## 6.5 Operational Monitoring Technology for Transparency Scenarios

Marius Stein

CANBERRA, France & Austria

### Abstract

Within the non-proliferation community, the International Atomic Energy Agency (IAEA) serves as the institution tasked with the control and verification that Non-Proliferation Treaty signatory states are in compliance with their safeguards declarations. Through its inspection efforts and the resulting Safeguards Implementation Reports the IAEA makes proliferation concerns (or the lack thereof) transparent to all member states without sharing information sensitive to each respective controlled country. Similar arrangements where a joint inspection agency controls multiple stakeholders in a transparent fashion exist on bi-lateral (ABACC) or multi-lateral (European Community) levels.

But transparency measures can also be envisioned more directly between multiple stakeholders, without being filtered by an intermediate agency while still keeping sensitive information undisclosed. The use of technology has significantly advanced the applicability of such measures. One example is the instrumentation-based Operational Monitoring where surveillance equipment along with other sensor technologies is installed at selected facilities. The generated data serve multiple purposes, each tailored to the interests of the stakeholders involved. The facility management can use the data as assurance that personnel are properly trained and responding. State authorities can use the information to verify that security measures are intact and the facility is operating in accordance with state regulations. Equipment donors, as a third stakeholder, can conclude that their investment is operational and used on a daily basis.

Sensitive information is protected by sharing only those data between the stakeholders that are necessary to satisfy each respective interest; their authenticity can be ensured by using authentication schemes only owned by each individual stakeholder. The proposed presentation will outline the concept of Operational Monitoring as it was first applied within the Department of Energy's Material Protection Control and Accounting (MPC&A) program. It will then give an overview on similar instrumentation-based approaches that can increase transparency and confidence building measures between multiple stakeholders. Two examples include a radiological sources detection system installed at Vilnius, Lithuania and a repository security system at Maisiagala, Lithuania. A flexible, sensor-integrating security platform that was recently developed will be presented next. Recommendations on how to effectively and efficiently implement such transparency measures will conclude the presentation.


# *Operational Monitoring Technology for Transparency Scenarios*

***Marius Stein***

***NPT RDM Europe/Middle East***

**International Workshop on Transparency Technology for Nonproliferation Cooperation in the Asia Pacific**

**Tokyo, February 20 – 22, 2008**

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## *Transparency*

**Transparency** – *The full, accurate, and timely disclosure of information*

*Wall Street Words. Houghton Mifflin Company. 15 Feb. 2008.*

**Transparency** – *The condition in which a state's nuclear programs, activities, facilities, capabilities, and intentions are known to other members of the international community, through explicit policies and actions of the state, by reason of its general climate and culture of openness, and by independent information available on the state.*

*"Transparency and Openness: Roles and Limitation in the Nuclear Nonproliferation Verification System",* JNMM, Fall 2006, Volume XXXV, No. 1, pages 36-51.

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## *Transparency and Verification The NPT Example*

- **Non-proliferation Treaty (NPT) is policy framework for International Safeguards**
- **Member States forego nuclear arms and work towards disarmament**
- **Assurance needed that all signatory states heed NPT commitments**
- **Treaty compliance verification by IAEA as transparency measure**
  - **Independent inspection efforts and data analysis**
  - **Transparency through Safeguards Implementation Reports**
- **Transparency and verification efforts can be envisioned more direct**

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## *Transparency and Verification Data*

- **Data Generation & Acquisition**
  - **Verification of presence or absence of certain circumstances**
  - **"Own Eyes"**
  - **Supporting Instrumentation**
  - **Data content – only relevant information**
- **Data Analysis**
  - **Authenticity**
  - **Completeness**
  - **Ability to draw conclusions**
- **Data Protection**
  - **Concerns of all stake-holders**
  - **Sensitivities**

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## *MPC&A Operational Monitoring (MOM)*

- **Joint US-Russian program to address non-proliferation concerns by supporting Material Protection, Control, and Accounting (MPC&A) measures in Russia to:**
  - **Monitor nuclear materials**
  - **Monitor personnel**
  - **Monitor key procedures**
- **MOM offers different tiers of advantages**
  - **Additional layer of security**
  - **Management tool for site operators**
  - **Compliance verification for regulatory authorities**
  - **Operability assurance for upgrade donors (DOE)**

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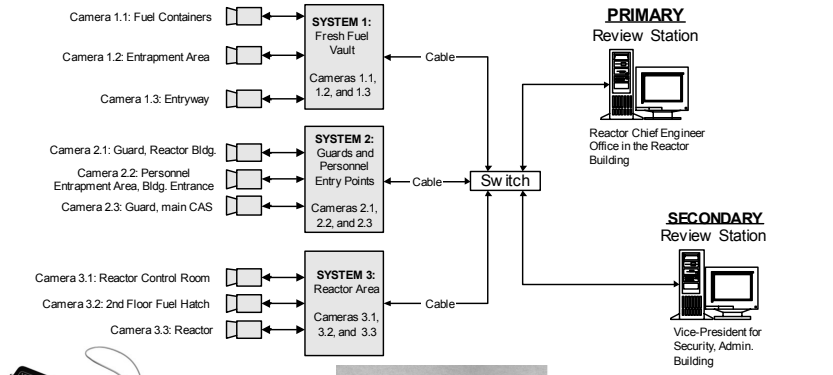
## MOM System Layout




***Seals & Cameras***

***Servers Base Stations***

***Review Stations***

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## Maisiagala, Lithuania Repository Site

- **Background: Site is a closed repository where Cesium and other sources of concern are stored underground. One unarmed guard is stationed at an unhardened guard post on the perimeter. The closest response force is 40km from the site. The guard is only able to communicate with a cell phone to the oversight agency.**

Guard Post at Maisiagala Repository front entrance.

Mound holds high risk radioactive sources.

Rear Entrance of Maisiagala Repository has no guard.

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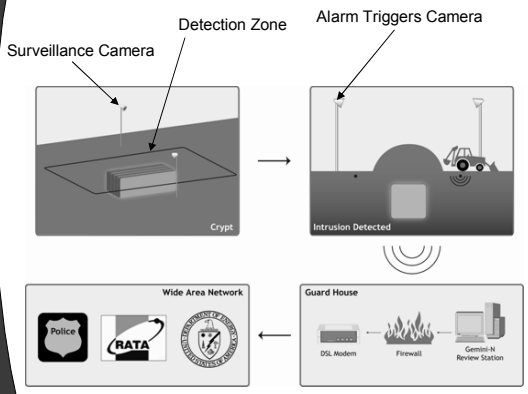
## Site Monitoring Approach




Alarm and video data are transmitted to multiple remote locations in real time.

- **Integrated intrusion sensor video surveillance system.**
- **Video and alarm data are transmitted in real-time to remote response force.**
- **Video and alarm data are simultaneously transmitted to the national regulatory authority.**
- **Enables response to attempted theft and provides assurances to regulatory authorities and the instrumentation donors that systems are operated and no theft has occurred.**

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## Installation

Mound with two surveillance cameras.

Data transmission antennae.

Data transmission antennae close-up view.

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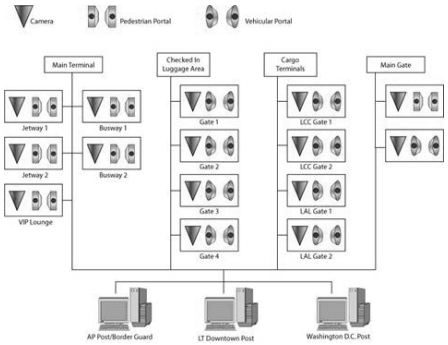
## *Security System at Vilnius, Lithuania Airport*

- **Increase ability to detect and prevent illicit trafficking of radiological and special nuclear materials**
- **Using commercially available unattended monitoring equipment to improve the effectiveness of airport screening and security personnel**
- **Primary and secondary screening**

- **Nuclear/Radiological Detection**
- **Surveillance Cameras**
- **Integration**
- **Data Transmittal**
- **Monitoring Stations**

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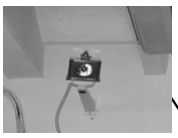
## *System Implementation*



Camera 1: Cargo and Baggage Area

Portal Monitor: Vehicle Entrance

Review Station 1: Airport Border Guards

Camera 2: Aircraft Jet Way

Base Stations

Review Station 2: Border Guard Headquarters

Camera 3: Vehicle entrance

Portal Monitor: Passenger Security Checkpoint

Review Station 3: DOE contractor's office, Washington, DC

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## *Homeland Security Surveillance System (HS³)*

- **Integrated unit for remote surveillance and visual assessment**
  - Image authentication, encryption, compression and processing at the camera
  - Bridges the gap between safeguards technologies and standard Security products
- **Sensor Integration Platform**
  - Cameras
  - RF Seals
  - Balanced Magnetic Switches (BMS)
  - Vibration Sensors
  - Radiation Sensors
- **Indoor and outdoor operation**
  - Extreme temperatures
  - Battery backup/solar power
  - Multiple redundant communication channels
  - Communication via cabled network, range of wireless methods
  - Commercial-off-the-shelf approach
- **Fixed and mobile applications**

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## *HS³ Data Flow*

**Material Protection Unit – Sensor Input**

*Electronic Data Seal: Broken seal will result in transmission of images and alarms wirelessly*

*Surveillance System: Alarms triggers surveillance*

*Area Radiation Detector (Option): Release of radiation triggers alarm and data transmission*

**Monitoring Station – Data Analysis and Alarm Management**

*Two Screens: (1) Left Screen – Review Images and Alarm Data; (2) Live Image*

*Data Review Interface*

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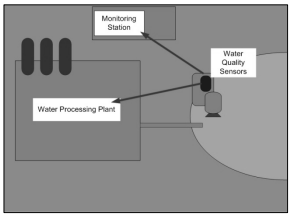
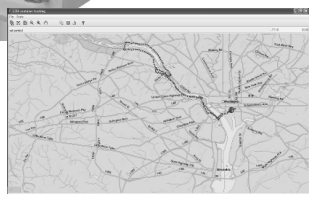
## *HS³ Sample Applications*




Water Reservoirs

Test Facilities

Mobile Monitoring



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## *Conclusions*

- **Transparency efforts can be supported by instrumentation**
- **Independent data authentication and evaluation**
- **Synergetic effects can be realized**
- **Implementation dependent of other factors**
  - **Sensitivity concerns**
  - **Security concerns**
  - **Impact on facility operation**
- **Applicability needs to be evaluated jointly by stakeholders on all levels**

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## 6.6 Remote Monitoring Implementation in Japan

Maximo Aparo

IAEA Tokyo Regional Office

### Abstract

The IAEA Remote Monitoring Project officially ended 31 December 1998 with the successful completion of all objectives including; identification and testing of system hardware and software, establishment of policy guidelines, development of a broad implementation plan and evaluation results identifying potential cost savings in money, manpower and time through the use of remote monitoring technologies.

Japan was one of the countries where the Remote Monitoring Project performed initial testing of hardware and software. At that time remote monitoring systems, based on surveillance and electronic seals, were tested at LWRs facilities. The implementation of Integrated Safeguards for LWRs in Japan did not include the use of remote monitoring and such a technology was not implemented anymore in this facility type. However remote monitoring was continued to be used at MOX fuel fabrication plant. Ten years after the initiation of remote monitoring implementation for safeguards purpose, remote monitoring systems are being planned to be used in both bulk handling and fast breed reactors in Japan. Those remote monitoring systems are quite different from the ones being implemented 10 years ago. New systems integrate different unattended monitoring and surveillance devices and transfer data to both Tokyo Regional Office and Vienna Headquarters. In addition, application software has been developed to automatically share remote monitoring data with Japan Sate Authority, once operator declaration is submitted, in accordance with the requirements of Joint Use Equipment procedure.

The paper will describe the present remote monitoring implementation in Japan and possible future expansion taking into consideration upcoming new technologies and trends.

# REMOTE MONITORING IMPLEMENTATION IN JAPAN

M. Aparo
Head of Tokyo Regional Office

**IAEA**
International Atomic Energy Agency

## Remote Monitoring in IAEA Safeguards

- Electronic transmission of SG surveillance, seal, and Unattended Monitoring data from a facility to Vienna-HQ and/or regional office over different types of communication lines.

- SG equipment can be in either SoH (State of Health) mode or full RM (remote monitoring) mode.

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# History of RM

- Remote monitoring (RM) was first used during the post-Gulf War inspections in Iraq, but with different goals
- IAEA RM Project was established in October 1996 with the objectives to develop and implement remote monitoring techniques in the Department of Safeguards.
- RM was proposed for South Africa as a confidence building measure in 1994; a test system was in place by April 1997
- Switzerland volunteered to be a test site as part of Programme 93+2
  - A RM approach was negotiated and approved in 1998
  - Systems were installed in 1999
- Systems were installed at two LWRs facilities in Japan in 1998
- The RM project was considered completed at the end of 1998 and RM implementation commenced.

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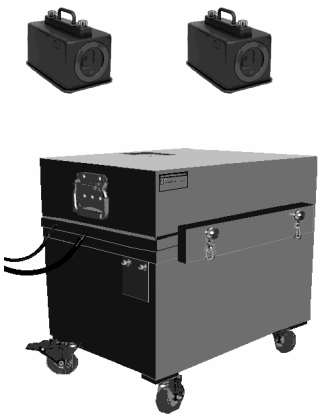
# RM Equipment – the first system: - *Server Digital Image Surveillance (SDIS)*



- High-capacity, on-site image and data storage (>20 Gbytes)
- Connection for up to 3 digital cameras on each of two serial (Com) ports
- Connection for up to 32 electronic seals on each serial (Com) ports
- Authentication, encryption, and battery backup in each camera
- Flexible communications interface
- Data security & access control
- Heavy-duty power back-up
- Local storage of images
- Windows XP Operating system
- 10-30 MB per Day, LWRs & storage facilities.
- 87 in Field: 44 RM, 25 SoH, 79% connected

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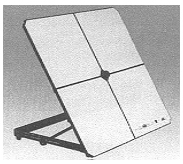
## *Evolution in Communication Options Used*

• **Public switched telephone network (PSTN)**

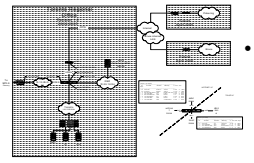
• **Integrated Services Digital Network (ISDN)**

• **Very small aperture terminal (VSAT) satellite network**



• **International Maritime Satellite (INMARSAT) network**

• **Asynchronous Data Subscriber Line (xDSL)**



• **LAN-Sharing**

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## RM advantages

- Minimize inspection effort (fewer on-site inspections) also reducing burden to facility operator;
- Improve safeguards effectiveness (Safeguards data can be reviewed any time)
- Minimize inspector radiation exposure
- Inspections are more efficient (no monitoring equipment to be serviced)
- Equipment failures can be identified and corrected sooner and sometime can be even prevented.

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# RM cost

- Hardware (monitoring equipment would be installed no matter whether RM is implemented or not)
  - Cameras: 5K (USD) each
  - Server: 20K - SDIS
  - Installation costs may be 20-50K
- Communications examples:
  - Swiss – 10K$ per year
  - South Korea - $60 per xDSL x 20 = $1200/month (50% paid by SG)
  - Japan – varies from 30 US$ to 300 US$ per month
- Average cost of a person day of inspection (PDI) is about 5K

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# RM Reliability

- System reliability
  - RM communications generally don't fail, but they could be delayed. There have been no prolonged communications outages.
  - It is usually the surveillance or unattended monitoring system that fails.
  - Even in the case of complete failure of the communication equipment, data are not lost but can be retrieved from system local data storage
  - The only inconclusive periods are when the lights went out in the facility.

