How NMIs Benefit Global Enterprises
- Success Stories of CIPM MRA in Korea -

8 October 2009

Myungsoo Kim
1. Activities for the CIPM MRA
2. Selected Success Stories
3. Global Partnership
4. Future Plan
**Joining the CIPM MRA in 1999**

KRISS, one of the signatories to the MRA in Oct 1999

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**Reconnaissance mutuelle**

des étalons nationaux de mesure
et des certificats d’étalonnage et de mesuregteémis par les laboratoires nationaux de métrologie

Paris, le 14 octobre 1999

[Supplement technique révise en octobre 2003 (pages 17-20)]

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**Mutual recognition**

des étalons nationaux de mesure
et des certificats d’étalonnage et de mesure

eémis par les laboratoires nationaux de métrologie

Paris, le 14 octobre 1999

[Supplement technique révise en octobre 2003 (pages 17-20)]

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**Comité international des poids et mesures**

<table>
<thead>
<tr>
<th>Bureau</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>International</td>
<td>Intergouvernementales</td>
</tr>
<tr>
<td>des poids et mesures</td>
<td>de la Convention</td>
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</table>

[Technical Supplement revised in October 2003 (pages 38-41)]

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**KRISS, one of the signatories to the MRA in Oct 1999**

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**Better Standards, Better Life!**
Better Standards, Better Life!

Working out Roadmap toward QMS

<table>
<thead>
<tr>
<th>Year</th>
<th>Quality Management System (QMS)</th>
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</thead>
<tbody>
<tr>
<td>1999</td>
<td>Education on QMS (ISO 9001, ISO/IEC 17025, ISO Guide 34)</td>
</tr>
<tr>
<td>2000</td>
<td>Documentation of Quality Manual, Procedures, Guides</td>
</tr>
<tr>
<td>2001</td>
<td>Evaluation of Lab Personnel, Environment, Equipment</td>
</tr>
<tr>
<td>2002</td>
<td>Establishment of CRM Certification System following ISO Guide 34</td>
</tr>
<tr>
<td>2003</td>
<td>Documentation of Measurement, Calibration and Test Procedures</td>
</tr>
<tr>
<td>2004</td>
<td>Evaluation of CMC in each field</td>
</tr>
<tr>
<td></td>
<td>Key Comparisons and Supplementary Comparisons</td>
</tr>
<tr>
<td></td>
<td>ISO 9001 Certification (QMS)</td>
</tr>
<tr>
<td></td>
<td>Peer Review on Technical Capabilities</td>
</tr>
<tr>
<td></td>
<td>Establishment of QMS at KRISS</td>
</tr>
<tr>
<td></td>
<td>Expanding QMS covering ALL activities of KRISS for Total QMS</td>
</tr>
<tr>
<td></td>
<td>Keep improving Total QMS</td>
</tr>
</tbody>
</table>
Operating Units for the CIPM MRA

Quality Assurance Committee

President

Vice President

Quality Manager
Standards & QM Team

Committee on Uncertainty in Measurement

Quality of Life

Technical Committee
Labs

Industrial Metrology

Technical Committee
Labs

Convergence Technology

Technical Committee
Labs

Better Standards, Better Life!
Carrying out R&D for the CIPM MRA

R&D Activities

For

Establishing New NMS
Expanding Ranges
Improving Uncertainty

AUV EM L M PR QM RI T TF

Better Standards, Better Life!
Participating in Key Comparisons

( as of July 2009)

Serving as Pilot lab for 30 KC’s
Expanding, Refining CMC’s

(as of September 2009)

<table>
<thead>
<tr>
<th></th>
<th>Germany</th>
<th>UK</th>
<th>USA</th>
<th>Japan</th>
<th>Korea</th>
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<tr>
<td>AUV</td>
<td>76</td>
<td>42</td>
<td>32</td>
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<td>EM</td>
<td>326</td>
<td>319</td>
<td>329</td>
<td>32</td>
<td>135</td>
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<td>L</td>
<td>94</td>
<td>46</td>
<td>49</td>
<td>30</td>
<td>5</td>
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<td>M</td>
<td>209</td>
<td>81</td>
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<td>PR</td>
<td>66</td>
<td>129</td>
<td>126</td>
<td>17</td>
<td>31</td>
</tr>
<tr>
<td>QM</td>
<td>592</td>
<td>357</td>
<td>975</td>
<td>279</td>
<td>430</td>
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<tr>
<td>RI</td>
<td>79</td>
<td>194</td>
<td>540</td>
<td>240</td>
<td>208</td>
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<tr>
<td>T</td>
<td>27</td>
<td>19</td>
<td>71</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>TF</td>
<td>25</td>
<td>12</td>
<td>9</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>1494</td>
<td>1199</td>
<td>2250</td>
<td>712</td>
<td>924</td>
</tr>
</tbody>
</table>

