Nuclear Human Capability Building Programs at KAERI for Future Generations

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KAERI is the only comprehensive national nuclear R&D organization funded by government and industry, founded in 1959. KAERI is assisting in the growth of business and the creation of jobs in Korea by spreading nuclear-based technologies.

**Manpower ['23.1]**

- **Total 1,752**
  - Researcher 1,143 (Ph.D. 911)
  - Scientific Technician 177
  - Support Staff 305
  - Admin, Staff 126
  - Board Member 1

**Budget ['23.1]**

- Research Funding 77%
  - $408M
- Gov. Contribution 23%
  - $122M
- Total $530M

**Business Development**

- 53 Companies (Establishing, Incubating, ...)
- 1,356 Jobs
- Revenue $485M/Year
KAERI’s R&D encompasses a broad range of scientific, engineering and technical activities, which are supported by the use of large research facilities at three sites and two provisional site.

- **HANARO**
  Platform for Nuclear Basic Research

- **ATLAS**
  Thermal-hydraulic Test Facility

- **PIEF**
  Post Irradiation Examination Facility

- **IMEF**
  Hot Cell Examination Facility

- **KURT**
  Research Facility for Geological Disposal

- **PRIDE**
  PyRo-processing Integrated inactive Demonstration facility

- **KOMAC**
  (Gyeongju)

- **KJRR**
  (Busan)

- **MARINS**
  (Gampo)

- **Proton Accelerator**
  Facility for Basic Science using Proton Beams

- **Cyclotron**
  Facility for Advanced Radiation Technology

- **New Research Reactor**
01

Nuclear HCB Achievements at KAERI
01 The Nuclear Age in Korea with HCB

- **Nuclear age began from Rhee-Cisler meeting in 1958**
  - Many high-quality scientists and engineers are essential for nuclear energy
  - “Nuclear power is an energy that is extracted from the human brain”

- **President Rhee sent 237 personnel abroad for nuclear education and training in 1958**
  - GDP/capita is about 60$
  - Investment cost > 6,000$ per person

- **Korean people benefited from the nuclear energy in two decades**
  - 1st NPP connected to grid in 1978

First Korean President, Dr. Syngman Rhee, groundbreaking the site for the first nuclear research reactor in Korea in 1959
Nuclear Contribution to National Economy

- In the last 70 years, Korea has experienced amazing economic progress
  - The GDP/capita increased from 60 $ in the 1950s to 35,000 $ in 2022

- The nuclear program has made a significant contribution to the national economy
  - National independence of nuclear technology resulted from qualified manpower.
  - With its high-quality and low-cost energy generation, nuclear plays an important role in Korean industry.
  - According to an IAEA’s case study, nuclear energy contributed to 2.2% of GDP added value and 1.6% of employment in Korea in 2015.
# Growth of Nuclear HCB Organizations

<table>
<thead>
<tr>
<th>Year</th>
<th>Regulators</th>
<th>Associations</th>
<th>Industries</th>
<th>R&amp;D</th>
<th>Universities</th>
</tr>
</thead>
<tbody>
<tr>
<td>'50</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>'60</td>
<td></td>
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</tr>
<tr>
<td>'70</td>
<td></td>
<td>KAIF</td>
<td>KOPEC</td>
<td>KAERI</td>
<td></td>
</tr>
<tr>
<td>'80</td>
<td></td>
<td>KARA</td>
<td>KEPCO-KPS</td>
<td>KEPCO, KHNP</td>
<td>Kyunghee Uni.</td>
</tr>
<tr>
<td>'90</td>
<td></td>
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<tr>
<td>'00</td>
<td>KINS</td>
<td></td>
<td>KEPCO-KPS</td>
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</tr>
<tr>
<td>'10</td>
<td>KINAC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>9</td>
<td>7</td>
<td>1</td>
<td>16</td>
</tr>
</tbody>
</table>