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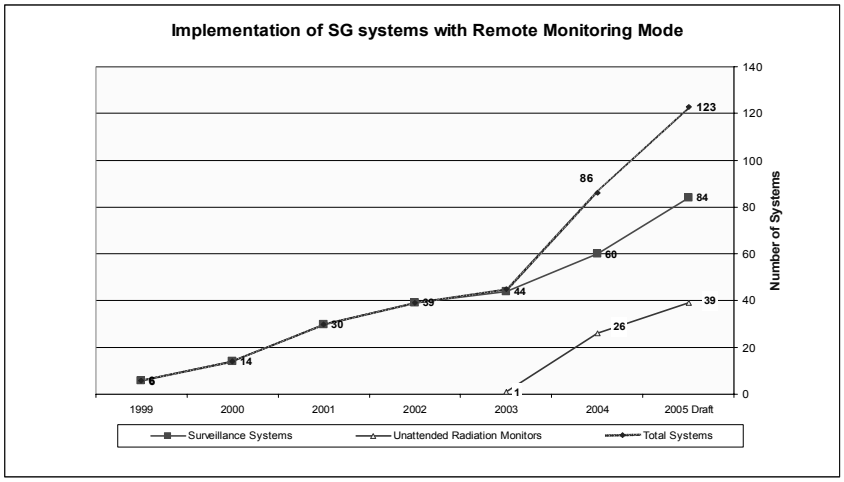
# Remote Monitoring Implementation

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# RM in Japan

- RM systems at LWRs were removed at the end of the field test since the Integrated Safeguards Approach did not require the continuous use of surveillance.
- A new RM system was implemented at PFPF initially for field testing only.

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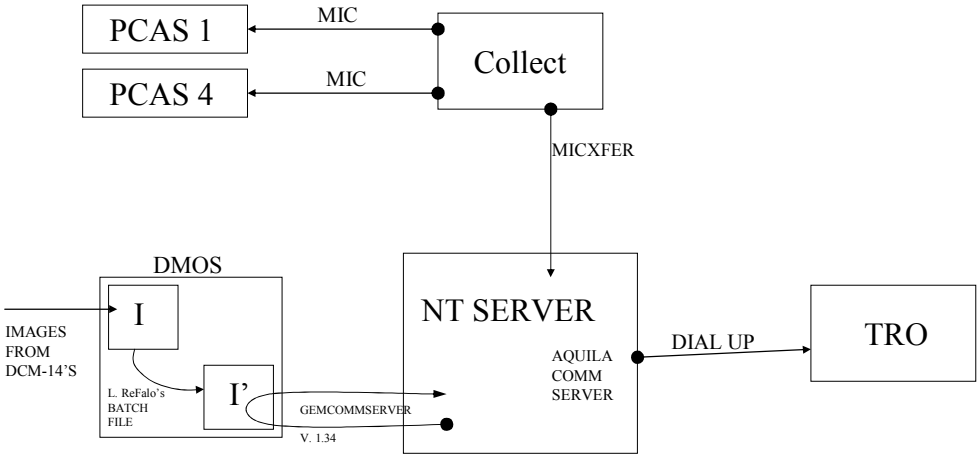


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# DATA Review

- Images are downloaded every night for the previous day
- Safeguards data is stored on the TRO DMZ server
  - NMCC and IAEA Inspectors jointly performs review on a dedicated desktop.
- Review SW (GARS, Radiation Review) used for the reviews.

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## RM Policy - *Data Requirements*

- Data integrity
  - Data acquired in unattended mode and transmitted over unsecured or public networks shall be authenticated.

- Data confidentiality
  - Data transmitted over unsecured or public networks shall be encrypted to protect proprietary information.

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## RM Data Security

- Hardware VPN is presently used for all satellite, PSTN and Internet communication.
- VPN provides the required authentication and encryption.
- The selected VPN is FIPS certified and it successfully underwent through different penetration tests which demonstrated that data cannot be modified and are not accessible.
- VPN also operates as firewall, therefore only IAEA can directly access the monitoring system for data download.

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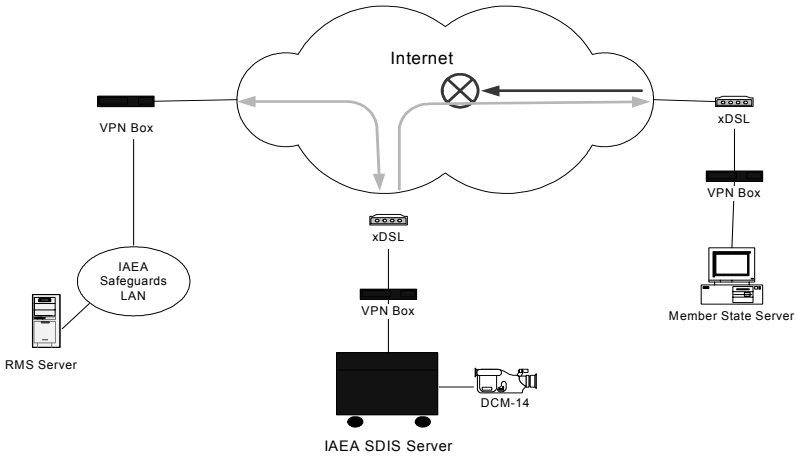
## RM over Virtual Private Network (VPN) with Data Sharing

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## RM Data sharing

- IAEA Policy Paper on Remote monitoring requires DDG-SG approval for data sharing (with State Authority) and limited the type of data that can be shared.

- The IAEA Policy Paper on Joint Use Equipment requires that data are shared only after the IAEA has received the operator's declaration.

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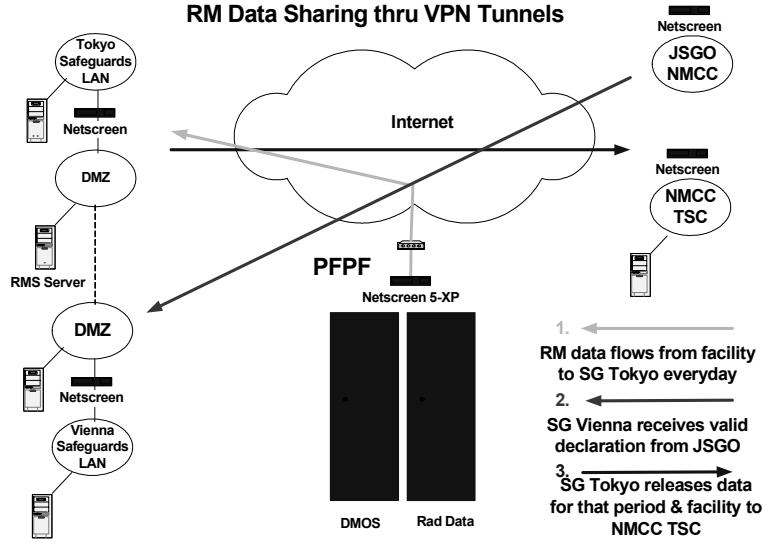


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# New RM trend in Japan

- New RM systems in Japan integrate (via Ethernet, WiFi, PHS) different unattended monitoring and surveillance systems within a facility.
- In 2008, as part of the Integrated Safeguards Approach all monitoring and surveillance system at JNC-1 site (including reprocessing and MOX fabrication plant) will be integrated with remote data transmission.
- Remote Monitoring will support Random Interim Inspection carried out at JNC-1 site.

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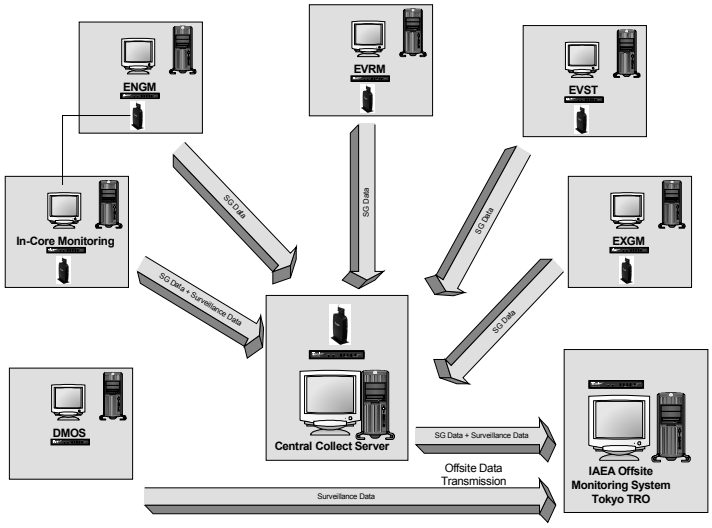
Monju Integration & Remote Monitoring Network
2008-02-15

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# Possible future RM expansion in Japan

- RM is being considered by IAEA to further reduce inspection efforts and increase efficiency at:
  - Rokkasho reprocessing plant
  - J-MOX plant
  - Spent Fuel Interim Storage Facility
  - LWRs with MOX fuel

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# Conclusion

- Although RM did not play a major role in the implementation of safeguards in Japan, it is expected its increase use in the future to both optimize inspection effort and improve effectiveness.
- The implementation of efficient and effective IAEA Safeguards are the best transparency measure in the area of nonproliferation.

**IAEA** ICAS 56-5.9

# 6.7 A Demonstration of Advanced Transparency at the Monju Fast Breeder Reactor Model*

V.D. Cleary[a], G.E. Rochau[a], K.L. McFadden[b], C.M. Méndez[c],
N. Inoue[d], T. Kitabata[d], and T. Irie[d]

[a]Sandia National Laboratories, [b]Sigma Software,
[c]Sociotecnia Solutions, and [d]Japan Atomic Energy Agency

## Abstract

Sandia National Laboratories (SNL) and the Japan Atomic Energy Agency (JAEA) formed a collaboration in 2004 to develop and Advanced Transparency Framework, capable of building trust relationships between political entities through the analysis of inherent process data. In 2006, SNL and JAEA collaborated to demonstrate the Advanced Transparency Framework at the Monju Fuel Handling Training Model at the International Nuclear Information and Training Center in Tsuruga City, Japan.

The Monju Fuel Handling Training Model is a one-twelfth scale model that represents the actual fuel handling activities at the Monju Fast Breeder Reactor. The operational data generated by the model is similar in nature to the actual data generated at the plant, making the model an ideal test bed for the Advanced Transparency Framework.

Traditional transparency in the past has meant the monitoring of fuel handing activities through the use of devices such as video cameras. SNL and JAEA sought to redefine transparency to increase confidence among political entities that nuclear fuel cycle facilities are being used for peaceful purposes. In order to accomplish this, SNL and JAEA felt that the new transparency framework should:

1. "Operate in real-time,
2. Provide a final quantitative result,
3. Utilize the inherent plant process data and design data, and
4. Utilize declared plant process." (Méndez et al., 2007)

The term "transparency" is used in many different applications. In the context of the nuclear fuel cycle, we define it as:

> "…a high-level concept, defined as a confidence building approach among political entities, possibly in support of multi-lateral agreements, to ensure civilian nuclear facilities are not being used for the development of nuclear weapons. Additionally, nuclear fuel cycle transparency involves the cooperative sharing of relevant nuclear material, process, and facility information among all authorized parties to ensure the *safe and legitimate use* of nuclear material and technology. A system is considered *transparent* when the parties involved feel that the *proliferation risk* is at an acceptable level. For this to occur, proliferation risk should be monitored in a continuous fashion." (Love et al., 2006)

In order to demonstrate the Advanced Transparency Framework being developed by SNL and JAEA, a prototype software package is being developed. The software package under development is capable of recording the inherent process data available at the Monju Model, securely transferring the data to SNL, processing the data and providing a quantitative result. During the past two years of software development and application, we have demonstrated the capability to extract and securely transmit large amounts of inherent process data from the automated model to SNL. We have accurately interpreted the signals received in accordance with the model operations. We have

*This work jointly sponsored by the Japan Atomic Energy Agency and Sandia National Laboratories under a Memorandum of Understanding No. 05-S-430. Sandia National Laboratories is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.

demonstrated the ability to detect "manual override events" or interruptions in the model's automated process.

The advanced transparency framework developed by SNL and JAEA is inherently different from remote monitoring. "Transparency is a bilateral agreement between two parties to share all process data available from the nuclear fuel cycle facility in order to increase confidence. Remote monitoring is the ability of the IAEA to remotely obtain negotiated data from a nuclear fuel cycle facility to draw safeguards conclusions." (Cleary et al, 2007) While transparency and remote monitoring have the same primary purpose, to verify the declared activities of the nuclear facility, with the transparency framework the measurement is in terms of change in risk, which provides an objective result, independent of any interpretation left up to the analyst. This is primarily because the transparency framework relies solely on sensors and remote monitoring relies on both sensors and monitors. The data transmitted by sensors is definite; on the contrary, the data from monitors (i.e. video cameras) is open to interpretation. In essence, Transparency relies little on subjective data where Remote Monitoring is highly reliant on subjective data and the observation and analyses made by the inspectors.

Sandia National Laboratories (SNL) and the Japan Atomic Energy Agency (JAEA) are working in cooperation to develop an advanced transparency framework capable of assessing diversion risk in support of overall plant transparency. "The diversion risk quantifies the probability and consequence of a host nation diverting nuclear materials from a civilian fuel cycle facility." (Cleary et al. 2007 (2)) This framework is currently being demonstrated at the Monju Fuel Handling Training Model at the International Nuclear Information and Training Center in Tsuruga City, Japan.

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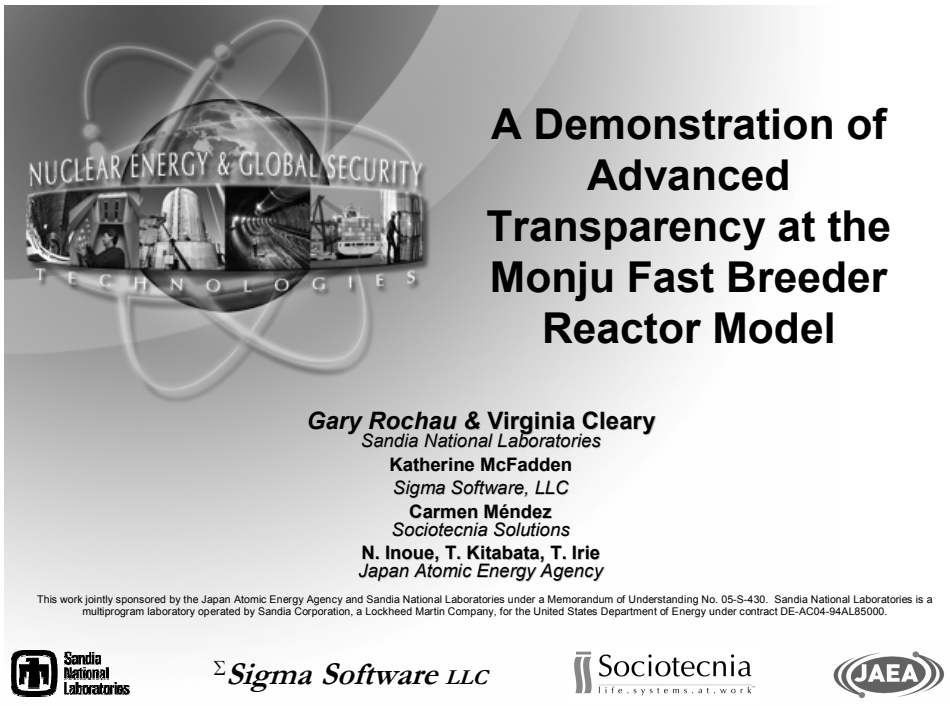
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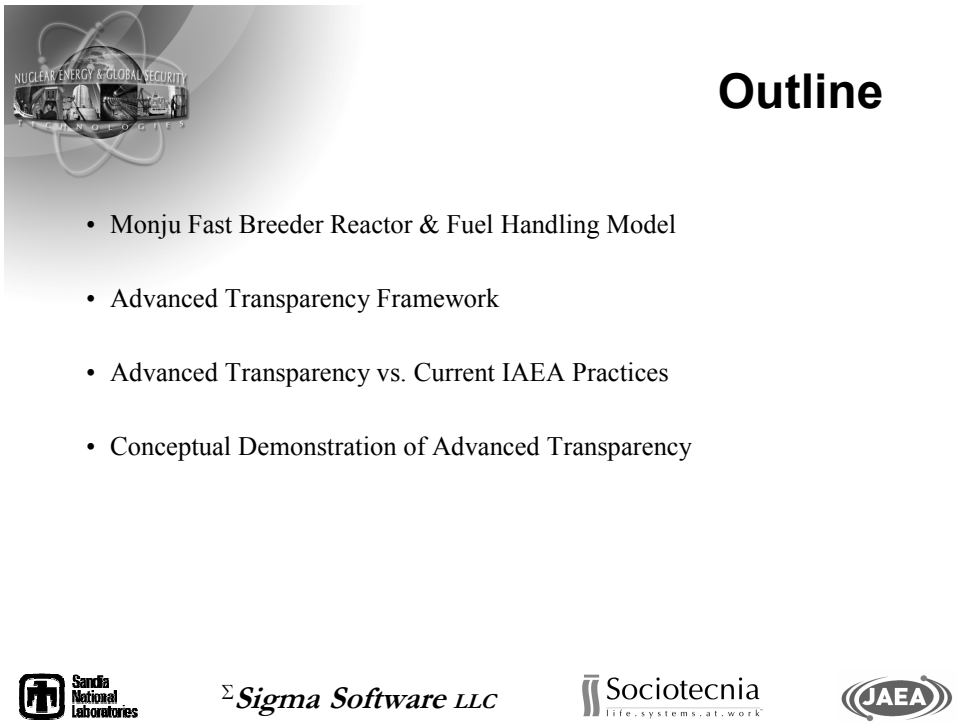
NUCLEAR ENERGY & GLOBAL SECURITY
TECHNOLOGIES
Outline
• Monju Fast Breeder Reactor & Fuel Handling Model
• Advanced Transparency Framework
• Advanced Transparency vs. Current IAEA Practices
• Conceptual Demonstration of Advanced Transparency
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# Monju Fast Breeder Reactor

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# Monju Fuel Handling Training Model

- The one-twelfth scale model represents the actual fuel handling activities at the Monju Fast Breeder Reactor.
- The operational data for the model is similar in nature to the actual plant operational data.
- The automation of new nuclear facilities requiring minimal manual operation provides an opportunity to utilize the abundance of process information for advanced transparency.