* CMC’s to be expanded more than 1 100.
QMS of KRISS: APMP pathway [B]

QMS Certified to ISO 9001
certification: Feb 2001
Renewed Dec 2006

Technical Capability
Recognized by Peer Reviews
1st round: 2001-2002
2nd round: 2006-2007
• Initial Certification: Feb 2001 (renewed Dec 2006)

• Certified by KFQ
  ▪ Korea Foundation for Quality

• QMS of KRISS Complied with;
  ▪ ISO 9001: 2000 (for QMS)
  ▪ ISO/IEC 17025: 2005 (for Calibration/Test)

• Scope of Certification;
  ▪ Research and development activities
  ▪ Dissemination of Standards: calibration, testing, RM
  ▪ Administration and technical support activities
• Technical capabilities recognized by Peer Reviews

• 1st Round: Sept. 2001 ~ Nov. 2002 covering 13 fields, 41 experts from 15 countries
• 2nd Round: Sept. 2006 ~ Dec. 2007 covering 13 fields, 23 experts from 10 countries
### Responding to Customers and Circumstances

Effectively responding to customer’s needs for measurement standards under ever-evolving circumstances

<table>
<thead>
<tr>
<th>Period</th>
<th>1980’s</th>
<th>1990’s</th>
<th>2000’s</th>
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<tbody>
<tr>
<td>Expanded Horizon of NEEDs for Measurement Standards</td>
<td>Traditional core industry</td>
<td>IT Nano/Materials</td>
<td>Environment Food/Health/Medicine</td>
</tr>
<tr>
<td>Open Markets</td>
<td>Traceability in local markets (1979)</td>
<td><strong>Global Equivalency Required (1999)</strong></td>
<td></td>
</tr>
<tr>
<td>Widespread End-users</td>
<td>ISO 17025 Test/Calibration lab</td>
<td>ISO Guide34 RM Producers</td>
<td>ISO 15189 Lab Medicine QMS</td>
</tr>
</tbody>
</table>

#### Evolving Needs of National Measurement Standards

- Science & Technology
- Commerce, Industry, Energy
- Health, Environment, Agriculture, Forestry, Fishery, Security, Climate, Food, Drug, …
Portfolio for Better Serving Customers

- Better Standards, Better Life!

- Technical Advice, Information

- Calibration, Test, CRM

- Education, Training

- Reference Data

- Measurement Club

- Ever-growing Satisfaction of Customers

- Efficient and Advanced System of Services
High quality services stimulating innovation of Industry based on internationally recognized traceability

- Calibration, testing and technical consulting
- Development of CRMs for industry
- Training and education on precision measurement

Services provided by KRISS (2008)

<table>
<thead>
<tr>
<th>Calibration</th>
<th>Testing</th>
<th>CRMs</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 411</td>
<td>2 377</td>
<td>4 423</td>
<td>631</td>
</tr>
</tbody>
</table>

Covering some 3 000 customer organizations
Better Standards, Better Life!

KRISS Measurement Clubs

- Experts from academia, private companies, government, institutes get together
- Holding on-/off-line meetings for networking;
- Sharing knowledge and experience of measurement technology.

25 special interest groups over 4,000 members.

< Measurement Club Workshop >
1. Activities for the CIPM MRA
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How NMIs Benefit Global Enterprises
- Success Stories of CIPM MRA in Korea -
DSME, Korea – BP, USA [2002]

DSME
Daewoo Shipbuilding and Marine Engineering (Korea)

BP
British Petroleum (USA)

REQUIRING calibration of all equipment to be used in construction
Traceable to NIST

An Order of Constructing Offshore Plant

• DSME Offshore Plant
DSME, Korea – BP, USA [2002]

- **US$ 1 million, two months** for recalibrating 130 items at NIST
- **US$10 million** for penalty of two month delay of project
DSME, Korea – BP, USA
[2002]

BP (USA) accepting
"Traceable to KRISS,
Traceable to NIST"

KOLAS Accreditation of DSME

ILAC MRA

CIPM MRA

NIST-KRISS

Accreditation by KOLAS

Calibration by KRISS

DSME (Korea) Traceable to KRISS
**Claim**
- Offshore plant order by BP, USA.
- Calibration traceable to NIST required.