- **Regulators:** 2 organizations
- **Associations:** 9 organizations
- **Industries:** 7 organizations
- **R&D:** 1 organization
- **Universities:** 16 organizations
02

Nuclear Training & Education Center (NTC)
## NTC Missions
- Development of nuclear human resources in Korea
- International cooperation in nuclear HRD

<table>
<thead>
<tr>
<th>Buildings</th>
<th>Facilities (Capacity in Persons)</th>
<th>Total Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NTC (Classrooms)</strong></td>
<td>Lecture Auditoriums #1, #2 (80/50), Class Rm. #1 - #4 (30 each), Class Rm. #5 (50) Seminar Rm. (20), Group Discussion Rm. (10)</td>
<td>330 Persons</td>
</tr>
<tr>
<td><strong>NTC (Laboratories)</strong></td>
<td>5 Radiation Labs (16 each), 2 Simulator Labs (10 each), 5 NDT labs (10 each), Computer Lab (30)</td>
<td>180 Persons</td>
</tr>
<tr>
<td><strong>INTEC</strong></td>
<td>Lecture theater (140), Class Rm. #1 (60), Class Rm. #2 (40), Conference Rm. #1, #2, #3 (24/16/14), Group discussion Rm. (10), Lounge (46)</td>
<td>350 Persons</td>
</tr>
</tbody>
</table>
02 NTC of KAERI

❖ Education and Training Programmes at NTC/KAERI

For Industry Personnel
- Nuclear power technology
- Fuel cycle technology
- Radiation protection and RI application
- Commissioned training for industries
- Re-training courses for license holders

~ 1,000 industries’ personnel a year

For Students & Teachers
- Next generation school on nuclear
- Experiencing & learning nuclear basic
- Research reactor experiment course
- Laboratory OJT during vacations
- Internship program
- Public acceptance and others

~ 1,500 students & teachers a year

For KAERI Staff
- Basic courses on nuclear energy
- Legal requirements of education programs
- Managerial education programs
- Self-development education programs
- Foreign language courses
- Computer skill courses

~ 1,700 regular staff

For Foreign Personnel
- Multilateral cooperation programs
  - IAEA, WNU courses
- Co-hosted/supported programs
  - KOICA, RCARO, KNA courses
- Bilateral cooperation programs
- KAERI-UST MS/PhD programs
- Workshops/meetings on nuclear HRD

~ 150 foreign personnel a year
E&T Programmes for Industry Personnel

- **Course on nuclear power and nuclear fuel technology**
  - Nuclear power technology, nuclear fuel material handling, nuclear quality assurance, nuclear disaster prevention, ASME code

- **Course on radiation protection and RI application**
  - RI use, radiation protection, gamma-ray radionuclide analysis

- **Commissioned training for industries**

- **Legal retraining course on nuclear license holders**
  - Nuclear material handling license, research reactor operation license holders
## E&T Programmes for Students and Teachers

<table>
<thead>
<tr>
<th>Target Audience</th>
<th>Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Domestic Programs</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Future generations</strong></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>• Visit program for the public</td>
</tr>
<tr>
<td></td>
<td>• IT course for the local public</td>
</tr>
<tr>
<td>Policy makers and project managers</td>
<td>• Nuclear program management</td>
</tr>
<tr>
<td>Primary school students</td>
<td>• Nuclear camp</td>
</tr>
<tr>
<td>Second’y school students</td>
<td>• Nuclear class for the next generation</td>
</tr>
<tr>
<td>University students</td>
<td>• Experiencing research reactor technology for nuclear engineering departments</td>
</tr>
<tr>
<td></td>
<td>• Experimental courses for non-nuclear scientists and engineers</td>
</tr>
<tr>
<td></td>
<td>• Internship programs</td>
</tr>
<tr>
<td></td>
<td>• Laboratory on-the-job training</td>
</tr>
<tr>
<td>Post-graduates &amp; youngsters</td>
<td>• KAERI-UST MS/PhD courses</td>
</tr>
<tr>
<td></td>
<td>• Nuclear schools</td>
</tr>
<tr>
<td><strong>Educators</strong></td>
<td></td>
</tr>
<tr>
<td>Teachers</td>
<td>• Course for primary and middle school science teachers</td>
</tr>
<tr>
<td></td>
<td>• Course for Meister high school teachers</td>
</tr>
<tr>
<td>Lecturers</td>
<td>• Training to train instructors for nuclear outreach</td>
</tr>
<tr>
<td>People looking for jobs in nuclear</td>
<td>• Pre-job education for small and medium sized nuclear related industries</td>
</tr>
<tr>
<td><strong>Int’l Programs</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Future generations</strong></td>
<td>• International training to train teachers and instructors for nuclear outreach</td>
</tr>
<tr>
<td>Professionals</td>
<td>• International nuclear schools</td>
</tr>
</tbody>
</table>
E&T Programmes for KAERI Staff