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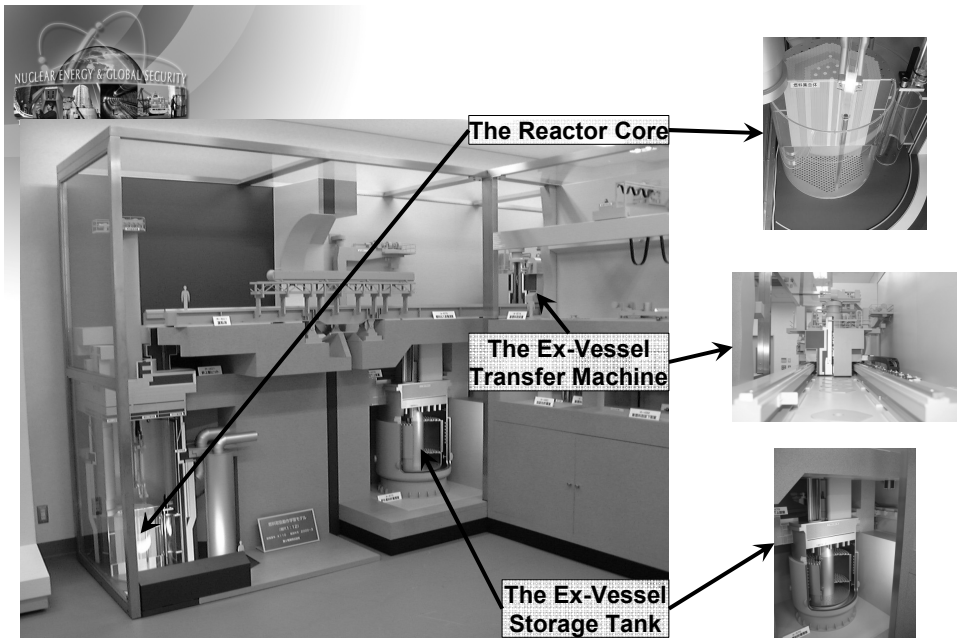


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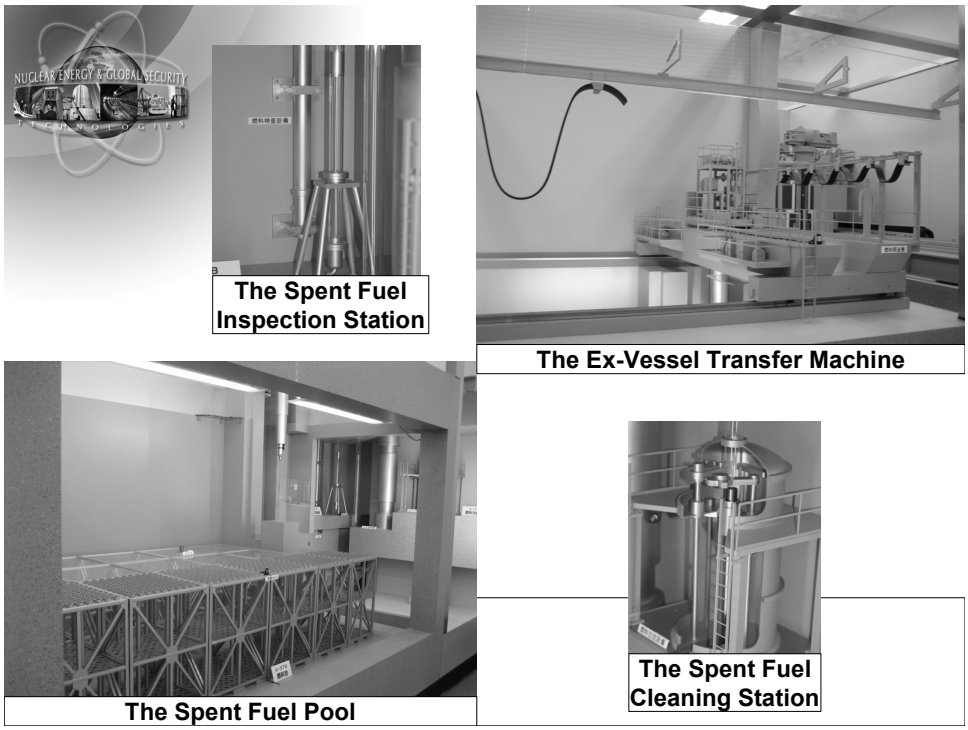

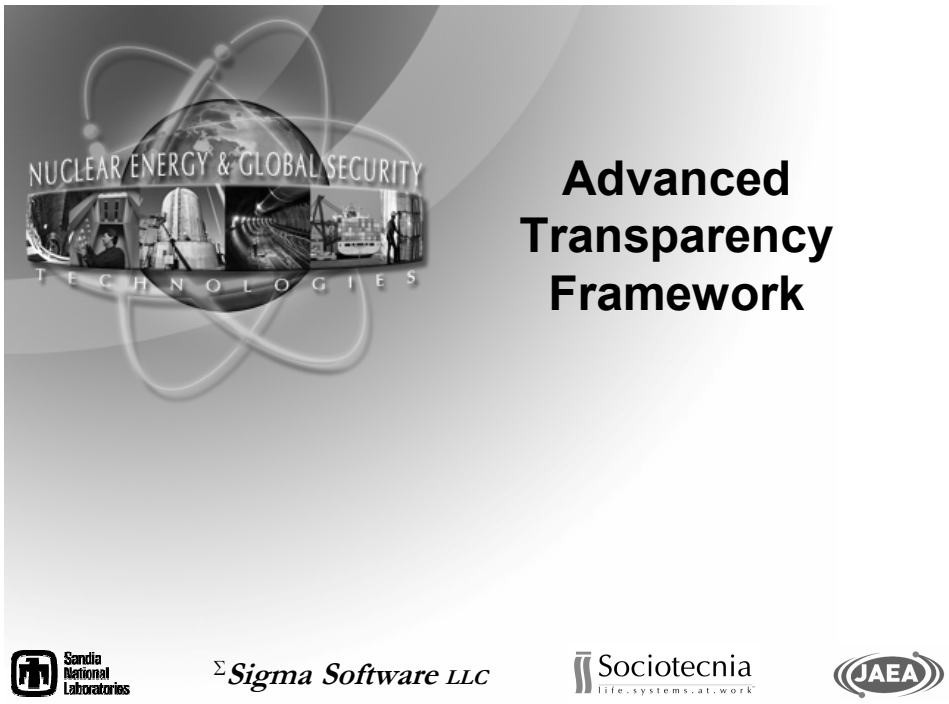
NUCLEAR ENERGY & GLOBAL SECURITY
TECHNOLOGIES
Advanced Transparency Framework
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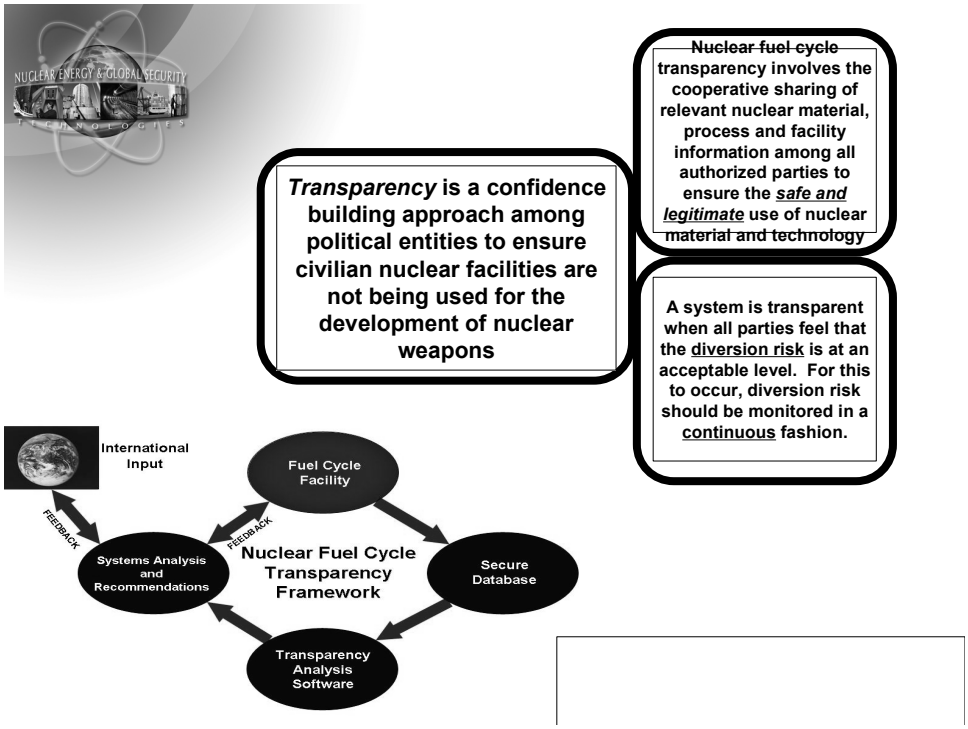
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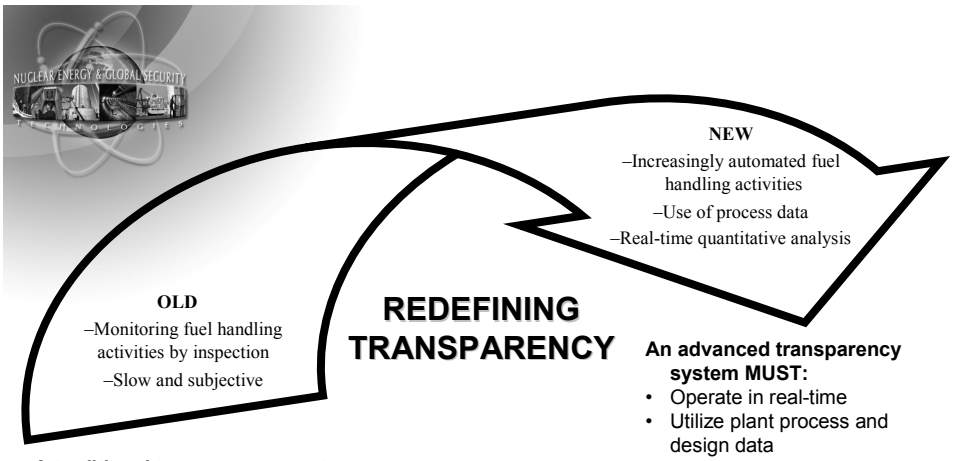
Transparency is a confidence building approach among political entities to ensure civilian nuclear facilities are not being used for the development of nuclear weapons
Nuclear fuel cycle transparency involves the cooperative sharing of relevant nuclear material, process and facility information among all authorized parties to ensure the safe and legitimate use of nuclear material and technology
A system is transparent when all parties feel that the diversion risk is at an acceptable level. For this to occur, diversion risk should be monitored in a continuous fashion.
International Input
Fuel Cycle Facility
FEEDBACK
FEEDBACK
Systems Analysis and Recommendations
Nuclear Fuel Cycle Transparency Framework
Secure Database
Transparency Analysis Software




**A traditional transparency system involves:**

- Use of external devices (i.e. video cameras)
- Subjective visual monitoring of activities
- Provides no feedback

**An advanced transparency system MUST:**

- Operate in real-time
- Utilize plant process and design data
- Utilize declared plant processes
- Conduct real-time, quantitative analysis of diversion risk
- Securely provide analysis to the facility and authorized parties

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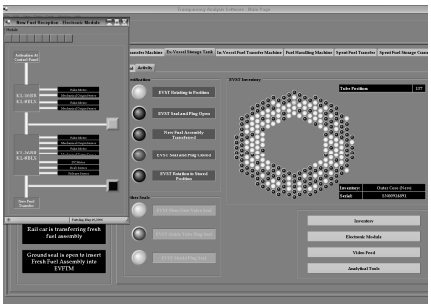
# Technical Developments

- Accurate collection of signals internal to the Monju Nuclear Fuel Cycle Model
- Live collection and transfer of these signals from the Monju Database Server (in Japan) to Sandia
- Accurate interpretation of signals in accordance with model operations
- Detection of "manual override events" or interruptions in automated processes