**Solution**
- DSME, accredited by KOLAS, a member of ILAC MRA.
- DSME keeps traceability of its standards traceable to KRISS.
- KRISS and NIST are all signatory to the CIPM MRA.
- NIST confirmed that “traceability to KRISS is equivalent to traceability to NIST” via the CIPM MRA.
- BP accepted accreditation by KOLAS and calibration certificates issued by KRISS.

**Benefit**
- US$ 11 million saved
- US$ 30,000 invested for calibration
- Recalibration at NIST: US$ 1 million
- Penalty of 2 month delay: US$ 10 million

**ROI**
360 times

**Economic benefits to global enterprise**

**Coming over technical barrier to trade**

**CIPM MRA, ILAC MRA**

**Better Standards, Better Life!**
**CIPM MRA Success Story in Korea (2)**

**SHI - SEIC, Russia [2003]**

- **Claim**
  - SHI constructing an offshore platform ordered by SEIC, Russia.
  - **All the measuring instruments installed in the platform required to be traceable to NMS of Russia.**

- **Solution**
  - KRISS and VNIIMS participate in the CIPM MRA.
  - KRISS and VNIIMS concluded a protocol recognizing the equivalence of NMS of both countries.
  - **SEIC approved all the measuring instruments of SHI traceable to KRISS as traceable to VNIIMS.**

- **Benefit**
  - US$ 16 million saved
  - US$ 150,000 Invested for calibration
  - **ROI 107 times**

*Had it not been for the CIPM MRA…*

- Additional 3 months of delivery & Calibration;
- Possible penalty due to delay of delivery: US$ 16 million

*The dimensions of the platform is approximately 95 m x 130 m x 120 m*
<table>
<thead>
<tr>
<th>Claim</th>
<th>Solution</th>
<th>Benefit</th>
</tr>
</thead>
</table>
| Mexican manufacturer of automobile parts demanded the proof of reliability of POSCO steel. | POSCO’s testing laboratory had been accredited by KOLAS. KOLAS is a member of APLAC and signatory to the ILAC MRA. POSCO has a traceability to KRISS participating in the CIPM MRA. POSCO’s steel accepted without being retested in India and Mexico. | US$ 5 million saved  
US$ 70,000 Invested for calibration  
ROI 70 times |

Had it not been for the CIPM MRA, ILAC MRA, … • Cost in transportation/retesting at Mexican and Indian lab’s  
• Cost due to delay in delivery
Korean Air - US FAA

Claim

• According to US Repair Station Act,
• US FAA required KA to secure calibration certificates traceable to NIST.

Solution

• KRISS and NIST participate in the CIPM MRA;
• FAA accepted all the KA measuring instruments traceable to KRISS as traceable to NIST.

Benefit

• US$ 9.4 million saved
• US$ 40,000 Invested for calibration

Had it not been for the CIPM MRA...

• Suspending services for 3 months while calibrated at NIST
or
• Additional cost to substitute instruments; and to establish a new system with traceability to NIST.

< Korean Air >
QMS of KRISS Honored

Global System Grand Prix Award 2009

- QMS of KRISS recognized in Korea.
- Organized by the New Quality Forum;
- Sponsored by The Korea Economic Daily.
KRISS, Recognized Center of Excellence in Korea

Annual Performance Evaluation by Government
Proves KRISS excellence in performance!
KRISS is the ONLY ONE!

Ranked TOP of government-supported Research Institute
For the consecutive 10 years since 1999
Activities for the CIPM MRA

Selected Success Stories

Global Partnership

Future Plan

How NMIs Benefit Global Enterprises

- Success Stories of CIPM MRA in Korea -
Global Partnership with Metrology Communities

- Membership to 9 Consultative Committees of CIPM
- Membership to CIPM

- Chairperson, Secretariat of APMP
- Chair of Technical Committees of APMP (TCPR, TCEM, TCFF, TCTF, TCL, TCRI, TCQM, WGMM)

- President of IMEKO
- Chair of Technical Committees (TC3, TC5, TC8, TC16)

