Knowledge Management in Nuclear Education and Training in Pakistan

June 15 to 19, 2015

Vienna, Austria

By

Dr. Aman-ur-Rehman
Pakistan Institute of Engineering and Applied Sciences (PIEAS)
P.O. Nilore, 45650, Islamabad, Pakistan
Layout of the Presentation

- Major areas of Nuclear Activities in Pakistan
- Importance and Need of Highly Developed Manpower
- Status of Nuclear Education in Pakistan
- Collaboration with Government and Industry
Four major areas

- Nuclear Power Generation
- Nuclear Fuel Production
- Nuclear Medicine and Oncology
- Radioisotopes Application in Agriculture & Industry

These activities are undertaken in respective plants, facilities and dedicated R&D institutes.
Nuclear Power Generation

- At present there are three operational nuclear power plants in Pakistan
  - Karachi Nuclear Power Plant (KANUPP) (1972)
  - Chashma Nuclear Power Plant (CHASNUPP-II) (2011)

- Construction of (CHASNUPP-III & IV) is in progress and are expected to be completed by 2016 and 2017 respectively.

- Construction of (KANUPP-II & III) is also in progress and are expected to be completed by 2019 and 2020 respectively.
Nuclear Fuel Production

- Nuclear Fuel Production is an essential requirement of nuclear power generation.
- Pakistan has been producing nuclear fuel for its first nuclear power plant KANUPP.
- Fortunately there are sufficient uranium deposits in various areas of Pakistan.

- As CHASNUPP-I and CHASNUPP-II are PWR type and the planned nuclear power plants would, most likely, be also PWR type, the government has made plans for production of nuclear fuel for PWR type reactors.
Nuclear Medicine and Oncology

- There are Eighteen (18) operational nuclear medical centers / institutes spread all over Pakistan for carrying out diagnostics by nuclear medicine techniques and treatment of cancer by radiotherapy.

- The two largest cities, KARACHI and LAHORE, have two nuclear medical centers each.
Nuclear Medicine and Oncology

Nuclear Education & Training in Pakistan
There are three institutes of nuclear research in agricultural and food preservation/sterilization in Pakistan:

- Nuclear Institute for Food and Agriculture (NIFA), Peshawar
- Nuclear Institute for Agriculture and Biology (NIAB) Faisalabad.
- Nuclear Institute for Agriculture (NIA) Tandojam.

These institutes focus upon utilization of isotopes in development of crop varieties which are resistant to local plant diseases and thus lead to enhancement in yield.
Radioisotope Application in Agriculture and Industry

- National Institute for Biotechnology and Genetic Engineering (NIBGE), Faisalabad conducts R&D work in the important area of biotechnology and genetic engineering.

- National Centre for Non-Destructive Testing (NCNDT), Islamabad and certain divisions in other Nuclear Research Institutes work on utilization of radiation and radioisotopes in industry.
Research and Development Institutes

- There are several institutes for research and development in the relevant areas of nuclear science and technology.

- Pakistan Institute of Nuclear Science and Technology (PINSTECH), Islamabad is the largest R&D centre for utilization of nuclear science and technology in the field of physical sciences.

- PINSTECH has a 9MW research reactor for training and production of radioisotopes.

- Many other smaller institutes are also active in specific area of their specialty.
Importance and Need of Highly Developed Manpower

Nuclear technology is a highly sensitive technology, so the professionals working in this field must be highly trained from

- Technical point of view and
- Ethical point of view

With the increase in number of power plants we need more trained human resource.
## Knowledgeable Professionals Getting Retirement & Projected Requirement