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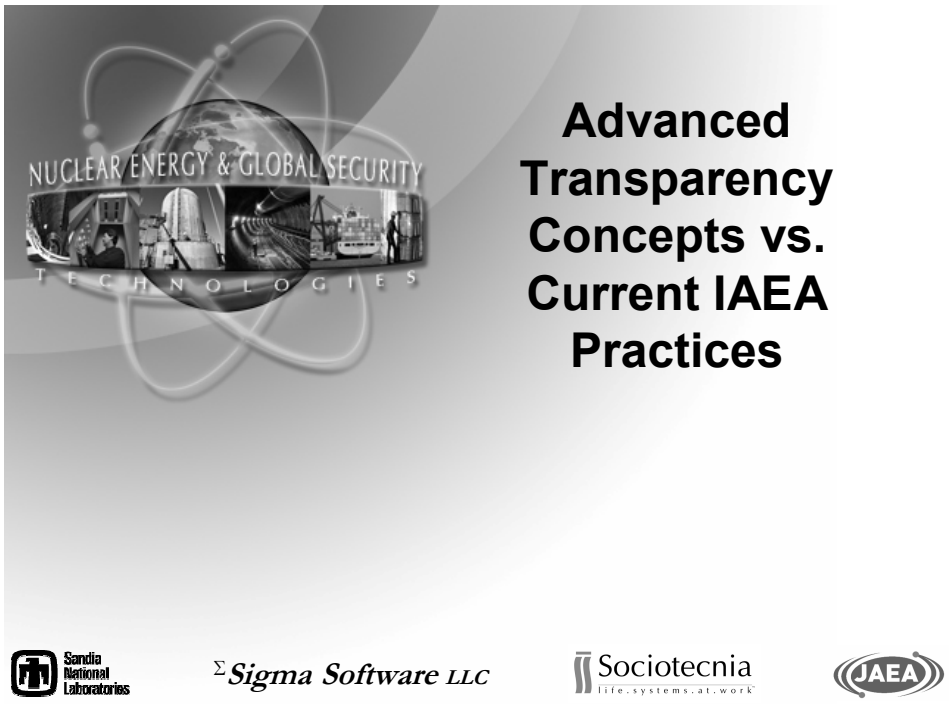
NUCLEAR ENERGY & GLOBAL SECURITY
TECHNOLOGIES
Advanced Transparency Concepts vs. Current IAEA Practices
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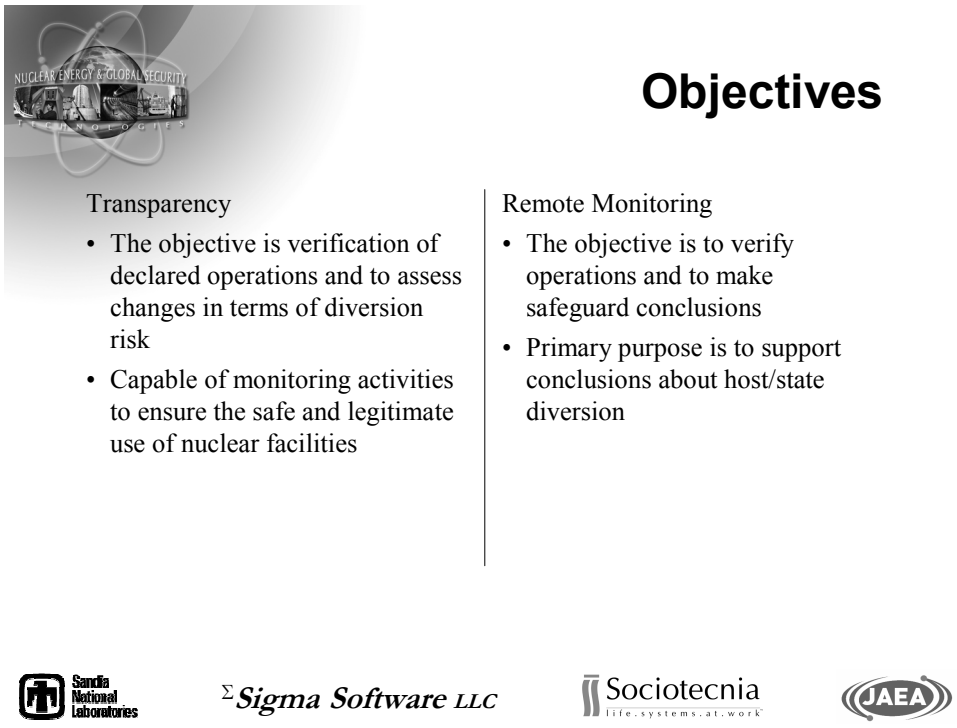
NUCLEAR ENERGY & GLOBAL SECURITY
TECHNOLOGIES
Objectives
Transparency
• The objective is verification of declared operations and to assess changes in terms of diversion risk
• Capable of monitoring activities to ensure the safe and legitimate use of nuclear facilities
Remote Monitoring
• The objective is to verify operations and to make safeguard conclusions
• Primary purpose is to support conclusions about host/state diversion
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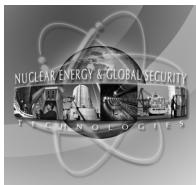


# Data Analysis

Transparency
- Data used is inherent to plant operations
- Data is collected and evaluated in real time
- Operations are declared prior to operating the plant
- Deviations can be quantified in terms of diversion risk
- Instant assessment of plant status

Remote Monitoring
- Data used is obtained via extrinsic sensors and monitors
- Data is collected in a scheduled time frame
- Operations are reported in parallel
- Analysis is conducted subsequent to operations

*BENEFIT: Transparency provides immediate detection of an increase in the risk of diversion as a result of deviations in plant operations from declared activities.*

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# Focus of Process Data Analysis

Transparency
- Assurance of nuclear material control
- Safety
- Security
- Operations

Remote Monitoring
- Supports safeguards conclusions

*BENEFIT: The Transparency framework can be modified to provide a single system that can successfully ensure safe and secure operations of nuclear facilities.*

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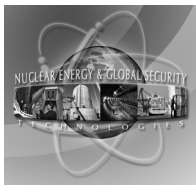


# Data Collection

Transparency

- Data is inherent to the plant
- No additional sensors or monitors are needed – except to provide another source of verification
- Data used is known by the operators

Remote Monitoring

- Relies solely on extrinsic monitors and sensors
- Data used is unknown to operators
- Cost of retrofitting the facility is high

*BENEFIT: Transparency is intrinsic to the facility design; thus, there is no cost of retrofitting the facility.*

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# Measurement

Transparency

- Measures deviations from declared operations as change in diversion risk
- No data interpretation is necessary since the inherent sensors provide objective information
  - i.e. temperature, pressure

Remote Monitoring

- Declared operations are verified, no quantitative measurement is reported
- Conclusions are drawn from extrinsic monitors and sensors
  - i.e. video camera

*BENEFIT: Transparency relies primarily on objective data.*

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# Agreements

Transparency

- Is a bilateral agreement between two (or more) parties
- All data available is shared
- All results of data analysis are shared

Remote Monitoring

- International requirement with regards to the NPT
- All data collected is negotiated
- Only final conclusions are shared with the applicable parties

*BENEFIT: Transparency is an agreement where sharing of all data and analysis occurs.*

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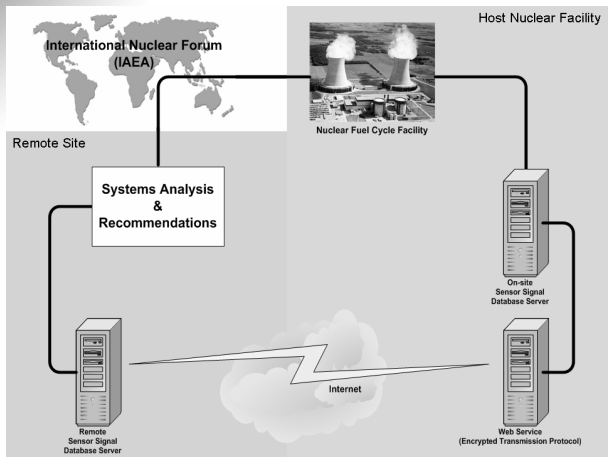
# Conceptual Framework for Advanced Transparency*




***prototype software**

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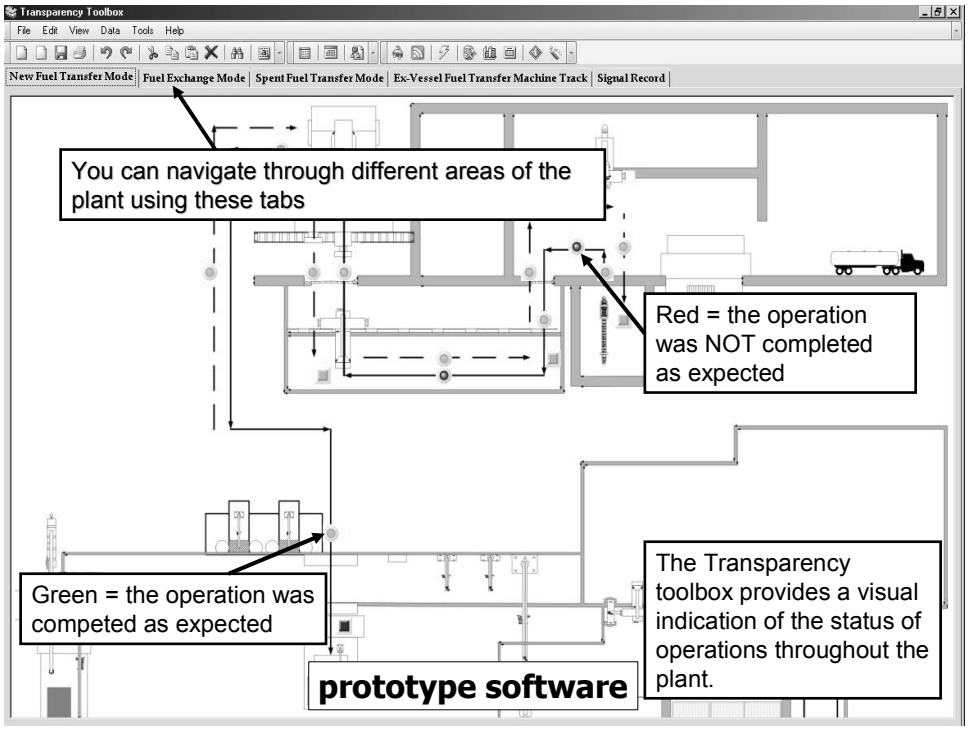
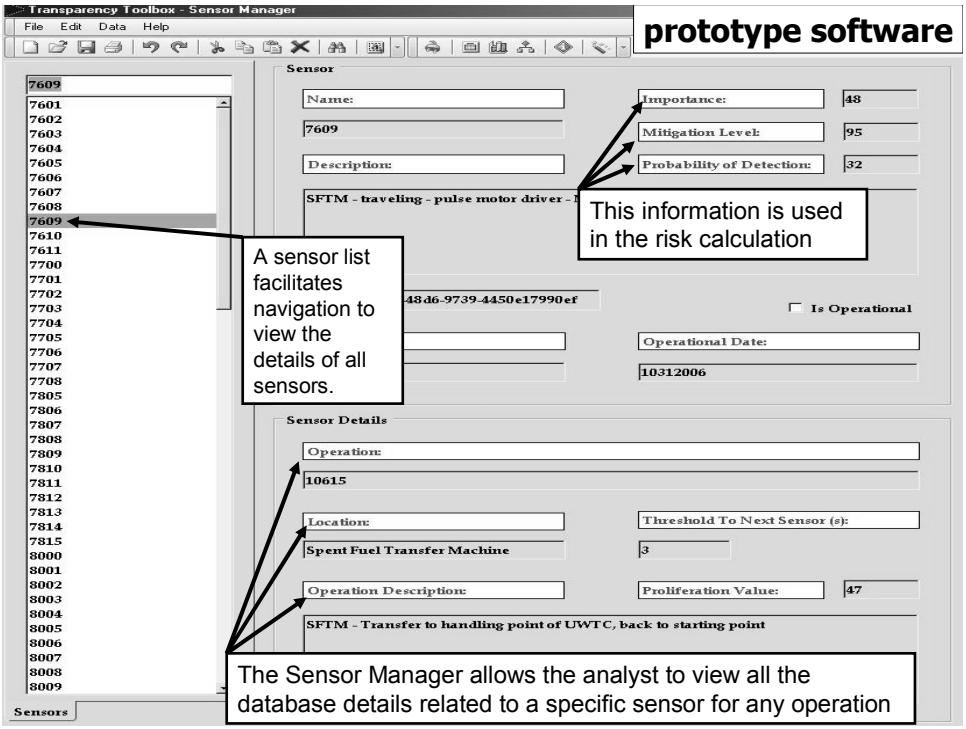
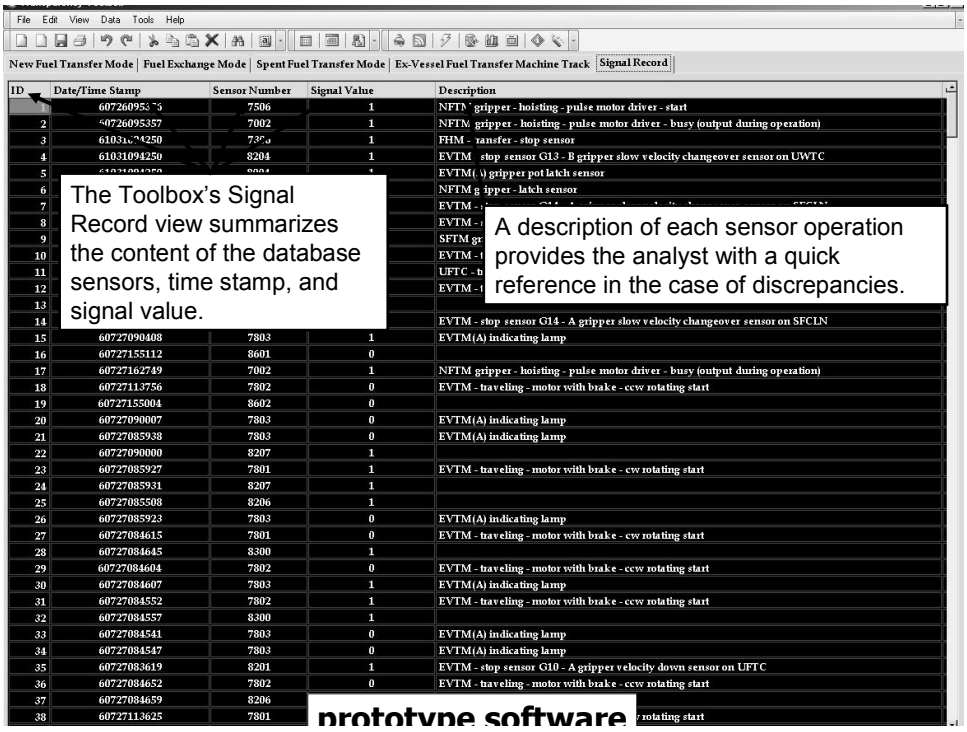
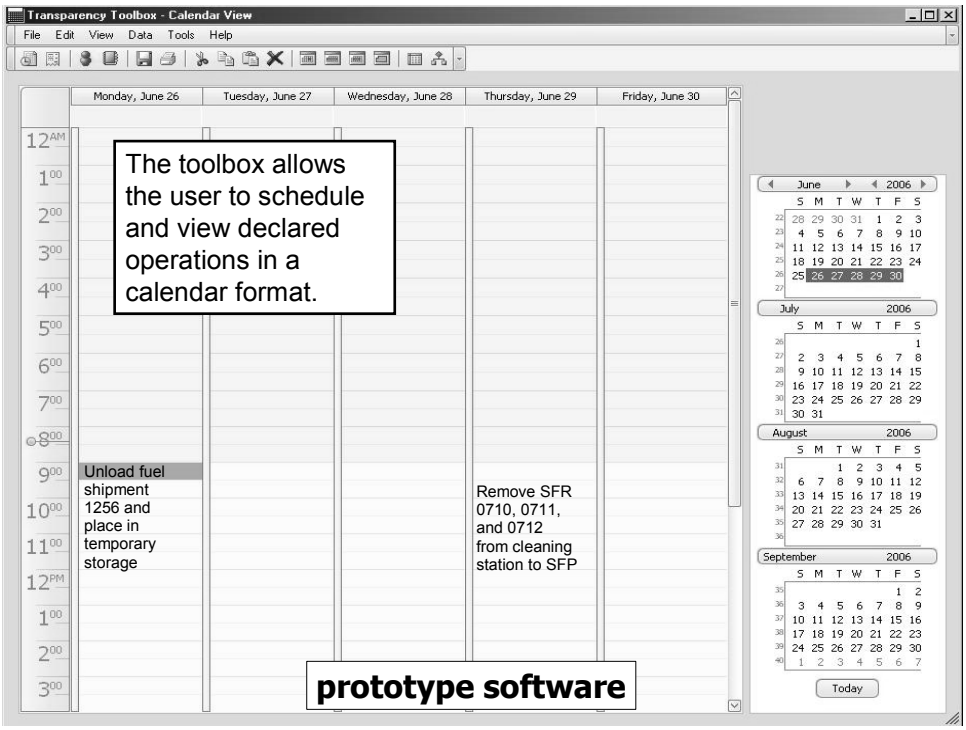
# Software Development

- Client Transfer Module
  - The raw, binary, inherent, process data from the automated system is encrypted at the facility and securely transferred through a VPN to the remote site, where the information is decrypted.
- Client Reader Module
  - After information is transferred to the remote site, an XML Reader parses through the information and populates the Transparency Database
- Transparency Toolbox
  - The Transparency Toolbox is the main Graphical User Interface (GUI) at the remote site and is used to display information and facilitate development of constraints.
- Transparency Analysis Software Module
  - The Transparency Analysis Software conducts the operational verification and calculates the diversion risk of a nuclear facility.




