GREEN
KRISS

BETTER STANDARDS,
BETTER LIFE!

GREEN
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Photographed by Yong Ki Park

GREEN KRISS

Creating a beautiful green globe for future generations!

In line with the national initiative of low-carbon green growth, the Korea Research Institute of Standards and Science (KRISS) has been working toward accelerating the development of technologies for the monitoring and surveillance of climate change, nuclear power safety, wind power, and hydrogen energy, along with advancing technologies for improving the efficiency of energy production and consumption.

KRISS has recently developed measuring equipment and certified reference materials for measuring, monitoring, and assessing greenhouse gases on the Korean Peninsula. Capable of measuring greenhouse gas emissions at an ultra-small scale of around 6 ppt (1/trillion) on a real-time basis, KRISS's trace level green house gas monitoring instrument is currently in use at the meteorological observation center on Korea's Anmyeon Island. The Institute has also transferred its measurement technology to help industries develop greenhouse gas-reducing devices for exportation to foreign semiconductor producers, thereby generating significant benefit not only to those industries but also to the global environment.

Green growth and measurement standards have a great deal in common, with their greatest similarity being a strong relevance to our daily lives. Green growth can be achieved when energy conservation and the use of new/renewable energy sources are fully incorporated into our daily activities. Likewise, measurement standards indicating length, time, temperature, luminous intensity, etc. can be interwoven into our daily lives only when we use and value them in a proper manner.

Against this backdrop, KRISS will continue to take the initiative in pursuing the research and development of eco-friendly measurement science and technology for humanity and the globe, ensuring that measurement standards will become an integral part of our daily lives.

PRESIDENT'S INITIATIVE

"Toward being a global-leading national metrology institute through communication and partnership"

1. Achieve a world-leading performance in measurement standards and science through:
   - Cultivation of world-class laboratories in measurement science and technology; and
   - Encouragement of creative ideas of researchers and support in their research activities.
2. Provide measurement solutions to the national and global agendas of science and technology, with an emphasis on:
   - Developing measurement technologies for the areas of climate change, atmospheric environment, and new and renewable energy; and
   - Providing reliability in testing and analysis in order to meet regulations on food quality, public health, medicine, safety, and other important standards.
3. Develop cutting-edge measurement technologies to create new growth engines through:
   - Exploring measurement technologies for emerging industries such as ultra-precision measurement and control technologies; and
   - Pursuing research in fundamental high-risk/high-return areas such as convergence technologies.
4. Improve the functionality of practical research applications, stressing:
   - Discovering outstanding research accomplishments and turning intellectual property rights into resources of technology transfer and commercialization; and
   - Innovation of an organizational structure for advanced management and proliferation of research results.
5. Promote partnerships and customer-oriented services, underlining:
   - Leadership in international metrology communities including CIPM, APMP, IMEKO, ISO/IEC, OIML, ILAC, and others;
   - Collaborative research with universities and industries; and
   - Communication and partnerships with metrology organizations at home and abroad.

Myungsoo Kim, Ph.D.
President

BRIEF *HISTORY*

DEC 1975
Established as KSRI
Korea Standards Research Institute

MAY 1979
Began Calibration Services

OCT 1991
Renamed as KRISS
Korea Research Institute of Standards and Science

FEB 1999
Officially designated by law as NMI of Korea
Framework Act on National Standards

OCT 2004
Affiliated with Korea Research Council of Public Science and Technology

MAR 2008
Affiliated with Korea Research Council of Fundamental Science and Technology
Under the Ministry of Education, Science & Technology

LEGAL GROUNDS

The Korean Constitution - Article 127
- "The State shall establish a National Standards System."

The Framework Act on National Standards - Article 13
- "KRISS shall act as the National Metrology Institute of Korea."




MISSION

As the national metrology institute (NMI) of Korea, KRISS has been assigned to conduct missions to promote the industrial competitiveness of Korea by advancing measurement standards, science, and technologies in ways that enhance the nation's economic performance and secure a better quality of life for all.