- **Common Competency:**
  - Talk concert at lunch time, customized delivery training, etc.

- **Leadership Competency:**
  - New employee, team leader, high-level leader, top manager, etc.

- **Job Competency and Self Development**
  - Nuclear R&D capacity building training, technical writing course, etc.
  - Global language course, reading correspondence, etc.

- **Compulsory Education:**
  - Radiation worker education, violence prevention education, etc.

- **KAERI-ACE (Atomic Community of Education)**
  - Training courses to improve job and personal competency for the achievement of management goals and for the effective implementation of R&D works

- **ISO 29990:2010 (Learning Service Management) (2018), Best-HRD (Public) (2008), etc.**
02 E&T Programmes for Foreign Personnel

- **E&T programs through multilateral agreements**
  - IAEA training courses, IAEA fellowship and scientific visit
  - WNU short courses
  - ANENT e-Learning courses

- **E&T programs through bilateral agreements**
  - Special training courses
  - On-the-job training

- **E&T programs supported by Korean organizations**
  - KOICA-KAERI-IAEA courses
  - RCARO-KAERI courses
  - KNA HRD courses

- **KAERI-UST MS/PhD programs**
  - Mater course, doctoral course
  - Master & doctoral integrated course
  - U-Link etc,
02 Participation in the ANENT* Activities(1)

- ANENT was established in 2004 as a regional partnership to cooperate in capacity building and HRD in nuclear technology in Asia and the Pacific region.
  - ANENT has 21 member countries and 9 collaborating member organizations.

* ANENT: Asian Network for Education in Nuclear Technology
Participation in the ANENT* Activities(2)

- **Establishment of ANENT and its basis for cooperation with IAEA and MSs**
  - Establish ANENT and its cyber platforms ANENT LMS
  - Conclude IAEA-KAERI Practical Arrangement in 2008

- **Dissemination of nuclear knowledge using ANENT LMS**
  - e-training (4 times incl. MESSAGE), lecturer training (3 times)
  - Develop new e-Learning courses (How to use LMS, NKM etc.)

- **Contribution to international nuclear society**
  - Support to build up cyber learning platforms for IAEA, UAE
  - Operate cloud-based ANENT LMS (Certified as ANENT Regional Hub in 2013)

- **Leading role of the IAEA regional cooperation project**
  - Serve as a chairperson of ANENT (’05~’07, ’15~’17)
  - Develop e-Learning courses and contents for ANENT member countries
02 ANENT Learning Management System (LMS)

- **ANENT LMS Structure**
  - http://lms.anent.online
  - Home
  - Areas of Learning
  - Courses

- **Areas of Learning**
  - Outreach
  - Human Resource Development
  - Energy
  - Radiation Technology
  - Human Health
  - Safety and Security
  - Agriculture and Food Security
  - Water and Environment