Transparency Toolbox - Sensor Manager
File Edit Data Help
prototype software
Sensor
Name:
7609
Description:
Importance:
48
Mitigation Level:
95
Probability of Detection:
32
SFTM - traveling - pulse motor driver -
This information is used in the risk calculation
Is Operational
Operational Date:
10312006
Sensor Details
Operation:
10615
Location:
Spent Fuel Transfer Machine
Threshold To Next Sensor (s):
3
Operation Description:
Proliferation Value:
47
SFTM - Transfer to handling point of UWTC, back to starting point
A sensor list facilitates navigation to view the details of all sensors.
The Sensor Manager allows the analyst to view all the database details related to a specific sensor for any operation
Sensors


File Edit View Data Tools Help
New Fuel Transfer Mode
Fuel Exchange Mode
Spent Fuel Transfer Mode
Ex-Vessel Fuel Transfer Machine Track
Signal Record
ID
Date/Time Stamp
Sensor Number
Signal Value
Description
The Toolbox's Signal Record view summarizes the content of the database sensors, time stamp, and signal value.
A description of each sensor operation provides the analyst with a quick reference in the case of discrepancies.
prototype software


Transparency Toolbox - Calendar View
File Edit View Data Tools Help
Monday, June 26
Tuesday, June 27
Wednesday, June 28
Thursday, June 29
Friday, June 30
The toolbox allows the user to schedule and view declared operations in a calendar format.
Unload fuel shipment 1256 and place in temporary storage
Remove SFR 0710, 0711, and 0712 from cleaning station to SFP
prototype software
June 2006
July 2006
August 2006
September 2006
Today


NUCLEAR ENERGY & GLOBAL SECURITY
Integration of Safeguards, Security, Operations, & Safety
We believe that our framework can be expanded to include Security, Operations, and Safety.
Thus, providing a means of complete TRANSPARENCY at a nuclear fuel cycle facility.
Safeguards
Security
ADVANCED TRANSPARENCY FRAMEWORK
Safety
Operations
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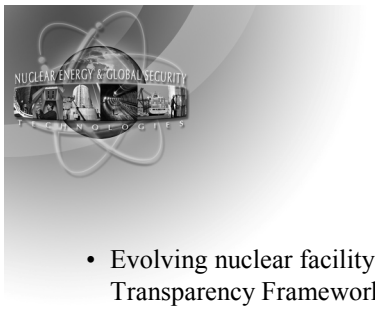


# Conclusions

- Evolving nuclear facility designs can support the Advanced Transparency Framework by designing in transparency features
- The primary goal of the Advanced Transparency Framework is to build confidence, not to replace IAEA protocol
- The Advanced Transparency Framework can support the needs of the IAEA with incorporation of data security and validation

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# 6.8 Cooperative Transparency for Nonproliferation – Technology Demonstrations at the Joyo Test Bed for Advanced Remote Monitoring

J. David Betsill* and Yu Hashimoto

Japan Atomic Energy Agency

## Abstract

The term "Transparency" has been used widely by many authors and practitioners for various purposes, and there is an assortment of definitions for the term. These definitions vary depending on the field in which the term is used and within the context of its usage. For the purposes of our current project on regional, cooperative nonproliferation transparency and remote monitoring, the relevant field is nuclear nonproliferation, and in this context, we define the term *Cooperative Nonproliferation Transparency* as: "Providing sufficient and appropriate information to a cooperating party so that they can independently develop their own evaluation and assessment of the reviewed party regarding their consistency with nonproliferation goals." Key aspects of cooperative nonproliferation transparency activities include mutually agreeing upon the type of information or data that will be shared, how it will be collected, and who has access to that information.

The Japan Atomic Energy Agency's (JAEA) Nonproliferation Science and Technology Center (NPSTC) has been exploring the possible use, development, and application of methods and technologies for Cooperative Transparency for Nonproliferation to support regional confidence building and cooperation in the peaceful use of nuclear energy throughout the East Asia region.

### Technology Development at JAEA for Nonproliferation Remote Monitoring

Assuring the safe and reliable peaceful use of nuclear energy is a complex, multidisciplinary task. In support of Japan's increase in nuclear energy, the JAEA's NPSTC has been working with the US Department of Energy (DOE) and Sandia National Laboratories since 1995 on the development, application, and testing of new, safe, and secure remote monitoring technologies for nonproliferation applications.

When the collaboration initially began, remote monitoring was just emerging as a useful technology tool box for Safeguards applications. To make it truly viable, appropriate monitoring equipment and technologies for secure transmission of data were developed over the course of time. The fresh fuel room at the Joyo Experimental Fast Reactor in the O'arai Engineering Research Center has been used to test and demonstrate various remote monitoring technologies and applications.

*David Betsill is on assignment from Sandia National Laboratories, Albuquerque, New Mexico. Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed-Martin Company, for the United States Department of Energy under contract DC-AC04-94AL85000.

The current remote monitoring system at Joyo includes a DCM-14 digital camera, balanced magnetic switch, and secure communications over the Internet via a virtual private network (VPN) system. Recent technical upgrades focused on configuring secure Internet access to facilitate remote review of monitoring data, adding fiber-optic data-transfer within the facility, and developing a website to share approved monitoring information. The upgrades streamlined and improved monitoring operations, hardware, software administration, and security. These enhancements make the system more reliable, provide a suitable test bed for new remote monitoring and transparency technology, and create a dependable and credible platform potentially usable for future transparency cooperation with other regional partners.

**Cooperative Transparency for Nonproliferation**

Standardized IAEA methods, technologies, and hardware are rightfully acknowledged as the reliable, time-tested, cornerstone and benchmark of traditional Safeguards. At the same time, interest by the regional community in non-traditional approaches that help expand and promote regional understanding, cooperation, and confidence building are an emerging trend. Parties are considering looking more broadly at a wider set of potentially available information when making their assessments of other regional entities. These Cooperative Transparency approaches are complementary to, but do not replace, a country's traditional approach to IAEA Safeguards. Therefore, the NPSTC is continuing to investigate how cooperative transparency methods and technologies can act as a complementary, but separate, role with Safeguards technologies to enhance regional cooperation.

The concept of "cooperative transparency for nonproliferation" supplements international Safeguards. Its value lies in developing and improving mutual trust regarding nonproliferation activities. Using their own data, review methods, and software to conduct independent assessments of agreed, shared information, it is possible for participating parties to reach independent conclusions regarding the consistency of activities and the perceived transparency and openness of regional partners.

To be effective, an important goal of Cooperative Transparency for Nonproliferation is to work in parallel with the IAEA Safeguards process; not in competition with it. Cooperative Transparency for Nonproliferation is envisioned as a voluntary approach by participating parties that increases confidence in the reviewed party's openness and willingness to comply with nonproliferation goals. Cooperative Transparency is complementary to, but goes beyond, traditional Safeguards for those entities that want to increase and enhance confidence and cooperation with other parties regarding their nonproliferation intentions. One key aspect of Cooperative Transparency activities is mutually agreeing on the type of information or data that will be shared, how it will be collected, and who has access to that information. Greater transparency, including a possible broader range of "soft" activities, therefore, can increase the degree of trust and openness among parties already under IAEA Safeguards.

Cooperative Transparency activities that are reciprocal between parties can enhance and provide an even greater amount of trust and confidence building. Such cooperation is behind the concept of a future Network for Regional Transparency. To promote the concept of a network for regional transparency, the NPSTC project conducts regional workshops on remote monitoring technical activities; appropriate technology selection, demonstration, and evaluation; and development of regional views and applications. In addition, a newly developed, remote monitoring transparency website can provide general information, and remote data viewing, communications, and information sharing for authorized participants.

**Regional Website Portal for Cooperative Nonproliferation Transparency**

The Regional Cooperative Nonproliferation Transparency Website Portal for Remote Monitoring Technology was developed in the spring of 2007. The portal is intended to provide information on

the peaceful use of nuclear technology for energy production in the East Asia region, and highlight and facilitate the transparency of nonproliferation efforts of entities within the region.

The website portal is primarily intended for a working-level group of regional transparency parties to collaborate and share agreed information regarding transparency. The website also provides an important pathway for communication and collaboration between these and other interested parties engaged in regional nonproliferation transparency projects. Currently, the portal is undergoing internal beta testing and improvement. Access to the website beyond a general introductory page of nonproliferation transparency information will be limited, and by invitation only, to approved project participants. In the future, as the project advances on regional cooperative nonproliferation transparency and remote monitoring technology, the website may be opened to a wider group of interested regional parties.

**Joyo RMS Test Bed for Advanced Remote Monitoring Technology**

Recently, the concept arose that the existing Joyo Remote Monitoring System (RMS) could possibly be applied for use as a Test Bed for a variety of transparency technologies that are under development. These include those technologies that are not necessarily destined for IAEA use or approval, but could, none-the-less, be useful for regional cooperation and confidence building.

The Joyo RMS Test Bed for Advanced Remote Monitoring Technology can be used to evaluate and addresses the practical, technical issues and problems associated with remote monitoring and cooperative transparency applications when they are used in confidence building measures. In addition, a variety of relevant, emerging technologies can be tested and evaluated at the Advanced RMS Test Bed.

Advantages of using Joyo for a Test Bed include realistic conditions and constraints in an operational facility and the ability to conduct technical field trials, evaluation, and comparison testing. Additional advantages include an existing infrastructure, wiring, computers, and communications; and most importantly, a user-friendly, operator-supportive environment. Technology transfer, training, and information dissemination are all part of the Joyo RMS Test Bed concept.

An initial evaluation of the Test Bed concept was conducted in January 2008 when a Hawk Digital Imaging System (HDIS) was temporarily installed at the Joyo Advanced RMS Test Bed. Currently, HDIS is in limited use by IAEA in a complementary fashion to traditional Safeguards. The current IAEA approach uses HDIS in a stand-alone, inspection support role – not as part of a remote-monitoring Safeguards installation.

The HDIS could also possibly be used for non-traditional Cooperative Transparency monitoring applications, and therefore, is being considered for regional cooperation and confidence building projects. Its recent demonstration at the Joyo Advanced RMS Test Bed provided a proof-of-concept for the test bed, as well as running the digital imaging system through its paces.

The Hawk Digital Imaging System records images using two, high-resolution (1280 x 960) pixel, very low-light, color cameras. The cameras can be aimed independently, the picture taking interval (PTI) can be set from 1 second to 1 hour, and the unit is capable of capturing 5 frames/sec on each camera. The basic unit holds 425,000 high resolution pictures and can capture 100,000+ sets of two pictures using internal batteries or external 12v DC input. A future option of a “digital wireless link” is under development for real-time data transfer and remote command support. The unit is encased in a watertight housing, and is easily portable within a carry-on case. A standard laptop or micro-PC running Windows XP is used for field setup, parameter and status monitoring, and camera alignment checks.

The initial proof-of-concept test of the Joyo Advanced RMS Test Bed concept (using the HDIS system) was successful, including outstanding support of the Joyo operational staff. The HDIS

system is planned to be re-installed for several months of additional test and evaluation. In the near future, upgrades of the basic HDIS will replace the existing unit and also be evaluated at the Joyo Advanced RMS Test Bed for potential use for Cooperative Transparency Monitoring. Additional monitoring and secure communications technologies are being solicited for testing and demonstration at the Test Bed.

## Conclusions

Remote Monitoring and Cooperative Transparency Technologies for Nonproliferation support regional acceptance of nuclear energy and fuel cycle development. Interest by the regional community in non-traditional approaches that promote regional understanding, cooperation, and confidence building are an emerging trend. Cooperative Transparency Technologies are complementary to, but do not replace a country's traditional approach to IAEA Safeguards. A key aspect of Cooperative Transparency activities is mutually agreeing on the type of information or data that will be shared, how it will be collected, and who has access to that information.

The effectiveness and efficiency of remote monitoring and Cooperative Transparency technologies and systems are being demonstrated and evaluated at the Joyo RMS Test Bed for Advanced Remote Monitoring Technology. A Website Portal for Regional Cooperative Nonproliferation Transparency Technology was developed and is intended to provide future information on the peaceful use of nuclear technology for energy production in the East Asia region, and highlight and facilitate the transparency of nonproliferation efforts of entities within the region. The initial trial of the Advanced RMS Test Bed concept using the HDIS system was successful, including outstanding support of the Joyo operational staff. Additional monitoring and secure communications technologies for traditional and non-traditional applications are being solicited for testing and demonstration at the Joyo Advanced RMS Test Bed.

# *Cooperative Transparency for Nonproliferation – Technology Demonstrations at the Joyo Test Bed for Advanced Remote Monitoring*

**David Betsill* and Yu Hashimoto**
Japan Atomic Energy Agency

**International Workshop on Transparency Technology for Nonproliferation Cooperation in the Asia Pacific – Applications of Remote Monitoring and Secure Communications for Regional Confidence Building**

**Co-Sponsored by JAEA/NPSTC and the University of Tokyo GLOBAL-COE**

**Tokyo, Japan**
**20-22 February 2008**

*The speaker is on assignment from Sandia National Laboratories, Albuquerque, New Mexico. Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed-Martin Company, for the United States Department of Energy under contract DC-AC04-94AL85000.

## Building Regional Cooperation through Nonproliferation Transparency Technology

- Transparency technology & remote monitoring can advance the acceptance and confidence in regional nuclear energy and fuel cycle development
- A key concept in developing regional nonproliferation transparency monitoring is:
  - providing outside parties sufficient and appropriate data and information that they mutually define & evaluate,
  - using the their own independent methods,
  - resulting in greater confidence that the monitored party is acting within acceptable conditions.
- Concept & goals of cooperative transparency for regional nonproliferation:
  - engage regional entities in dialog and activities that would lead to regional technical cooperation on nonproliferation transparency
  - develop a possible remote monitoring data and information network
    - the basic technical components of individual systems are currently operational through existing, independent JAEA-SNL and KINAC-SNL-INL projects
    - a network could be expanded to include other entities and countries

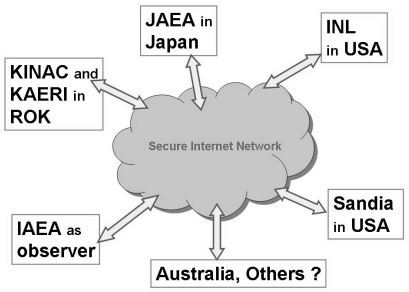
## New Monitoring Technologies can Enhance Transparency among Regional Entities

- Remote Monitoring for Cooperative Transparency
  - Builds on years of international development & tests
  - Can use combinations of commercial and IAEA approved standard technology
  - Flexible, functional-requirements approach
- Secure Communications
  - Virtual Private Network (VPN)
  - High-bandwidth Internet connections
  - Reduced costs
- Regional Networks Possible
  - Increase technical cooperation
  - Increase nonproliferation transparency
  - Increase Confidence Building and Trust

## Concept Development for a Regional Cooperative Transparency Technology Network

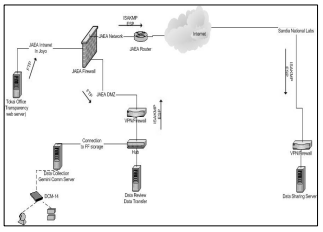
**Example**: **Future cooperation between Japan and the ROK may allow regional technology & information sharing, and network development**

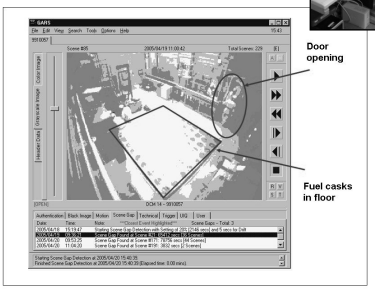
- Japan, ROK, & US as charter members
- Other regional parties could join
- IAEA as interested observer
- Sharing development of remote monitoring and secure communication technology
- Potential future sharing of nonproliferation or operational information for enhanced cooperative transparency