MAIN FUNCTIONS

Establishment and Improvement of National Measurement Standards
- Establishment of National Measurement Standards with International Traceability
- Development of New National Measurement Standards

Research and Development of Standards and Metrology
- R&D on New and Better Technology for Measurement Standards
- R&D on Measurement Technologies for Emerging Industries

Dissemination of National Measurement Standards
- Calibration and Testing of Instruments, Development and Supply of Certified Reference Materials (CRMs)
- Education and Training of Measurement Techniques for Industry

KRISS'S ROLE

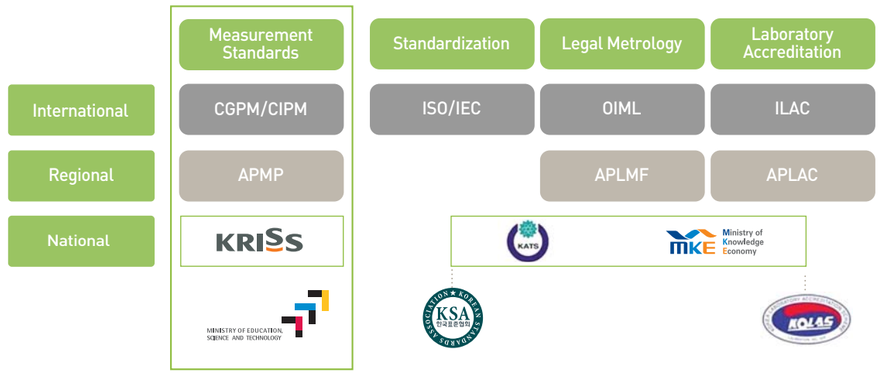
In the Korean National Standards System

As the NMI representing the Republic of Korea, pursuant to Article 13 of the Framework Act on National Standards, KRISS has established national measurement standards in over 170 areas as of 2009. KRISS provides internationally recognized national measurement standards to its customers in various industries as a means to help improve the quality and competitiveness of Korean industrial products and exports in global markets.

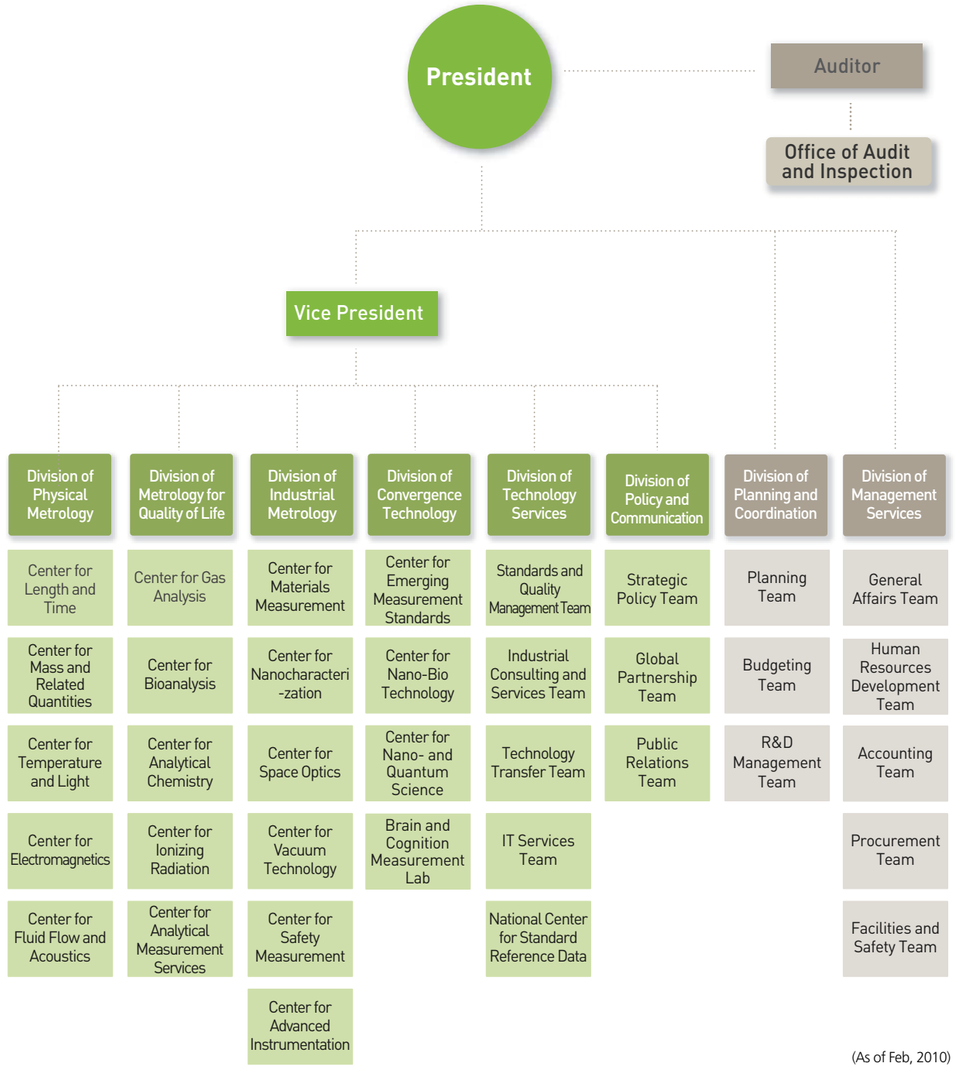
KRISS has also engaged in developing new measurement technologies and standards required for cutting-edge technological innovations, such as in nanotechnology, biotechnology, and information and communications technologies, and is playing a leading role in the development of forward-looking innovations.