- **Courses**
  - IAEA Fellowship_Korea 2019
  - IAEA Fellowship -Thailand 2019
  - IAEA Fellowship - Indonesia 2019
  - IAEA Fellowship_Philippines 2019
  - 2022 Meeting on TC Project RAS0091
  - ANENT Learning Management System User Guide
    - Teacher: Minjin, Sung-A, Hae-Jung, Sung-A, Seung, Min, Jin
    - ANENT Regional-LMS (2014, Korea)
    - e-training course on how to use ANENT Regional-LMS (2015, Korea)
02 KAERI e-Learning Courses in 2020-2021

- E-learning courses implemented in 2020 and 2021 at the ANENT LMS
- Recently, the open course on e-learning on Radiation Medicine was uploaded

<table>
<thead>
<tr>
<th>e-Learning Courses</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCA/KAERI Introductory e-Learning Course on Radiation Technology and its Application</td>
<td>2020. 10.12 ~ 10.23</td>
</tr>
<tr>
<td>KAERI-WCI-IAEA e-Learning Course on Diagnostic and Therapeutic Radioisotopes and Radiopharmaceuticals Application</td>
<td>2020. 11.30 ~ 12.18</td>
</tr>
<tr>
<td>KOICA-KAERI-WCI-IAEA Joint Training Course on Establishment of Long-Term Management Plan by Strengthening Capacity for Diagnostic and Therapeutic Radioisotopes and Radiopharmaceutical Application</td>
<td>2020. 11.02 ~ 11.13</td>
</tr>
<tr>
<td>RCA/iTRS-HYU Radiation Safety Training Course</td>
<td>2020. 11.01 ~ 11.13</td>
</tr>
<tr>
<td>KAERI-WCI-IAEA e-Learning Course on Diagnostic and Therapeutic Radioisotopes and Radiopharmaceuticals Application</td>
<td>2021. 08.02 ~ 08.20</td>
</tr>
<tr>
<td>RCA/KAERI Introductory e-Learning Course on Radiation Technology and its Application</td>
<td>2021. 10.04 ~ 10.15</td>
</tr>
<tr>
<td>E-learning on Radiation Medicine including Radiation Therapy and Tumor-Theranostic RI Technology</td>
<td>2021. 7.26 ~ (Open course)</td>
</tr>
</tbody>
</table>
HCB under UST Program
Mission & Vision of UST

World-class Science & Technology Graduate School

**HISTORY**

- **(Oct. 2003)** Obtained approval to found the university (Ministry Education & Human Resources Development)
- **(Mar. 2004)** Opening of UST and 1st matriculation ceremony
- **(Feb. 2020)** Dr. leehwan Kim appointed as the 5th president
- **(Oct. 2023)** 20th anniversary of UST’s foundation

**MISSION**

Work alongside government-funded research institutes to cultivate talented individuals in the field of science and technology who will generate future value.

**VISION**

Serve as a government-funded research institute university that nurtures key future talent.

**Strategic Goals**

**Research Project Plan**

Establish an educational system that meets the needs of both industry and the public sector, and nurture talent capable of leading technological innovation.

**Institutional Management Plan**

Strengthen collaborative ties between UST and affiliated research institutes, and uphold the principles of responsible management.
03 Structure and Operation UST

32 Campuses (GFRIs, Government-funded Research Institutes)

- Seoul
  - KIST (Korea Institute of Science and Technology)
  - KOERM (Korea Ocean Research and Education Institute)
- Incheon
  - KOPRI (Korea Polar Research Institute)
- Gyeonggi-do
  - KICT (Korea Information Technology Research Institute)
  - KRI (Korea Research Institute of Chemical Technology)
  - Institut Pasteur Korea
- Chungcheongnam-do
  - KITECH (Korea Institute of Industrial Technology)
- Jeollabuk-do
  - KFRI (Korea Food Research Institute)
- Daejeon
  - ETRI (Electronics and Telecommunications Research Institute)
  - KRISS (Korea Research Institute of Standards and Science)
- Gyeongsangnam-do
  - KERI (Korea Electrotechnology Research Institute)
- Busan
  - KIOM (Korea Institute of Ocean Science and Technology)
Fact and Figures