**Table 1. Projections of Requirements of Professionals for Enhanced Activities in Various Areas of Nuclear Science and Technology**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Required for</th>
<th>Number</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Generation and Nuclear Fuel Production</td>
<td>Operation &amp; Maintenance</td>
<td>500</td>
<td>Per Plant</td>
</tr>
<tr>
<td></td>
<td>Design and Safety</td>
<td>500</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>Nuclear Fuel Production</td>
<td>100</td>
<td>Per Plant</td>
</tr>
<tr>
<td></td>
<td>Substitution of Retirees</td>
<td>75</td>
<td>Per Annum</td>
</tr>
<tr>
<td></td>
<td>Nuclear Physicians</td>
<td>20</td>
<td>Per Centre</td>
</tr>
<tr>
<td></td>
<td>Radiation Oncologists</td>
<td>10</td>
<td>Per Centre</td>
</tr>
<tr>
<td></td>
<td>Medical Physicists</td>
<td>5</td>
<td>Per Centre</td>
</tr>
<tr>
<td></td>
<td>Substitution of Retirees</td>
<td>5</td>
<td>Per Annum</td>
</tr>
<tr>
<td>Nuclear Medicine &amp; Oncology</td>
<td>Professionals</td>
<td>50</td>
<td>Per Annum</td>
</tr>
<tr>
<td></td>
<td>Substitution of Retirees</td>
<td>10</td>
<td>Per Annum</td>
</tr>
<tr>
<td>Agriculture &amp; Biology</td>
<td>Scientists</td>
<td>120</td>
<td>Per Annum</td>
</tr>
<tr>
<td></td>
<td>Engineers</td>
<td>50</td>
<td>Per Annum</td>
</tr>
<tr>
<td></td>
<td>Substitution of Retirees</td>
<td>30</td>
<td>Per Annum</td>
</tr>
<tr>
<td>Total Requirement</td>
<td>660 Professionals per Annum</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Nuclear Education Centers in Pakistan

- Pakistan Institute of Engineering and Applied Sciences (PIEAS), Islamabad
- Karachi Institute of Nuclear Power (KINPOE), Karachi
- Chasnupp Centre for Nuclear Training (CHASCENT), Mianwali
Pakistan Institute of Engineering and Applied Sciences
Introduction

Pakistan Institute of Engineering and Applied Sciences (PIEAS) is:

- A public sector degree awarding institution
- Offering higher education in Engineering and Applied Sciences to
  - Students from all over Pakistan, in particular
  - Students from other countries of the region, in general
Educational & Training Programs at PIEAS

*Four major categories*
- Ph.D. program (9)
- MS / MPhil programs (12)
  - Nuclear Engineering
  - Electrical Engineering (Power)
  - Radiation Physics
  - Systems Engineering
  - Nuclear Medicine
  - Radiation and Medical Oncology
  - Medical Physics
  - Process Engineering
  - Materials Engineering
  - Mechanical Engineering
  - Laser, Plasma and Computational Physics
  - Computer Science
- Undergraduate program (2)
  - Electrical Engineering
  - Mechanical Engineering

- Short training courses in specialized areas
- Nuclear orientation courses
MS in Nuclear Security

- Due to prevailing security situation in the world we have started MS Nuclear Security program as a sub specialty of MS Nuclear Engineering Program.

- The students are taught about Nuclear Security and Physical Protection.

- In this program students are taught about the various measures that can be taken to avoid security threats during various phases of a nuclear power plant.

- Personals from operating, regulatory and security organizations benefit from this program.
Educational & Training Programs at KINPOE

On MS program:
- M. Sc. in Nuclear Power Engineering

Two diploma programs:
- Post Graduate Diploma (PGD) in Nuclear Technology for Engineers
- Post Diploma Training Program (PDTP) for technicians
Educational & Training Programs at CHASENT

- **Post Graduate Training Program (PGTP)**
  - One Year Training for fresh Engineers and Scientists in Nuclear Fundamentals, CHASNUPP Systems / Equipment and On-Job Training

- **Post Diploma Training Program (PDTP)**
  - One Year Training for fresh technicians in Nuclear Fundamentals, CHASNUPP Systems / Equipment and On-Job Training

- **PWR Systems Training Program**
  - For existing Engineers / Scientists/ Technicians from PAEC
PIEAS Faculties & Departments

- **Faculty of Engineering**
  - Department of Nuclear Engineering (DNE)
  - Department of Electrical Engineering (DEE)
  - Department of Mechanical Engineering (DME)
  - Department of Metallurgy & Materials Engineering (DMME)
  - Department of Chemical Engineering (DCHE)

- **Faculty of Applied Sciences**
  - Department of Medical Sciences (DMS)
  - Department of Physics and Applied Mathematics (DPAM)
  - Department of Computer & Information Sciences (DCIS)
  - Department of Communication & Management Sciences (DCMS)
Admission Criteria

- **Eligibility** requirement for admission to MS degree programmes at PIEAS is a minimum of 16 years of education with degree in a relevant discipline of engineering, science or medicine.

