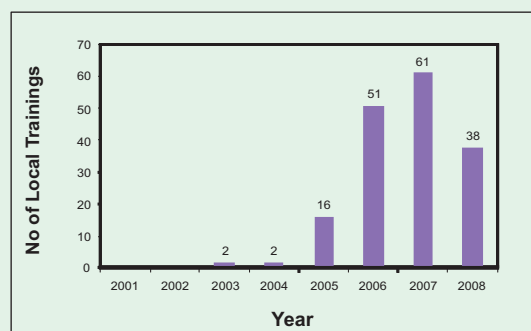
regulatory oversight of nuclear and radiation facilities in the country by PNRA. Figure 4 presents a comparison of PNRA's overall performance since its inception.

The self-assessment of PNRA's performance initiated in 2006 in collaboration with LUMS was completed in March 2007. A comprehensive report was submitted by LUMS identifying the strong and weak areas of PNRA's regulatory performance. During the reported period, PNRA focused its resources for improving its performance in the identified weak areas. In parallel, PNRA is making efforts to develop meaningful quantitative sub-indicators for the annual assessment of its performance.

In addition to conducting self-assessment, PNRA has prepared a comprehensive plan for the development, implementation, and assessment of its Management System. Work remained in progress on the development of this system and a draft Management System Manual was prepared in accordance with international practices during the reporting period. The manual is currently under review. It is envisaged that implementation of the Management System will commence in 2009.