1
Top South Korean papers in 3D Printing and IoT as ranked by IITP ’18

2
Ranked as the 2nd best South Korean university in CWUR ’18

100
Top young universities By Nature Index ’19

1,359
Faculty members

1,298
Students

3,185
Graduates

As of Feb. 2023
Features and Benefits

Research Capacity
- Participate in national R&D projects
- Utilize high-tech research facilities and infrastructure
- Conduct team-based education and research

Faculty
- Utilize the pool of Ph.D.-level Researchers from GFRIs
- Professor to students ratio of **approximately 1:1**

Cooperation
- Center of Industry-academia-research cooperation
- Utilize international cooperation networks of GFRIs

Majors & Curriculum
- Majors of new convergence fields
- Field-oriented education that meets industrial and social demands
- Flexible operations of majors
- Newcomers’ IP(Innovative Program)

Globalization
- **Excellent competence** related to educational globalization

Student Welfare
- A stable learning and research environment for student researchers
School Structure

- Students studying together with research staffs at labs.
  - 30 students under 50 professors
- Radiation Science in Jeongeup
  - Accelerators & Quantum Beams
  - Radiation Life Science
- Nuclear Science and Technology
  - Radiochemistry
  - Quantum Energy Chemical Eng.
  - Nuclear System Eng.
- Nuclear & Radiation Safety
### International Admission

#### Admission Type

<table>
<thead>
<tr>
<th>Degree</th>
<th>Ph.D.</th>
<th>Master's</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Program</td>
<td>Ph.D.</td>
<td>Integrated</td>
</tr>
<tr>
<td>Minimum Period</td>
<td>2 years</td>
<td>4 years</td>
</tr>
<tr>
<td>Maximum Period</td>
<td>6 years</td>
<td>8 years</td>
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</tbody>
</table>

#### Procedure

- **Application**
  - Students
    - Selection of degree program & Major(School)
    - Submission of the required documents

- **Documents Screening**
  - Schools

- **In-depth Interview**
  - Schools

- **Announcement of Successful Applicants**

#### Admission Schedule

<table>
<thead>
<tr>
<th>Admission</th>
<th>Application Period</th>
<th>Documents Screening</th>
<th>In-depth Interview</th>
<th>Announcement of Successful Applicants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall(Sep.)</td>
<td>Feb. ~ May / July</td>
<td>May / July</td>
<td>June / July</td>
<td>June / Aug.</td>
</tr>
</tbody>
</table>
RCA Scholarship Admission

- **RCA from 1972 & RCARO from 2002**
  - International agreement for the East Asia & Pacific region, under the auspices of the IAEA, in which the Government Parties undertake, in cooperation with each other and with the IAEA to promote and coordinate cooperative R&D and training projects in nuclear science and technology through their appropriate national institutions.
  - RCA Regional Office (RCARO) was established in Daejeon, Republic of Korea, in 2002 to contribute to increasing RCA Visibility through specific roles and responsibilities.

- **The scholarship Agreement among RCA, KAERI, & KIRAM in 2023.**
  - Around 10 students from the RCA member states (21 countries) may apply for the scholarship program beginning in the first semester of 2024.
  - RCA is prepared to provide exceptional financial assistance during the admissions process.
ICERRR Network
(International Center based on Research Reactor)
**04 KAERI-ICERR**

- **ICERR (International Center based on Research Reactor)**
  - A scheme initiated by the IAEA in 2015 to foster international cooperation and capacity building by facilitating access to world-class research reactors and associated facilities.