## Joyo Remote Monitoring System – Test Bed Upgraded in 2007

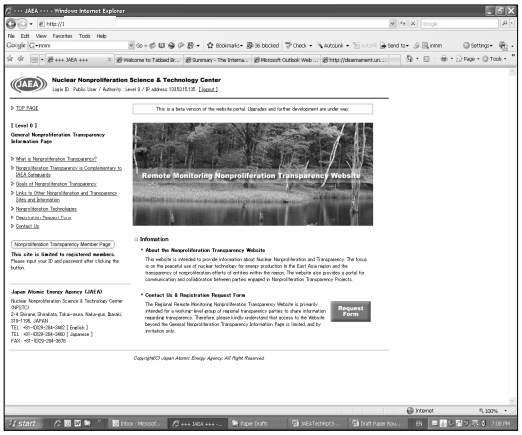
- **Remote Monitoring System Test Bed**
  - Developed over several years
  - Can be used for IAEA approved technology or emerging technologies
  - Provides a realistic site for evaluating new remote monitoring & transparency technologies
- **Upgrade: Streamlined and improved system, security, & information flow**
  - New fiber optic cabling from FF Room to SG Office eliminated >1km cabling to IT Center
  - New computer - Data Review / Data Transfer & upgraded GARS review software in SG Office
  - Computers remotely accessible for upgrades and trouble shooting
- **Enhancements make the system more reliable and suitable for a future Regional Cooperative Transparency Network node**



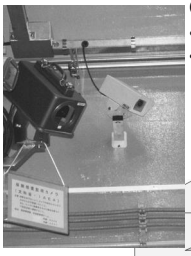



## Developed Cooperative Transparency Website Portal

- Portal Focus: Regional Nonproliferation Cooperative Transparency & Remote Monitoring
- General Access Area:
  - Introduction to Concepts
  - Nonproliferation, Transparency, & Technology descriptions
  - Links to JAEA, NPSTC, CMC, IAEA, KINAC, etc. homepages
- Authorized Visitors Only Areas:
  - Project Overview & Details
  - Network Portal for sharing agreed information
  - Future Regional Network Node
    - Remote Viewing of *Agreed Information* is Possible
- Undergoing Internal Beta Testing

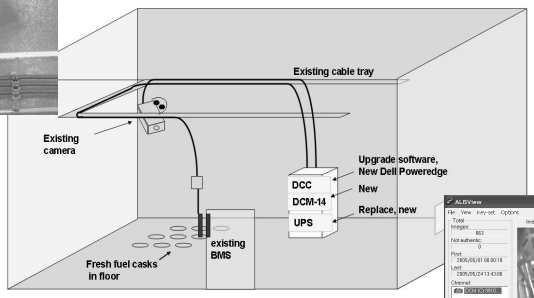


## Current Joyo RMS in Fresh Fuel Storage Room
## Remote Monitoring & Transparency Technology

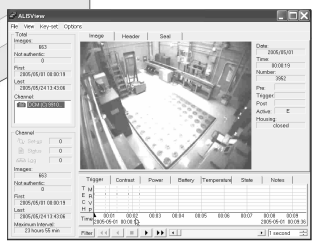


**Camera View**
- fresh fuel casks in floor
- door on opposite side of the room

**Secure Communications**
- virtual private network
- high bandwidth Internet



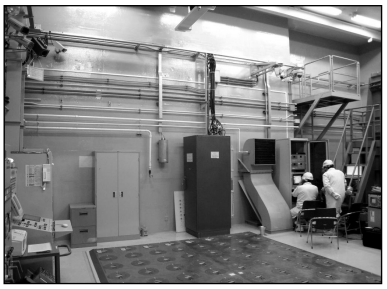

**Data Review Software**
- GARS
- ALISView

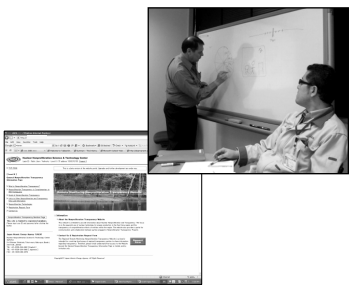


**Test Equipment**
- DCM-14 camera & controller
- door switch for external event trigger
- data collection computer

## *Currently Developing Joyo RMS Test Bed for Advanced Remote Monitoring Technology Demonstrations*

- Applications
  - ✓ Transparency
  - ✓ Regional Collaborations
  - ✓ Other Applications for technology R&D
- Advantages of using Joyo for Test Bed
  - ✓ Realistic conditions & constraints in operational facility
    - Field trials & evaluation
    - Comparison testing
  - ✓ Existing infrastructure, wiring, computers
  - ✓ User friendly; Operator supportive
- Initial Subtasks, Demonstrations, & Goals
  - ✓ Technology Testing & Evaluation
    - Hawk Digital Imaging System (HDIS)
    - Secure Sensor Platform (SSP)
    - Advanced Secure Communications
    - Web-based Transparency Portal Trials
  - ✓ Technology
    - Training
    - Transfer
    - Information Dissemination





## First Cooperative Transparency Technology Demonstration at Joyo RMS Test Bed –

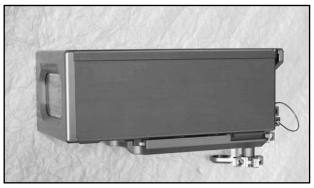
*HDIS Dual Camera Recorder, Jan. 2008*

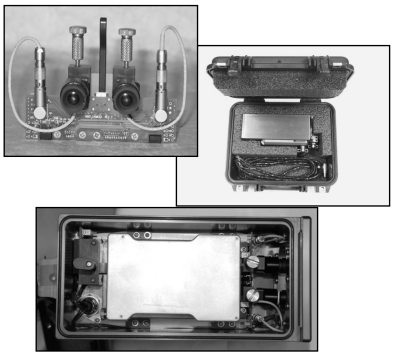
## HDIS – an Example of Complementary, Cooperative Technology Applications

- **Cooperative Transparency Applications**
  - Non-traditional approaches that promote regional understanding, cooperation, and confidence building are an emerging trend
  - The non-traditional area is complementary to a country's traditional approach to IAEA Safeguards
  - Cooperative transparency methods and technologies can play a complementary, but separate, role with Safeguards technologies to enhance regional cooperation
  - Exploring applications of Cooperative Transparency in this Workshop
- **Currently, HDIS is in limited use by IAEA as a complement to traditional Safeguards**
  - IAEA approach uses HDIS in a standalone, inspection-support role – *not* as part of a remote monitoring installation
- **Uses of HDIS and other technologies for non-traditional Cooperative Transparency are being considered for regional cooperation and confidence building applications**

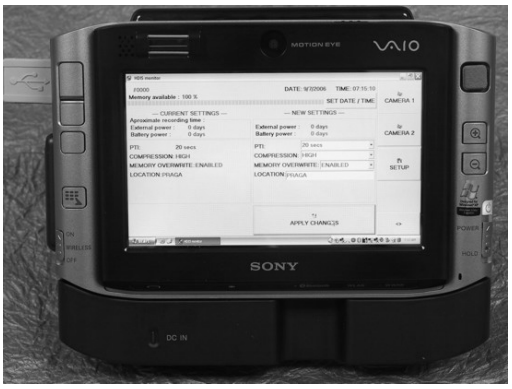
## Overview of HDIS System Specifications

- Hawk Digital Imaging System (HDIS)
- Records using two, high-resolution (1280 x 960) pixel, very low-light, color cameras
- Can be aimed independently
- Picture taking interval (PTI) can be set from 1 second to 1 hour
- Capable of capturing 5 frames/sec on both cameras
- Basic unit holds 425,000 high resolution pictures
- Captures 100,000+ sets of 2 pictures using internal batteries or external 12v DC input
- Optional “digital wireless link” under development for real-time data transfer and remote command support
- Watertight housing
- Easily portable carrying case





## HDIS Field Support Micro-PC Monitor




- Windows XP-based PC for field setup, parameter & status monitoring, and camera alignment checks
- Can use standard laptop or micro-PC

## Data & Playback Display from HDIS Demonstration at Joyo Advanced Remote Monitoring Test Bed


## Summary and Conclusions

- Remote Monitoring and Cooperative Transparency Technologies support regional acceptance of nuclear energy and fuel cycle development
- Interest by the regional community in non-traditional approaches that promote regional understanding, cooperation, and confidence building are an emerging trend, ***and*** are *complementary, but do not replace* a country's traditional approach to IAEA Safeguards
- Remote Monitoring and Cooperative Transparency Technologies are useful tools for regional confidence building – enhanced regional cooperation in nuclear nonproliferation and transparency is achievable
- The effectiveness and efficiency of remote monitoring & cooperative transparency technologies and systems are being demonstrated and evaluated at the Joyo RMS Test Bed for Advanced Remote Monitoring Technology
- Further refinement of the concept and demonstration of technologies for regional nonproliferation cooperative transparency and remote monitoring are under investigation

## 6.9 Transparency and Technology – Applications Across Industries

Susan E. Pickett

Ludlum Measurements, Inc

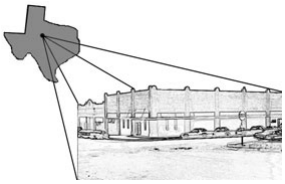
### Abstract

This presentation will briefly highlight what transparency means in other industries and sectors. Transparency is an important concept in the medical, energy as well as banking and computing sectors. The presentation will present two different technologies – one, used by the medical industry for tracking waste, and the other, a technology developed in the energy sector to foster on-line cooperation and collaboration across the globe. By looking at some of the important aspects to a "transparent" system in other sectors, the nonproliferation community may be able to generate new approaches to remote monitoring and transparency technology for use in nonproliferation and regional confidence building at nuclear energy facilities.

# Transparency Technologies across Industries

Susan E. Pickett
Ludlum Measurements, Inc

JAEA/NPSTC Workshop



## Overview

- Transparency in other industries
- Hospital area monitor system
- On-line communities and collaborative idea development
- Key characteristics

- Are there lessons, ideas for nonproliferation transparency efforts in the Asia region?

# Transparency and why it matters… other experiences

**Oil Industry:** Strengthening transparency enhanced oil transparency can also lead to **stronger accountability** and in turn can **contribute to improved governance and strengthened business confidence**.

*"Sunlight is the best disinfectant….Transparency helps stop corruption."*

**Health Care**: Transparency means providing *health care consumers* with the **information they need** – and the **means to interpret it** – in order to evaluate the quality of *care* provided by individual providers and institutions. *Transparency is the missing ingredient to truly informed choice.* ….

By maintaining a **focus on quality improvement and safety rather than penalizing providers or facilities**, transparency advocates are likely to gain greater acceptance and involvement from key stakeholders

JAEA/NPSTC Workshop

# Transparency …cont.

**Banking:** researchers found considerable evidence that supervisory and regulatory practices that focus **on transparency and public disclosure of information improve the efficiency and integrity** of bank lending when countries have effective legal systems, which could have implications on banks' IT infrastructures.

**Public Involvement and Waste Siting**: ..honest risk communication and **transparency cannot be added to an unpopular project like seasoning to a plate of food**. Both must have taken place before the start of the program. Public interest groups and knowledgeable, concerned citizens must first agree … it is necessary and appropriate.

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# Medical Sector: Area Monitor Network

- Hospitals are a small but frequent user of radioisotopes
  - waste includes such things as filters, cleanup rags, lab supplies, and discarded protective clothing
- Concerns
  - Minimization
  - Contamination
  - Efficient disposal
  - Cost/consequences
- Goals
  - Operate within public safety and regulatory statutes and guidelines to ensure dose limits are met
  - Efficiently identify radioactive wastes in order to ensure it is properly handled
  - Ensure management is notified properly if waste is mischaracterized
- Solution
  - LAN or web-based system of area monitors

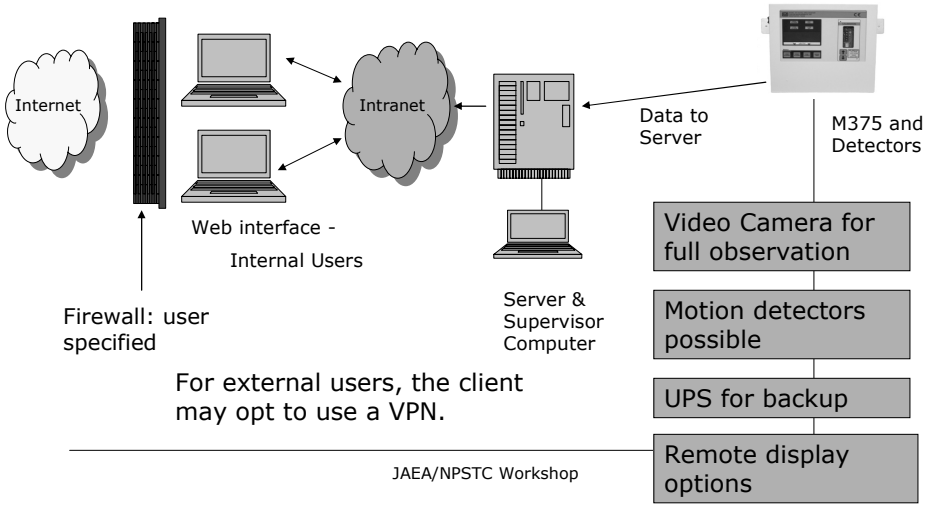
JAEA/NPSTC Workshop

# Area monitor system: Key Components

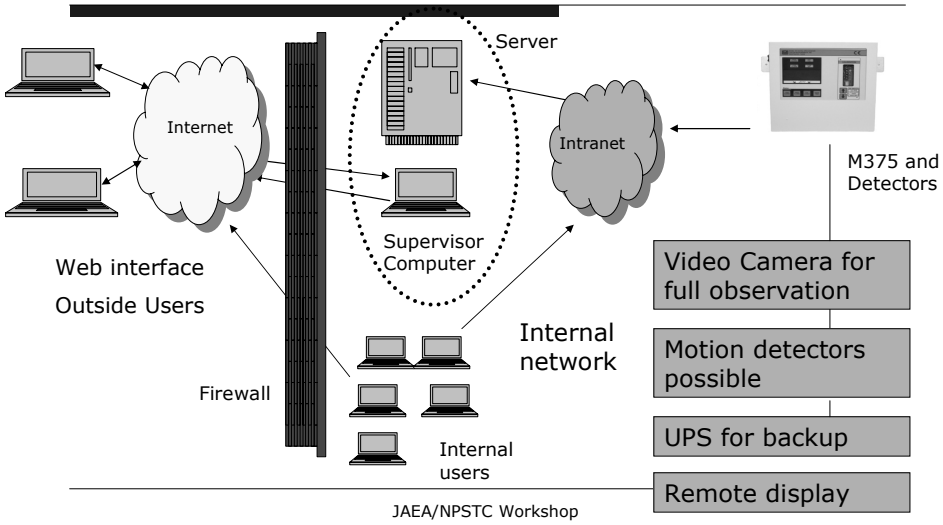
- Monitor: Video Camera
- Detector: Radiation Detectors – gamma, neutron
- Software/network: LAN or Webservice
  - LAN – capable of 50 detectors
  - Data logging to MS access database
  - Server Capability – MS server

JAEA/NPSTC Workshop

# System Diagram – internal system




# System Diagram – alternate external connection

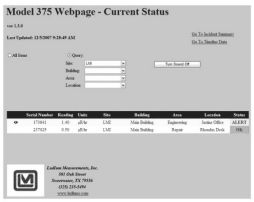


# The Web-based system – M375

- Monitors and stores data from up to 50 Ethernet-enabled Model 375s
  - Instrument readings and status are accessible to network users using a standard web browser.
- Communication System
  - Uses TCP/IP for basic communication across an Ethernet (LAN) Local Area Network.
  - Security system – firewall/VPN – user defined
- Program operates in background while the computer is turned on
  - allows more complete 24/7 data logging and webpage service
  - UPS
- WEBPAGE
  - Accessible by any network user with proper permissions using a standard web browser like Internet Explorer or Mozilla Firefox.