Yearwise Technical Manpower Strength of PNRA



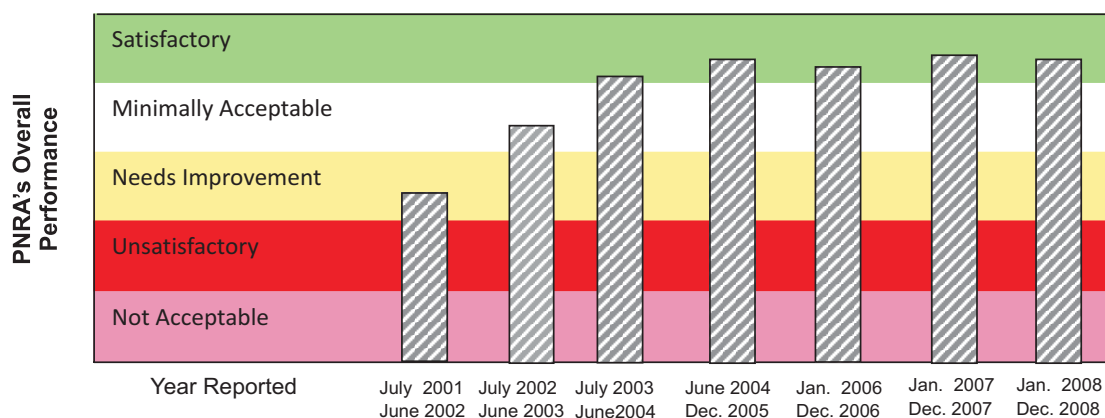
Local Training Profile of PNRA Officers

Figure 2: Rating of PNRA's Performance in 2008

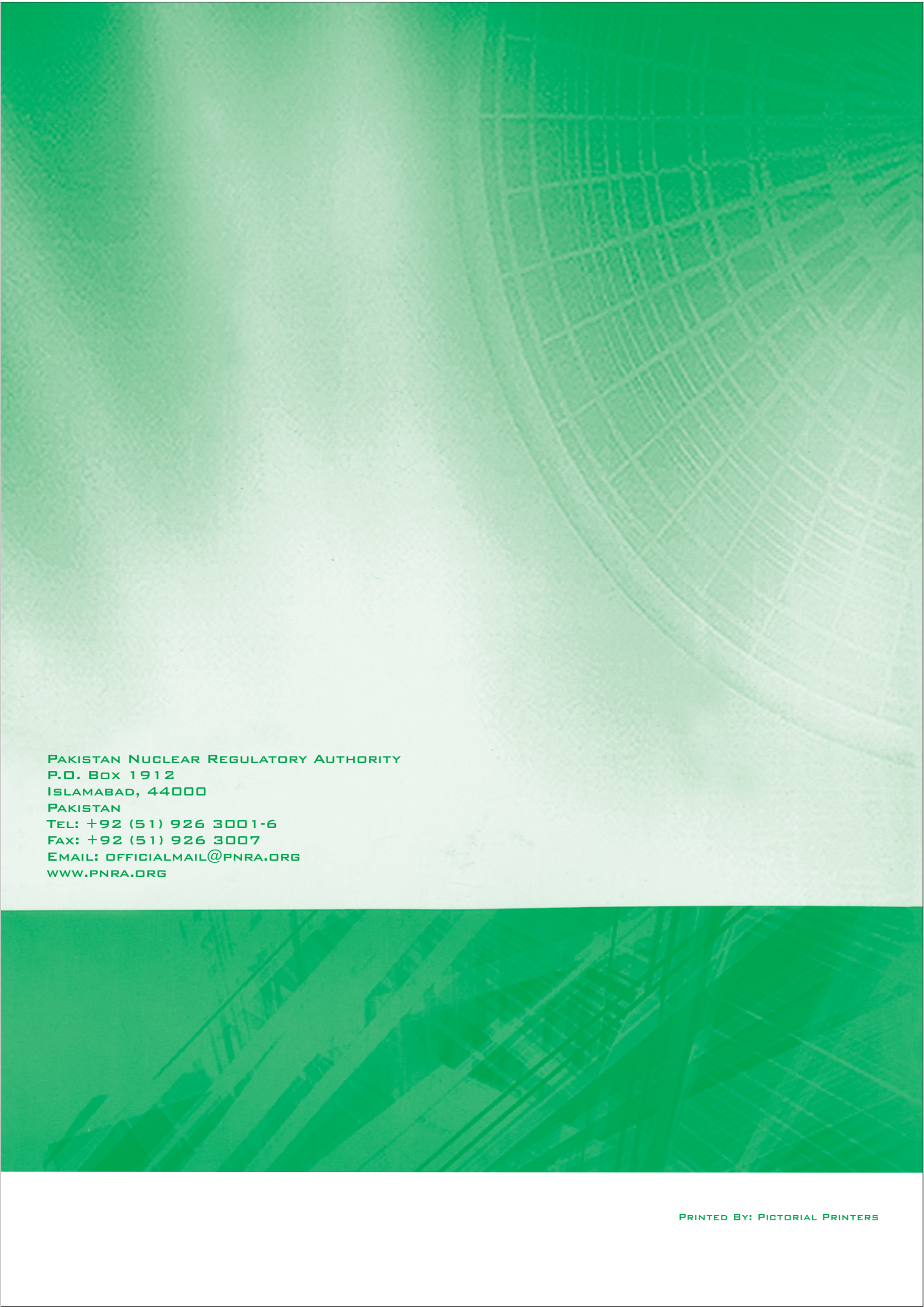
Ensures that acceptable level of safety is being maintained by licensees (Indicator 1)	Ensures that regulations and procedures are in position and understood by licensees (Indicator 2)	Strives for continuous improvement of its performance (Indicator 3)
Takes appropriate actions to prevent degradation of safety and to promote safety improvements (Indicator 4)	Takes appropriate steps for human resource development and has competent and certified regulatory staff (Indicator 5)	Ensures that adequate legal provisions exist for enforcement, e.g., dealing with non-compliance or licence violations (Indicator 6)
Performs its functions in a timely and cost-effective manner (Indicator 7)	Ensures that a well established quality management system exists (Indicator 8)	Ensures that adequate resources are available for performing its functions and Technical Support Centre is available for specialist assistance when required (Indicator 9)
Performs its function in a manner that ensures confidence of the operating organizations (Indicator 10)	Performs its functions in a manner that ensures confidence of the general public (Indicator 11)	Performs its functions in a manner that ensures confidence of the Government (Indicator 12)

Rating Scale	
Green	Satisfactory
White	Minimally acceptable
Yellow	Needs improvement
Red	Unsatisfactory
Pink	Not acceptable

Figure 3: Rating of PNRA's Overall Performance, 2001-08



Rating Scale	
Green	Satisfactory
White	Minimally acceptable
Yellow	Needs improvement
Red	Unsatisfactory
Pink	Not acceptable



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