In the Global Metrology Communities

An active member of international metrology organizations such as APMP and CGPM, KRISS has sought to ensure the equivalence of Korea's national measurement standards with those of the international community and to reinforce its leadership in these international bodies in order to enhance the global recognition of Korea's metrology capabilities.



ORGANIZATIONAL STRUCTURE OF KRISS



(As of Feb, 2010)

VISION 2020

With a view of being a global leading NMI by 2020, KRISS has set up its long-term Vision 2020. To turn this vision into a reality, KRISS has worked out four strategic goals:

- To secure world's top 5 capability in measurement standards
- To ensure global excellence in R&D performance through KRISS World Class Laboratories
- To establish national measurement system in good practice
- To maximize customer satisfaction

R&D ACTIVITIES

Founded in 1975 as the central organization in the national standards system of Korea, KRISS has been contributing to the economic growth of the nation with measurement science and technologies, which are indispensable infrastructures for industrial development. In close partnership with academia and industry, KRISS has also played an essential role in science and technology advancement through its R&D activities within a wide range of measurement and analysis innovations.

In addition, KRISS has been engaged in the development of new measurement standards for emerging technologies, including biotechnology (BT), nanotechnology (NT), and environment technology (ET), among others. KRISS has also focused its capabilities on providing measurement solutions to important national and global agendas. These include such topics as environment monitoring, new and renewable energy, food safety, health, medicine, structural safety, and so on.

KRISS's research activities are structured into four R&D divisions. Each division consists of centers and groups with specific functions and responsibilities for improving KRISS's service capabilities to society and global communities.

DIVISION OF
PHYSICAL METROLOGY

The Division of Physical Metrology is responsible for the realization and dissemination of measurement standards for the six base units of the International System of Units (SI), as well as their derived units. The division also focuses on developing new standards for emerging industries.

The division carries out research projects in the following areas:

- Short gauge block interferometry (up to 250 mm);
- Cesium atomic fountain frequency standard;
- Research on ITS-90 fixed points;
- Solar cell evaluation and calibration;
- LED photometery;
- Quantum Hall resistance standard;
- High voltage/current standards;
- Programmable Josephson voltage standards for waveform synthesizers;
- Primary RF/microwave power standard;
- 1 GPa high pressure standard;
- Fluid velocity measurement of turbine blades for renewable energy; and
- Sound pressure and power in ultrasonic fields.