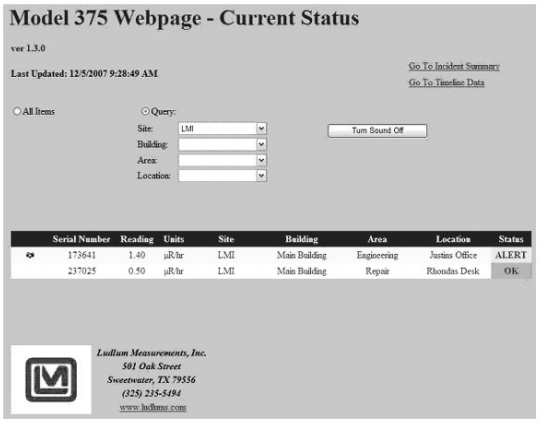


# Web interface




- Windows available
  - Current Status - Current status and reading of all or selected Model 375s
  - Incident Summary - List of alarms or failure messages of all or selected Model 375s over a specified time/date range
  - Timeline Data - graph of a particular instrument's radiation readings over a specified time/date range
- E-Mail Support
  - The E-mail Setting tab allows the configuration of the e-mail capability of the software. 3 sets of 10 e-mail addresses are available separated by shift number and by alarm category.
  - Often hospital staff work round the clock in shifts
- Camera Support
  - Optional Ethernet cameras can capture a picture of what triggers the alarm.

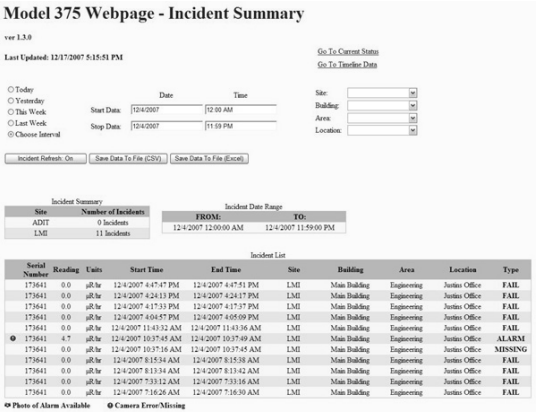
# Current Status Monitor




- Current status and reading of all or selected Model 375s

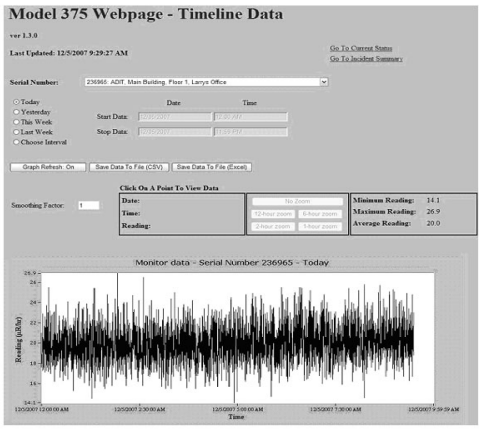


# Incident Summary Display




- List of alarms or failure messages of all or selected Model 375s over a specified time/date range

# Timeline Data




Query specific time

Zoom in on data

Smoothing option

Obtain Min/Max/ Average readings

- Graph of a particular instrument's radiation readings over a specified time/date range



# Video Monitor on LMI demo

# Summary: Area Monitor System

- Management needs to be confident that hospital waste is being managed properly
- Leadership support and decision
  - Clear goals, need to meet regulations and guidelines
  - Clear communication of goals to staff and technology supplier
  - Active support of the system
- Ease of implementation/installation
  - Easy to use
  - Compatible with current systems
- Ease of operation
  - Staff training/education
  - Review of data – 24 hours
- Cost



# On-line Collaboration

- The past 10 years have seen an increase in on-line communities and connectivity
- Such mechanisms can be used by industry and organization to **improve/enhance collaboration** within and outside the organization
  - How to promote innovation to improve operations, efficiency and effectiveness
  - While innovation is not new, how connectivity is affecting the process of innovation is…
  - A Fortune 500 Oil company wanted to improve internal innovation mechanisms as it eyed new business opportunities
- **What does this have to do with transparency??**

# Idea Generation Project Goals

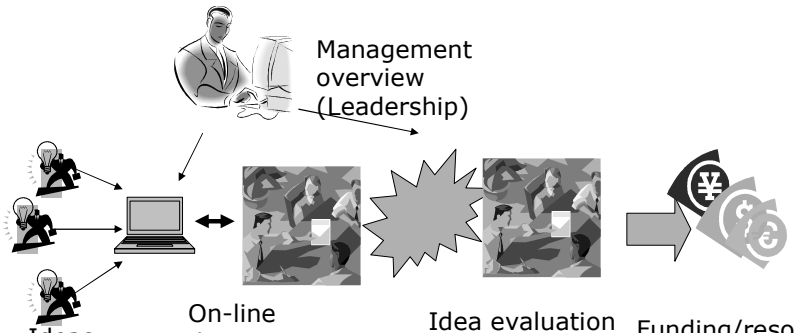
- **Promote innovation to improve operations, efficiency and effectiveness**
- **Open the idea generation process** to as many people within – and eventually- beyond the organization
- Create an idea capture and development mechanism that **enabled all parties to participate in the process**
- **Use collaborative discussions** to rate, provide feedback and eventually act on ideas
- **Devote resources** to maintaining and supporting the system
- **Provide incentives** for participation



# Idea Collaboration System

- System allowed employees to share, develop (contribute) and evaluate ideas
  - Share ideas
  - Comment on ideas
  - Attach supporting data
  - Champion the idea
  - Create a business solution
- Co-location was not necessary

# Idea Development Process




JAEA/NPSTC Workshop

# Summary: Collaborative on-line system

- What are the technologies and secure communication methods that can support **the goals** and **foster remote collaboration**
- How to encourage **active participation** of a range of employees and possible external interested parties
  - Incentives
  - Why will people care?
- What are the **modes to implement a system**:
  - Collaborations, training, and technology development
  - Ensure that the system operates adequately (RESOURCES)
- Defining **measures of success** (what is the process used in defining this success?)
  - Ideas are promoted
  - Recognition

JAEA/NPSTC Workshop

# Summary: Collaborative on-line system

- **Information sharing**
  - What is sufficient and acceptable to disclose, and to whom? Who gets credit? Security?
  - What is the format of the **data/communication styles**
- **Champion of the idea to bring it to fruition**
  - Interaction with upper management
  - **Trust** in the system – that the **leadership supports the effort**



# Some Transparency Characteristics

- Different levels of technologies
  - Full implementation
- Stakeholders/States
  - Sovereignty
  - Addressing and assisting concerns of States, Operators, Inspectors, and Public regarding nonproliferation transparency cooperation
- Information sharing
  - Availability of information and data
  - Format of sharing information – what are the communication styles/cultural challenges/opportunities
  - Technologies available
- Participation
  - Voluntary
  - Credible partners – investment in the process
  - Trust

# Conclusions

- Stakeholder involvement
  - Training, technology understandings
- Champion/Leadership
  - Support
  - Feedback/monitoring
- Incentive to participants
  - Understanding of the benefits
- Success
  - What defines success



# References


- Why Transparency in Maternity Care Matters: A Fact Sheet for Birth Advocates, http://www.lamaze.org/Advocacy/
- Banking reference: Professor Ross Levine http://www.econ.brown.edu/fac/Ross_Levine/ International Monetary Fund, http://www.imf.org/external/pubs/ft/pdp/2006/pdp02.pdf
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**6.10 Working Group Discussions on "Issues and Technologies to Achieve Trasparency Cooperation"**

# "Group Discussion"

## Issues and Technologies to Achieve Transparency Cooperation

**MODERATOR: Jor-Shan Choi**
**Secretariat: David Saltiel**

***Ground Rules :***

**1. Comment / Question: raise 1 finger**
**2. Counter argument / answer: 2 fingers**
**3. Moderator makes a list and prioritizes**

**Students Have Priority**

**6.10 Working Group Discussions on "Issues and Technologies to Achieve Trasparency Cooperation"**

# "Boundary Conditions"

## Transparency Technology for Nonproliferation Cooperation in Asia Pacific

**Implying:**
**Not Plant Safety, Physical Protection/Security, Environmental Releases, or Proprietary Technologies**

**For Asia Pacific Region**

- **Transparency deals with Information (Acquisition, Conveyance)**
- **Not Verification (e.g., No authentication, No 100% completeness, etc.)**
- **Based on:**
  - **Voluntary : e.g., to web**
  - **Mandatory (Obligatory) : e.g., for Safeguards**
  - **Cooperative (to serve useful purposes)**

**6.10 Working Group Discussions on "Issues and Technologies to Achieve Trasparency Cooperation"**

# “Issues”

- **Adequacy of current framework（with IAEA)**
- **Lack of a regional cooperative framework (stakeholders, responders, etc.)**
- **What can IAEA do to help?**

**6.10 Working Group Discussions on "Issues and Technologies to Achieve Trasparency Cooperation"**

# “Technologies”

- **Reducing duplication of efforts (How to use existing technologies required for security, safeguards, safe plant operation, etc. for transparency purposes?)**
- **Cost effectiveness to provide adequate degree of completeness (0 to 99%)**
- **What can IAEA do to help?**

**6.10 Working Group Discussions on "Issues and Technologies to Achieve Trasparency Cooperation"**

# “Cooperation”

- **Is there a need for a regional cooperative framework in Asia Pacific?**
- **Can cooperation be achieved without such a framework?**
  **(Yes, but transparency needs some kind of formality, such as a Memoranda of Understanding (MOU) among cooperative parties, a Terms of Reference (TOR) for transparency implementation, and a method of implementation (MOI) involving mutually-agreed technologies)**
- **What can IAEA do to help?**

## *7. Focus on Transparency Future*

Dr. David Betsill, Moderator

- Design Exercise for a Future, Hypothetical, Regional Cooperative-Transparency Network

- Workshop Roundtable Group Discussion, Summary, and Recommendations

22 February: On Day 3, the working group of experts and university students applied their skills and ideas during an exercise to develop and propose future, hypothetical, regional transparency designs, technologies, and approaches. Enhanced issue awareness, new ideas, and potential solutions to complex, interrelated issues applicable to nonproliferation transparency were among the goals and outcomes of this exercise.

The emphasis of the exercise was on creating acceptable solutions for various Stakeholders for nuclear nonproliferation, confidence building, and cooperative transparency. The outcome of this exercise will be used to help to define the requirements of future regional transparency systems, approaches, and networks, and to identify what new technologies and methods are needed to fulfill these goals. The exercise also provided valuable training of the university students, and a unique opportunity to work and interact with professionals who are experts in the areas of nonproliferation, transparency, and technology.

The Workshop concluded with an informal Roundtable Group Discussion and Summary, moderated by session leaders. The key ideas, notes, and comments from the entire three days of the Workshop were used to encourage discussions and dialog during the Group Discussion and Summary.

The focus was on summarizing the goals of cooperative transparency, identifying the key issues of different Stakeholders, and identifying the high-priority areas for research, development, and application of technology needed to address those issues and promote regional cooperation and confidence building for nuclear energy development in the Asia Pacific.


Student Session: University students designed and presented ideas, innovative and traditional technologies, and approaches for regional transparency.

*(Photo: Regional Applications Group Presenter – Lisa Kokaji, Univ. of Tokyo)*

## 7.1 Group Design Exercise – Instructions and Description

### University Students and International Experts
### Jointly Design a Hypothetical, Regional Transparency Network for Three Different Scenarios

A major goal of Day 3 was to engage and highlight the University Students and encourage interactions with the international Expert Group. The exercise also provided valuable training of the University Students, and a unique opportunity to work and interact with professionals who are experts in the areas of nonproliferation, transparency, and technology. The session also elicited new ideas from the Experts and Students for applications, methods, and technologies for Cooperative Transparency.

Goals of the Exercise were to:

- Better understand Transparency issues, context, relevant technologies, and applications of "cooperative transparency"
- Encourage interaction between Experts and Students as the next generation of nuclear experts
- Develop new ideas for technology R&D

The Students presented their Assignment (Scenario and draft Design) to the entire group. Then, the Expert Group worked with the students and to make suggestions on how to better improve the overall Design for each Scenario.

In the afternoon there was a group Roundtable Discussion. The entire group of Experts and Students discussed the challenges, and potential solutions, to Cooperative Transparency that were brought up over the course of the entire Workshop. A key outcome of this session was the identification of key issues, and ideas of new and existing technology to help solve those issues.

Group Design Exercise Assignment:

Based on current university class work, personal experience, and participation in Days 1 & 2 of the Transparency Workshop, the university had the following Assignment. The Assignment was handed out in advance so that the Students could focus their attention and seek relevant information during the sessions on Days 1 & 2 to complete the Assignment.

The University Students divided into three Teams representing the three Stakeholder/Scenarios, below. These three Stakeholder/Scenarios reflect some of the key Presentations and Panel discussion topics on Day 1.

Three Stakeholders/Scenarios:
1. Domestic Applications: Operator-to-Regulator/Inspector
2. Bilateral Applications: State-to-State
3. Regional Applications: State-to-Multilateral/Public/NGOs

Assumptions:
- Current nuclear facilities and global situation.
- Cost is not a factor in these examples, but the designers need to be reasonable in their approach so that their Design will be acceptable by their funding agency.

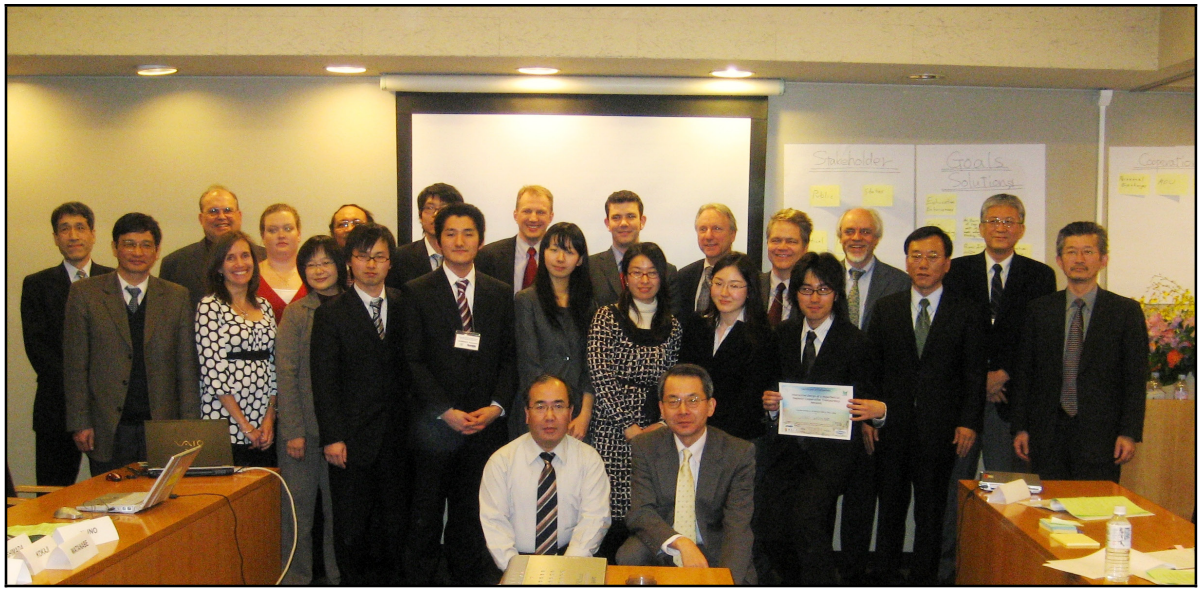
Questions and Assignment:
- What is the Confidence Building Measure and what are the goals of Transparency in the CBM for their Scenario?
- How does the Stakeholder define Transparency for their Scenario?
- What are the primary issues facing the Stakeholder regarding their Transparency and Remote Monitoring Scenario – Technical, Political, Other? Please describe.
- What type of information and data are they willing to share? With whom are they willing to share this information and data? How do they think this will help encourage Transparency and Cooperation? What sensitivities do they have with this information and data?
- Design a draft of a simple Hypothetical Transparency Remote Monitoring System for nuclear nonproliferation transparency for your Stakeholder group and Scenario. Please include the sensitive items or processes monitored, sensors and communication tools used, and type and content of the information and data that are proposed to be shared. The draft Design will be presented, reviewed, and refined during a joint discussion with the international Expert Group.
- Based on your Scenario and Design, what new technologies, methods, or procedures are needed in order to enhance the success or effectiveness of the Hypothetical Transparency Design Scenario?