- Candidates are selected on the basis of their performance in a **written test and an interview**.

- Selected candidates are offered a **fellowship** which covers tuition fees, hostel room charges and a monthly stipend for the living expenses.

- The successful graduates are **offered a position** of Engineer or Scientist or Medical Officer in Pakistan Atomic Energy Commission (PAEC) and other relevant governmental organizations.
Fellowships Available at PIEAS

• **For MS Programs**
  - Stipend: Rs. 25000 per month
  - Tuition Fees: Nil
  - Hostel Accommodation: Free
  - Indoor Medical Treatment: Free

  *On completion, induction as Jr. Engineer / Jr. Scientist with three increments and 3-year seniority*

• **For PhD Programs**
  - Various fellowships are available from:
    1. Higher Education Commission (HEC)
    2. PIEAS IT and Telecom Endowment
    3. Government Technical Organizations
Admissions 2014

- Eligible Candidates: 7600
- Took Test: 6930
- Interviews: 1031
- Offered admission: 400
- Joined: 300

Nuclear Education & Training in Pakistan
Student Enrolment (2000 – 2014)

Nuclear Education & Training in Pakistan
## Graduates of Degree Programs

<table>
<thead>
<tr>
<th>Degree Program</th>
<th>Starting Year</th>
<th>Graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td>PhD</td>
<td>2001</td>
<td>125</td>
</tr>
<tr>
<td>MS Nuclear Engineering</td>
<td>1969</td>
<td>1390</td>
</tr>
<tr>
<td>MS Systems Engineering</td>
<td>1988</td>
<td>528</td>
</tr>
<tr>
<td>MSc Nuclear Medicine</td>
<td>1989</td>
<td>161</td>
</tr>
<tr>
<td>MS Medical Physics</td>
<td>2001</td>
<td>144</td>
</tr>
<tr>
<td>MS Information Technology</td>
<td>2001</td>
<td>49</td>
</tr>
<tr>
<td>MS Materials Engineering</td>
<td>2002</td>
<td>140</td>
</tr>
<tr>
<td>MS Process Engineering</td>
<td>2002</td>
<td>267</td>
</tr>
<tr>
<td>MS Mechanical Engineering</td>
<td>2006</td>
<td>175</td>
</tr>
<tr>
<td>M Phil Physics</td>
<td>2006</td>
<td>93</td>
</tr>
<tr>
<td>MSc Radiation and Medical Oncology</td>
<td>2008</td>
<td>24</td>
</tr>
<tr>
<td>BS Computer &amp; Information Sciences</td>
<td>2000</td>
<td>238</td>
</tr>
<tr>
<td>BS Electrical Engineering</td>
<td>2009</td>
<td>93</td>
</tr>
<tr>
<td>BS Mechanical Engineering</td>
<td>2009</td>
<td>76</td>
</tr>
</tbody>
</table>
## International Graduates (MS Degree)

<table>
<thead>
<tr>
<th>Country</th>
<th>Graduates</th>
<th>MS Programs completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jordan</td>
<td>16</td>
<td>Nuclear/Systems Engineering</td>
</tr>
<tr>
<td>Indonesia</td>
<td>9</td>
<td>Nuclear Engineering</td>
</tr>
<tr>
<td>Libya</td>
<td>5</td>
<td>Nuclear Engineering</td>
</tr>
<tr>
<td>Myanmar</td>
<td>2</td>
<td>Nuclear Medicine</td>
</tr>
<tr>
<td>Algeria</td>
<td>1</td>
<td>Nuclear Engineering</td>
</tr>
<tr>
<td>Iraq</td>
<td>1</td>
<td>Nuclear Engineering</td>
</tr>
<tr>
<td>Kuwait</td>
<td>1</td>
<td>Nuclear Engineering</td>
</tr>
<tr>
<td>Sudan</td>
<td>1</td>
<td>Nuclear Medicine</td>
</tr>
<tr>
<td>Syria</td>
<td>1</td>
<td>Nuclear Engineering</td>
</tr>
<tr>
<td>Yemen</td>
<td>3</td>
<td>Nuclear Medicine</td>
</tr>
</tbody>
</table>