Center for
- Length and Time
- Mass and Related Quantities
- Temperature and Light
- Electromagnetics
- Fluid Flow and Acoustics

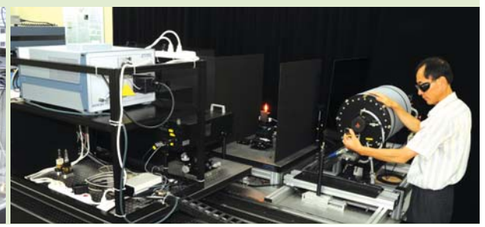
R&D Highlights _ Physical Metrology

▸Primary Frequency Standard, KRISS-1

KRISS has developed optically pumped Cs beam frequency standard
- Short Ramsey cavity (36 cm) is installed
- Uncertainty: 1×10^{-14}
- Frequency stability: 4×10^{-15} (1 d)
- First report of KRISS-1 published in BIPM Circular-T, February 10th 2009 issue

▸Spectral Radiance and Irradiance Standards

KRISS has developed spectral Radiance and Irradiance Standard Equipment (KRISS-RISE) that can be used for evaluating the performance of LEDs or solar cells.
- Installed a black body that can reach 3,500 K
- Covering a wide range from 250 nm to 2.5 μm
- Enhancing the reliability of solar simulators
- Can also be used for the calibration of ultraviolet radiometers



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DIVISION OF
METROLOGY FOR QUALITY OF LIFE

The Division of Metrology for Quality of Life serves as the nation's reference laboratory by providing measurement standards in the fields of chemical analysis, bioanalysis, and ionizing radiation. The primary missions of the division are the development, maintenance, and dissemination of national measurement standards to strengthen the quality of measurements in the areas of food safety, the environment, and public health.

The division carries out R&D projects in the following areas:
- Establishment and maintenance of national measurement standards for chemical, biological, and ionizing radiation;
- Securing international comparability and equivalence of measurement standards through international key comparisons;
- Harmonization of measurement results in the nation through calibration services and certified reference materials (CRMs); and
- Development and dissemination of CRMs and proficiency test samples.

Center for
- Gas Analysis
- Bioanalysis
- Analytical Chemistry
- Ionizing Radiation
- Analytical Measurement Services

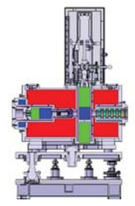
R&D Highlights _ Metrology for Quality of Life

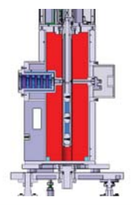
▸Primary and Secondary Cesium-137 Radiation Standards

Cesium-137 radiation sources are most frequently used for the calibration of radiation detectors and sensors. Two primary radiation sources, built by the Center for Ionizing Radiation, use cesium-137, and their radiation levels reach up to 78.1 and 4.81 TBq, respectively. A secondary source was also designed and assembled in-house by the center. These radiation sources have now replaced commercial sources that had been used by the center for a long time. By acquiring the capability to design and build these sources, the center was able to improve the uncertainty of calibration services and air-kerma measurements.

▸Rice Flour CRM for Elemental Analysis

Rice is the most important food staple for Koreans. KRISS has developed a new batch of rice CRM for the analysis of such elements as lead, cadmium, copper, iron, and zinc. The rice processed for the CRM was naturally contaminated at a level of 0.36 mg/kg when processed as a freeze-dried powder. This CRM is intended for the method validation and/or verification of the elemental analysis of rice or similar grains. The same material was used for a proficiency test in Korea and for an APMP Key Comparison, APMP.QM-K24.





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DIVISION OF
INDUSTRIAL METROLOGY

The Division of Industrial Metrology deals with applied metrology that is closely related to industry or is demanded in the public sector. The division also supports the development of core technologies for advanced instruments.

Current research areas include:
- Metrology in materials including nanomaterials;
- Monitoring of vacuum-related processes for advanced industries;
- Monitoring of the safety of large constructions such as buildings, bridges, tunnels, and energy generating facilities;
- Public-security inspection technologies;
- Large-scale optical mirrors for space applications; and
- Advanced instrumentation technologies.