- **HANARO received the ICERR designation by the IAEA in July 2019**
  - 5th ICERR in the world, the first in the Asia-pacific region
  - ✔ Education and training
  - ✔ R&D services
  - Designation fields
    - ✔ HANARO (Research Reactor) including Irradiation Facilities (Capsule Irradiation, NAA, NTD, etc.)
    - ✔ Neutron Beam Facilities
    - ✔ RIPF (RadiolIsotope Production Facility)
    - ✔ IMEF (Irradiated Material Examination Facility)
    - ✔ NTC (Nuclear Training and education Center)
KAERI-ICERR Facilities

Neutron Beam Facilities
- Thermal neutron beam facilities
- Cold neutron beam facilities

HANARO
- 30 MW_{th}
- Max. Thermal Neutron Flux: \(4.39 \times 10^{14} \text{ n/cm}^2\text{s}\)
- Max. Fast Neutron Flux: \(2.1 \times 10^{14} \text{ n/cm}^2\text{s}\)
- 7 horizontal ports & 36 vertical holes

RIPF
- RI Production
- Cancer/Target therapy
- Hydrology

Irradiation Facilities
- NAA
- NTD
- Capsule irradiation
- Professionals and comprehensive R&D facilities
- Provides regional/interregional training courses
- PIE of irradiated materials
- Evaluate of irradiation behavior of fuels and structural materials

NTC

IMEF
KAERI-ICERR Activities

- **ICERR Cooperation between KAERI and PNRI (Philippine)**
  - From 2021, a capacity-building project in research reactor use has been underway
  - **✓ Scientific visits** by Filipino university scholars and PNRI personnel to KAERI-ICERR facilities (done in Sep. 2022)
  - **✓ Training** of PNRI staff at KAERI-ICERR facilities, as well as professional advice in the development of a demonstration facility for Neutron Activation Analysis of PNRI (scheduled for 2023)

- **NTC offers a variety of training programs for research reactors and auxiliary facilities**
  - Radioisotope use training, medical radioisotope applications, research reactor experiments, and so on
  - Training workshop on important infrastructure development issues for Kenya concerning research reactor and its application (online, Feb. 14-17, 2022)
  - Several international trainings courses (online during the COVID-19 pandemic)
KAERI Welcomes ICERR Cooperation

- KAERI-ICERR offers IAEA Member States possibilities for capacity building and joint R&D

- Hands-on Training
  - KAERI offers hands-on training for capability building in the fields of utilization and engineering for research reactor & ancillary facilities.
  - KAERI provides regional/international training courses and fellowship programs.

- Joint R&D
  - KAERI offers joint R&Ds using HANARO and ancillary facilities such as Neutron Beam Facilities, RIPF, IMEF, Capsule Irradiation, NAA, NTD, etc.

- Contact Point
  - Sung Ho Ahn (KAERI-ICERR representative to the IAEA)
  - E-mail: shahn2@kaeri.re.kr
Summary

- Korea's incredible economic accomplishment has benefited from ambitious investments in the future human capabilities initiative.

- KAERI plays a critical national role in developing high-quality nuclear professionals and disseminating nuclear experience.
  - E&T programs and ANENT activities based on KAERI/NTC
  - IAEA (RCA) e-learning cooperations
  - Degree program at KAERI-UST school
  - ICERR platform and so on...

- But, HCB will face new challenges in the coming generations
  - Ensuring effective knowledge transfer and expertise preservation
  - Coping with the increasing complexity and diversity of nuclear technologies
  - Developing and retaining competent and motivated staffs, especially for young professionals and women
Summary

- Innovations required to build strong human capability
  - Development of effective training programs that incorporate both theoretical and practical aspects of nuclear technology
  - Investment in research and development to develop new and innovative nuclear technologies
    - Digital technologies for monitoring and optimizing plant performance
    - Small modular reactors (SMRs) for improved safety and flexibility
    - Robotics and automation for reducing human exposure to hazard
  - Innovation in safety and security measures to minimize the risk of accidents or nuclear terrorism.
  - Collaboration between countries in terms of sharing knowledge and expertise, standardization of safety regulations, and joint research projects
  - Encouraging and attracting talented individuals to the nuclear sector by promoting the benefits of working in the nuclear industry

A combination of education, research and development, safety and security, international cooperation, and recruitment and retention strategies is necessary
THANK YOU