IAEA sponsorship may also become available to international students for studies at PIEAS.
# Full-Time Faculty

<table>
<thead>
<tr>
<th>Highest Qualification</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D.</td>
<td>95</td>
</tr>
<tr>
<td>Pursuing Ph.D.</td>
<td>14</td>
</tr>
<tr>
<td>MS / M Phil</td>
<td>21</td>
</tr>
<tr>
<td>M.Sc. / MA / MBBS / BE</td>
<td>6</td>
</tr>
</tbody>
</table>

**Total:** 136
National Civil Awards
Conferred upon PIEAS Graduates

- **Hilal-e-Imtiaz**: 2
- **Sitara-e-Imtiaz**: 10
- **Pride of Performance**: 50
- **Tamgha-e-Imtiaz**: 11

Nuclear Education & Training in Pakistan
# Honors & Distinctions for Faculty

<table>
<thead>
<tr>
<th>Awards</th>
<th>Recipients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitara-e-Imtiaz (Star of Distinction)</td>
<td>3</td>
</tr>
<tr>
<td>President’s Pride of Performance</td>
<td>6</td>
</tr>
<tr>
<td>Tamgha-e-Imtiaz (Medal of Distinction)</td>
<td>3</td>
</tr>
<tr>
<td>President’s Medal for Technology</td>
<td>1</td>
</tr>
<tr>
<td>Aizaaz-e-Kamal (Honor of Prominence)</td>
<td>1</td>
</tr>
<tr>
<td>Aizaaz-e-Fazeelat (Honor of Excellence)</td>
<td>3</td>
</tr>
<tr>
<td>Best Teacher Award (by HEC)</td>
<td>10</td>
</tr>
</tbody>
</table>

Nuclear Education & Training in Pakistan
Strength in Knowledge Management

- Student Share and Faculty Share in soft form
  - Some video lectures are available
  - Home work, class notes, assignments etc.
  - Reference books (subject to the availability in digital format), Faculty notes are shared among the faculty.
  - Announcement of time table, exam date sheets, scheduled and un scheduled events.
  - Research papers and other academic materials
Strength in Knowledge Management

- Video conferencing facility which is networked with other universities of the country.
- Planning to move forward to share these resources with affiliated institutes.
Collaborations

- We are collaborating with the following organizations working in the field of Nuclear Technology
  - Pakistan Atomic Energy Commission (PAEC)
  - Pakistan Nuclear Regulatory Authority (PNRA)
  - Pakistan Centre of Excellence for Nuclear Security (PCENS)

- We provide not only trained manpower to these organizations but also keep them updated by offering many short courses.
Recent Short Courses

- Nuclear Reactor Thermal Hydraulics
- Key Issues in Nuclear Science and Technology
- Long-term Demand Forecasting and Projection Techniques
- Symposium on Bio-photonics
- Cyber Security: A Practical Approach
- Advanced Structural Dynamics using ANSYS
- Small Modular Reactors (SMR’s)
Active Areas of R&D

- Nuclear Safety
- Radiation Safety
- Simulation and Modeling
- Nuclear Reactor Design
- Atmospheric Modeling
- Nuclear Fuel Management
- Nuclear Security
- Nuclear Medicine and Oncology
Our Mission...

- Offer **quality higher education** in required disciplines of engineering and applied sciences
- Fulfill **national and regional requirements** for highly qualified professionals
- Contribute to the **welfare of humanity** through education, research and development
Thank you...