Center for
- Materials Measurement
- Nanocharacterization
- Space Optics
- Vacuum Technology
- Safety Measurement
- Advanced Instrumentation

R&D Highlights _ Industrial Metrology

▶Development of Large Aspheric Optical Mirror
- Applying advanced metrology, KRISS is developing large-scale aspheric optical mirrors.
- Mirrors of up to 2 m in diameter can be manufactured with a surface error of 10 nm rms.
- These mirrors are to be used for large telescopes and high-resolution satellite cameras.

▶Development of CRMs for Rockwell, Vikers, and Brinell Hardness measurements
- 45 types of CRMs developed for Rockwell, 12 for Vikers, and 5 for Brinell
- Over 1,200 pieces supplied to industries each year
- CMC (Calibration Measurement Capability): Rockwell Hardness: 0.40 HRA, 0.60 HRBW, 0.33 HRC (0.30 HRC), Brinell Hardness: 0.8 % ~ 1.5 % (0.6 % ~ 0.8 %), Vickers Hardness: 0.9 % ~ 2.5 %




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DIVISION OF
CONVERGENCE TECHNOLOGY

The Division of Convergence Technology works on research that enables the emergence and convergence of cutting-edge technologies. The division's research activities are multidisciplinary in nature and cover the fields of nanotechnology, nanobiotechnology, quantum technology, and cognitive science. The division also supports creative initiatives that apply novel methods to extend the boundaries of present-day metrology.

Its research program currently encompasses the following themes:
- Applications of nanotechnology to enhance measurement accuracy;
- Nano-bio-imaging technologies for biomedical applications;
- Metrology based on quantum phenomena; and
- Biomagnetic sensing of cardiac and cognitive functions.

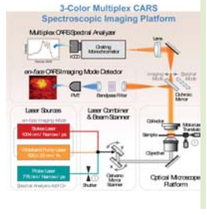
Center for
- Emerging Measurement Standards
- Nano-Bio Technology
- Nano- and Quantum Science

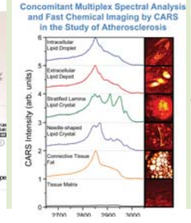
Brain and Cognition Measurement Lab(WCL)

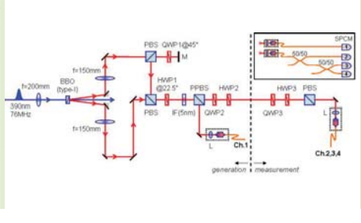
R&D Highlights _ Convergence Technology

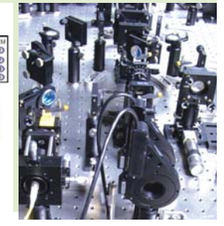
▶Development of 3-color Wideband Multiplex CARS Microspectroscopic Imaging System
- A wideband multiplex CARS imaging system for the prompt chemical analysis of biological cells and tissues:
  - Full spectral coverage of CH stretching molecular vibrations (Raman shifts ranging from 2600 cm-1 to 3100 cm-1)
  - Real-time (1 frame/s) CARS-based microscopic histology with a sub-micrometer resolution on the same platform.
  - To be used in the label-free study of 3D lipid-rich tissue structures of significant biomedical concern, such as in atherosclerosis and obesity.

▶Generation of Quantum Entanglement with Single Photons
- Heralded generation of high-visibility 3-photon N00N states
  - Linear optics scheme
  - Double photon pair emission from a single source
  - Photon-number entanglement
- Single photon interferometry
  - 4-Photon coincidence counting-super-resolution interference
  - Visibility > 70%
- Quantum information processing, quantum lithography









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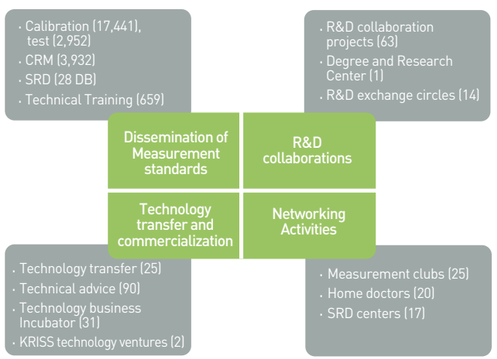
TECHNOLOGY SERVICES FOR CUSTOMERS