Working in close partnership with global metrology communities and partner NMIs allows KRISS to play a leading role in solving the global issues of metrology such as the CIPM MRA.
Global Partnership with NMI & Institutes abroad

Collaborations with some 40 partners over the world
Sharing Experiences with Developing Economies

Emphasis on

- **Human Resources Development**
- **QMS Establishment**

<table>
<thead>
<tr>
<th>Service</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training/Education</td>
<td>51</td>
</tr>
<tr>
<td>Technical Advice</td>
<td>26</td>
</tr>
<tr>
<td>Calibration</td>
<td>84</td>
</tr>
<tr>
<td>Peer Review</td>
<td>14 experts for 7 NMI</td>
</tr>
</tbody>
</table>
Statistics of KRISS Today

- **Total Area:** 500,147 m²
- **4 R&D Divisions Operating 20 Centers**
- **311 SCI Papers (2008)**
- **247 Patents (2008)**
- **399 Permanent staff, 230 Research Scientist Ph.D.: 215 (93%)**
- **Budget: US$ 90 million (FY 2009)**
- **Direct Value created**: US$ 860 mil (for 10 years of 1994-2003), **BCR of 1.5**
  
  (Data: Revenue from calibration/testing and CRM services for 10 years: 1994-2003)

- **Economic Impact**: US$ 812 mil, **BCR of 12.76** (FY 2003 budget of $ 63.7 mil)

- Data prepared/analyzed: Bearing Point, Inc. (Jul. 2004)

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**Graph: Total Benefit vs. Cost (Unit: million US$)**

- **Balance**

*BCR: benefit to cost ratio*
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How NMIs Benefit Global Enterprises
- Success Stories of CIPM MRA in Korea -
NAP: National Agenda Projects

“National-Global Agenda”

- Energy
- Public health
- Climate change
- National security
- Public safety
- Environment

NAP’s

Greenhouse gas
- Avian influenza
- Influenza A virus type H1N1

Renewable energy
- Green ocean
- Next-generation Internet network

Solutions to National/Global Issues

National Research Institutes
Solution Provider

Academy | Industry | Foreign institutes

Sustainable Green Growth of Nation/Globe

Better Standards, Better Life!
Development of Measurement Technology for Solving Climate Change

- Measurement technology to estimate national inventory of GG
- Standardization of GG emission amount
- Development of GG tracing & monitoring technology
- Performance enhancement of GG reduction system & Development of evaluation technology

Enhancing reliability of national total emission inventory of GG, prerequisite to establish the national policy for meeting climatic change

※ GG : Greenhouse Gases
Establishing SI Traceability of Solar Cell Conversion Efficiency

- Establishment of the radiometric standards relevant to photovoltaic scale (completed)
- Absolute calibration of primary reference solar cell (ongoing)
- Dissemination of reference solar cells (2010)

Role of KRISS for Industry

World photovoltaic scale maintained by international comparison

Absolute calibration Uncertainty ≤ 2 % (PTB, NREL, AIST, etc)

Comparison calibration Uncertainty ≤ 5 % (KIER, KTL, etc)

Industry Products

WMO: World Meteorological Organization
Development of Measurement Technology for Reliability of Wind Turbine

- Measurement technique for reliability & performance of wind turbine
- Performance evaluation for type certification of WT with less than 1.5 MW

Reliability of Wind Turbine Blade
- Material
- Static & Fatigue Strength
- Damage

System Performance
- Smart sensing
- In-service Performance monitoring
- Safety Management

Environment Performance
- Low-noise WT
- Prediction of Noise/Vibration
- Wind velocity

Real size blade testing
Development of Technology for Safety in Hydrogen Life Cycle

- Production
- Storage & transport
- Usage
- Safety (KRISS)

Remote Sensing of Leakage

Ex- & In-situ Measurement of Hydrogen Damages

Active Hydrogen Confinement

- Measurements on 
  H₂ purity, concentration & absolute amount

H₂ Life-cycle
Global Leading National Metrology Institute

VISION (2020)

Regional Leader in Metrology
Pathfinder of Technology Convergence

Measurement Solution Provider to National Agenda
Customer-Oriented Service Provider

Core Values
Customer Values
People & Excellence
Integrity
Global Partnership of KRISS pursues

Sharing Fruits of Shared Efforts

Finding Solutions to Global Issues in Metrology

Creating More Values to Customers & Partners Worldwide