Maximizing customer satisfaction
Through creating more and better value for customers
In close collaborations with customers

Open network of services

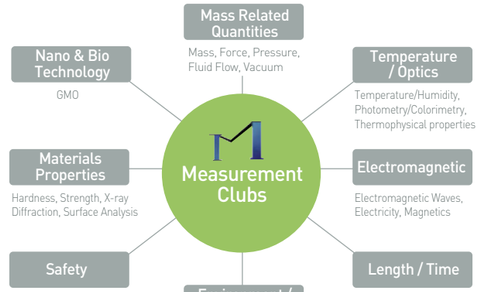
KRISS has been providing a variety of technology service programs for customers in ways that promote effective and efficient dissemination of national measurement standards and technology across the nation. The technology service programs consist of dissemination of national measurement standards; R&D collaborations; technology transfer and commercialization, and networking activities. The services are offered through open networks with thousands of its customer organizations, which include industry, academia, and research institutes. Recent achievements of technology services offered through the networks are illustrated as follows:



Programs and recent achievements of technology services of KRISS through its open network with customers

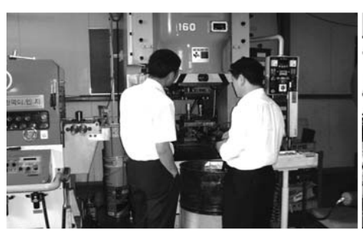
KRISS Measurement Clubs

With a view to learning more clearly of technical hurdles confronted by industries, and to finding the most substantial solutions to pass and clear such hurdles, KRISS has been operating measurement clubs. At present, there are 25 measurement clubs, covering specific areas of measurement technologies, such as mass, temperature, length & time, chemistry, nano & bio technology, materials properties, safety, and the environment. Coming from industry, research institutes, academia, and governmental agencies, about 5,000 members are sharing efforts for the KRISS measurement club activities, through on- and off-line meetings.



KRISS Home Doctor Program

In response to the demands of precision measurement techniques for medium- and small businesses, KRISS has been operating an expert-to-business service program - KRISS Home Doctor program. The program puts emphasis on solving problems faced on site of industries relating to measurement technique. Individual experts of KRISS take care of the companies in charge in the form of exchanging visits. There are about 30 companies who enjoy the services of the Home Doctor program. Among selected success stories are the commercialization of precision flow meter employing gas dilution method and development of surface resistance meter for semiconductor and displays. KRISS has a plan to expand the partners of KRISS home doctors up to 40 so as to cover the areas of chemistry and materials industries.



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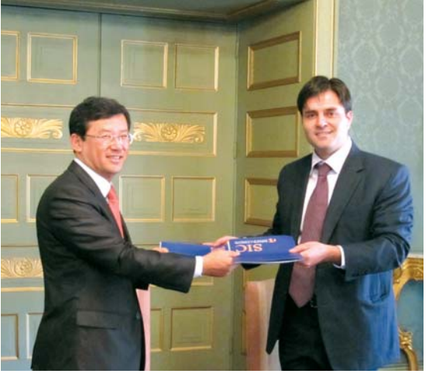

GLOBAL
KRISS

Expanding a global partnership in metrology, and sharing the fruits of cooperative effort with all partners in metrology under the spirit of "Better Standards, Better Life!"

Partnership and Leadership of KRISS in Metrology

The global partnership of KRISS pursues sharing the fruits of cooperative effort in the spirit of "Better Standards, Better Life!" Over three decades of serving as the national metrology institute (NMI) of Korea since 1975, KRISS has been continually expanding its partnerships with international metrology organizations, foreign NMIs, and research organizations. KRISS is a signatory of some 50 agreements or MoU's with its partners abroad, including the NIST (USA), PTB (Germany), NMIJ (Japan), NIM (China), NPL (UK), LGC (UK), and LNE (France), among others.

A signatory to the CIPM MRA in 1999, KRISS has been participating in a series of key comparisons (KC's) while refining its quality management system in conformity to relevant international standards such as ISO 9001, ISO/IEC 17025, ISO Guide 34, and so on. With an excellent performance in KC's and R&D in measurement science and technology, KRISS has been playing a leading role in regional and global metrology communities such as APMP, IMEKO, and CIPM.

CIPM
- Membership to 9 Consultative Committees of CIPM
- Membership to CIPM (1996~)
- CIPM : International Committee of Weights and Measures

APMP
- Chairperson, Secretariat of APMP (Nov 2007~Dec 2009)
- Chair of Technical Committees of APMP (TCEM, TCFF, TCL, TCM, TCPR, TCQM, TCRI, TCTF, WGMM)
- APMP : Asia-Pacific Metrology Programme

KRISS's Leadership in Global Metrology Communities

"KRISS's Partners with Bilateral Agreement"

In order to provide measurement solutions for important national and global agendas, KRISS has been working closely with its partner NMIs for the development of cutting-edge measurement technologies in such areas as food safety, monitoring of the environment, brain cognition, nano-bio-conversion, and so on. Its recent achievements include a joint workshop with the US NIST on nanometrology, a joint symposium with the UK LGC on food safety, and the annual seminar of Asian Collaboration on Reference Materials (ACRM). ACRM is a joint effort of the three NMIs of Korea, China, and Japan for the development of high-quality certified reference materials.

When it comes to collaborating with developing economies, KRISS puts greater emphasis on promoting human resources. People of developing economies are encouraged to take advantage of the education and study programs offered by KRISS.

Center of Excellence Program: KRISS's World Class Laboratory (WCL), Since 2009

- **Concept and Goal of KRISS's WCL program**

  Securing a world-leading performance in research and development, by means of:
  - Forming global research networks among world-leading scientists and research teams; and
  - Developing state-of-the-art research facilities, equipment, and systems.

- **KRISS WCL-1: Brain and Cognition Measurement Laboratory**
  - Led by Dr. Yong Ho Lee (yhlee@kriss.re.kr), the WCL-1 of KRISS aims to develop the "Brain Magnetic Resonance Technology at Ultra-low Field for Direct Imaging of Brain Activity", in close collaboration with its world famous partners, including the Los Alamos National Laboratory in the USA.

Partnership Programs for Developing Economies

By joining the Development Assistance Committee of the OECD in November 2009, it is envisaged that the Korean government will drastically increase its official developmental aid for developing economies. In concert with governmental efforts, KRISS endeavors to be instrumental in advancing the infrastructure and capabilities of national standards and measurement systems in developing economies. In addition, KRISS has been working closely with such international organizations and agencies as APMP, UNIDO, and APEC in finding more opportunities and investments available for sharing its experiences in developing Korea's metrology capabilities. The NMIs of Vietnam, Indonesia, Malaysia, Mongolia, Sri Lanka, Iraq, and Egypt are among KRISS's partners, with frequent collaborations and specific projects financed by KRISS and other donor organizations at home and abroad. The portfolio of partnership programs operated by KRISS includes the following:

- **Education and Training Programs**
  - ***KRISS-UST Graduate School of Metrology*** offers graduate (master and doctoral) courses in measurement science and technology financed by KRISS;
  - ***KRISS Metrology Training Center*** offers tutorials in selected subjects of measurement standards, together with quality management systems and uncertainty in measurement, co-organized by KRISS and international organizations such as APMP and UNIDO; and
  - ***Individual training programs*** to be organized upon request.
- **Workshop on National Standards System and Precision Measurements**
  - A two-week group training course annually organized under the auspices of KOICA, the Korea International Cooperation Agency
- **Calibration & Testing Services**
  - Quality services of calibration and testing available at a competitive rate.
- **Technical Consultations and Assessors for Peer Reviews**
  - Expert services offering technical consultations on solving measurement problems faced on-site; and
  - Sending experienced, highly-qualified experts for capability assessment in measurement standards.

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