Format:
- Informal presentations and discussions were conducted by each Team; but with the attitude of one, flexible, large working group that included the Experts and other participants and students.
- Materials such as paper Post-it charts and PowerPoint were provided for the presentations.
- Simple in presentation style and format. Each Team will had one hour to make their design presentation and receive feedback from the Expert Group.

Design Presentations and Interaction with the Expert Group:

One-by-one, each Team reported on their Assignment, and then presented their draft Design and ideas for their Scenario. Each draft Design presentation was followed by interactive critique and a team re-design working directly with the international Expert Group. The Expert Group provided their experience, advice, perspective, and encouragement while working with each Team to improve their hypothetical Design for each Scenario. The other Teams observed and contributed as appropriate. Key ideas, notes, and comments were captured by the Session Secretary for later Group Discussion. Each Team had one hour for their presentation and re-design with the experts.

A summary of the Group Design Exercise is captured in the Session Notes.



Group Design Exercise – University Students and International Expert Group

University Students receive certificates of completion for the Group Design Exercise from David Betsill, Session Moderator. Yuko Kawakubo, Univ. of Tokyo (left), and Tomooki Shiba, Tokyo Institute of Technology (right).

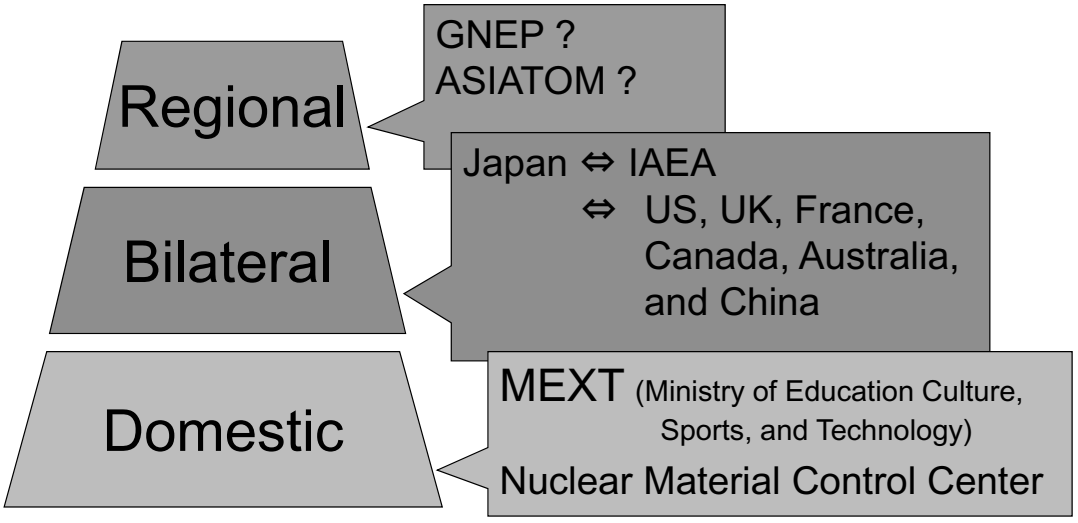

Certificate of Completion

**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**

# Transparency between Domestic Regulator and Operator

**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**

# Hierarchal Framework of Inspection @Japan



**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**

# Domestic Inspection in 2006

| Type of Site | Number of Facility | Amount of Inspection [man*day] | | |
|---|---|---|---|---|
| | | METI | NMCC | Total |
| Fuel Processing | 6 | 29 | 283 | 312 |
| Reactor | 79 | 124 | 406 | 530 |
| Reprocessing | 3 | 18 | 1439 | 1457 |
| Use of Nuclear | 171 | 10 | 495 | 505 |
| Other | - | 117 | - | 117 |
| Total | 259 | 298 | 2623 | 2921 |

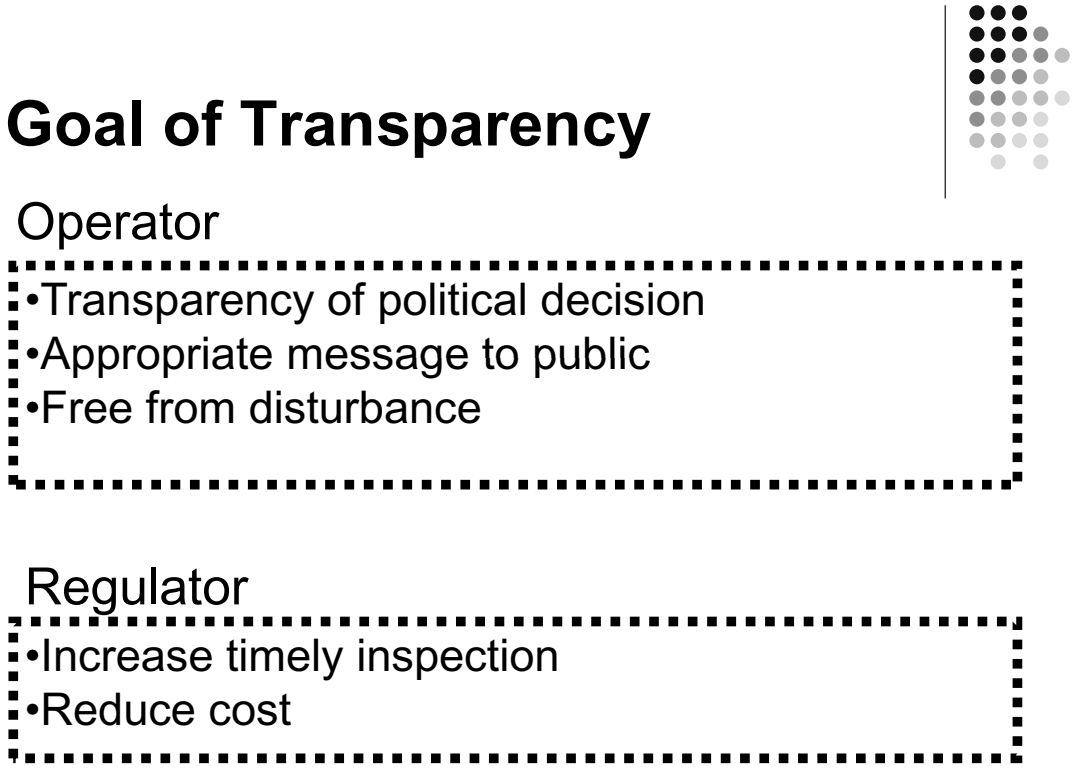
**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**

# Who are the stakeholders?

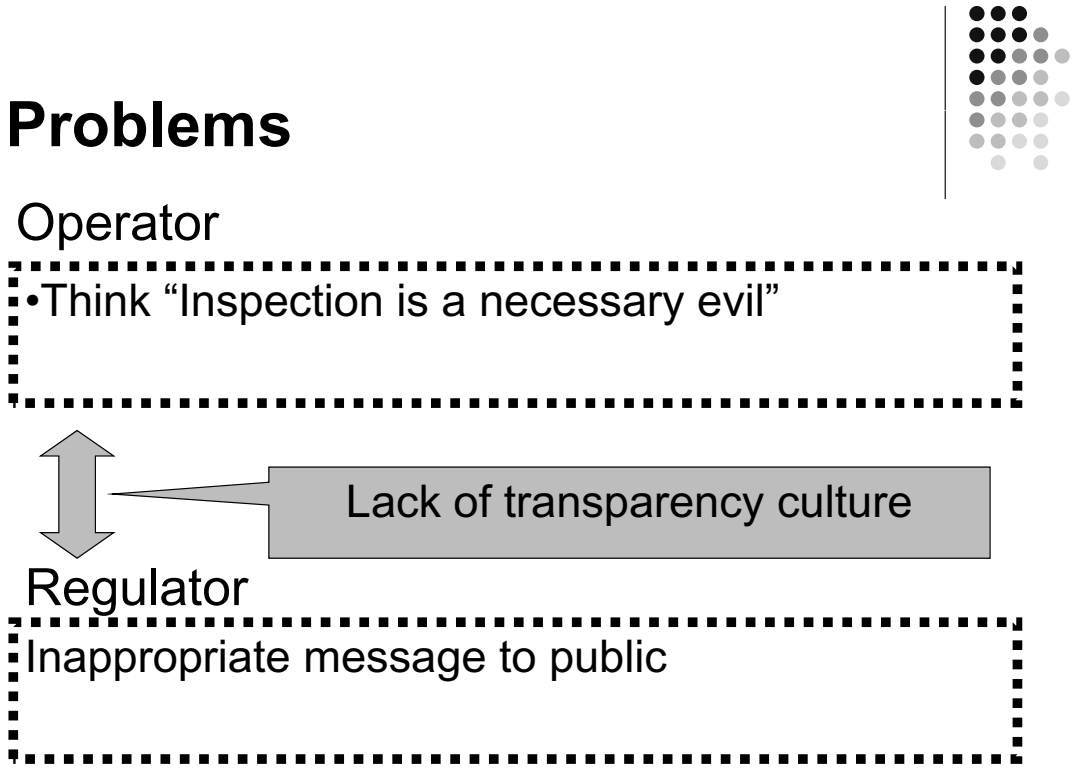
- Operator (power companies, JNFL)
- Regulator (MEXT & NMCC)
  - Public: Rarely care about safeguard
  - Academia:

    Definition of safeguard is already discussed

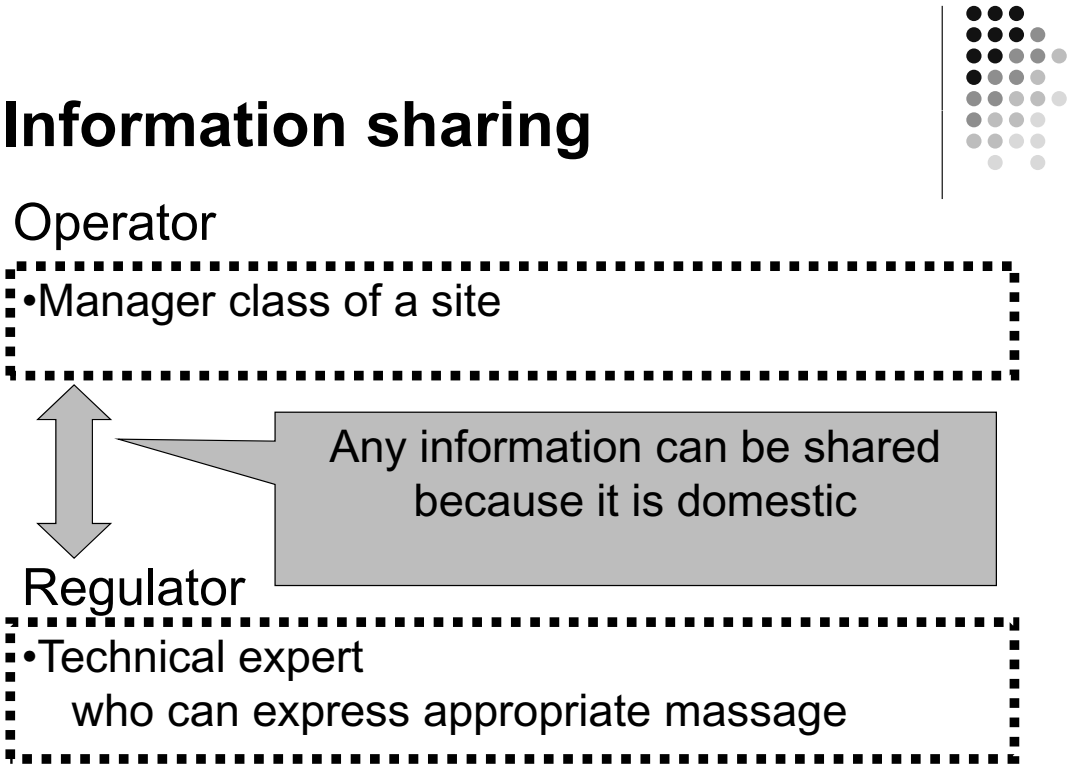
**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**




**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**



**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**

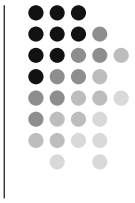



**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**

# What information should be shared?

- Information about abnormal operating around fuel
- Monitor of
  - Spent fuel pool
  - Pressure vessel head
- Transportation of fuel
  - Serial number of assembly
  - Enrichment, Burnup

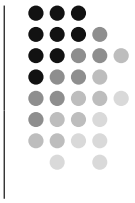
**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**



# Conclusion

- Lack of transparency culture is the problem
- Any information can be shared

**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**

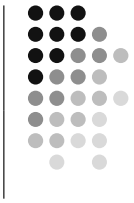


# ASSUMPTION

- If we do not establish the above confidence building…

What will happen??

**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**



- Consequence 1

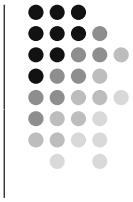
The operator may sell nuclear fuel to terrorist！！

- Consequence 2

The operator may sell nuclear fuel to malicious country！！

They are the crisis of nonproliferation.

**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**



**So we need transparency.**

Now, we have some ideas to promote nonproliferation.

Let’s see them.

**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**

# item 1

- We suppose GPS transmitter that directly put in a fuel rod.

Why is it useful?

Because we can track the fuel rod to prevent exportation at port, airport and other places.

**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**

# item 2

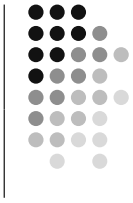
- Radiation monitor which installed at above the reactor pressure vessel.

Why is it useful?

Because it can monitor whether fuel rods are extracted secretly.

Why Japanese government set it, now?

**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**



# Last suggestion.

We worry about security of information transmission.

Around the world, there are many cracker.

If more information is shared, the risk of cracking is increasing.

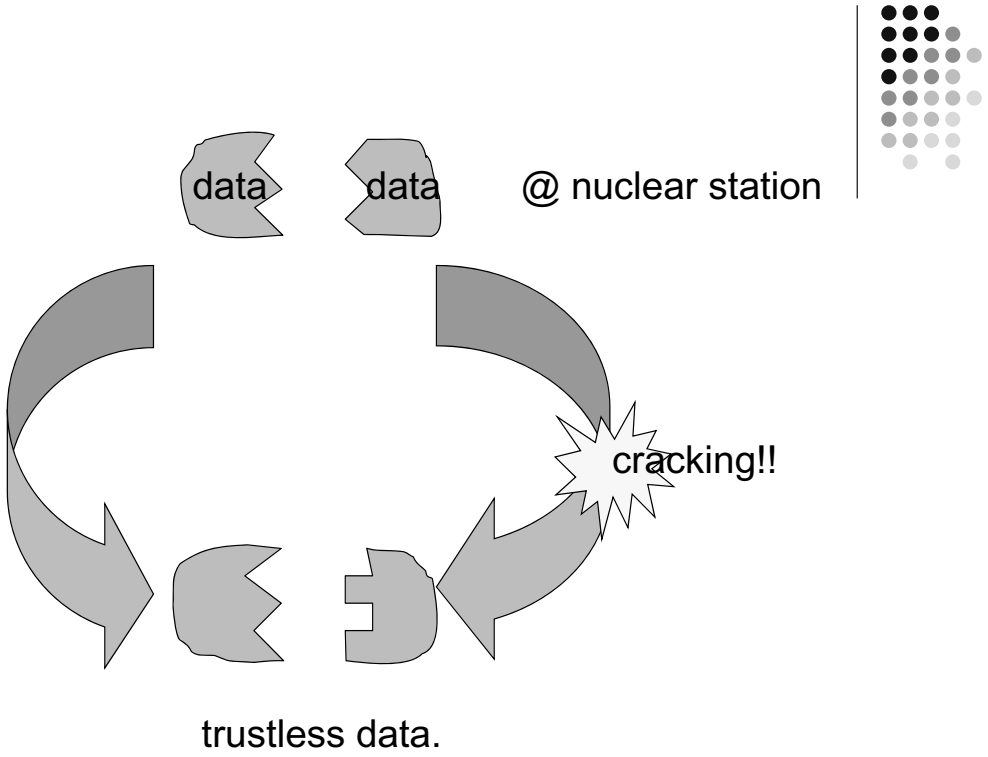
How do we solve the problems?

**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**

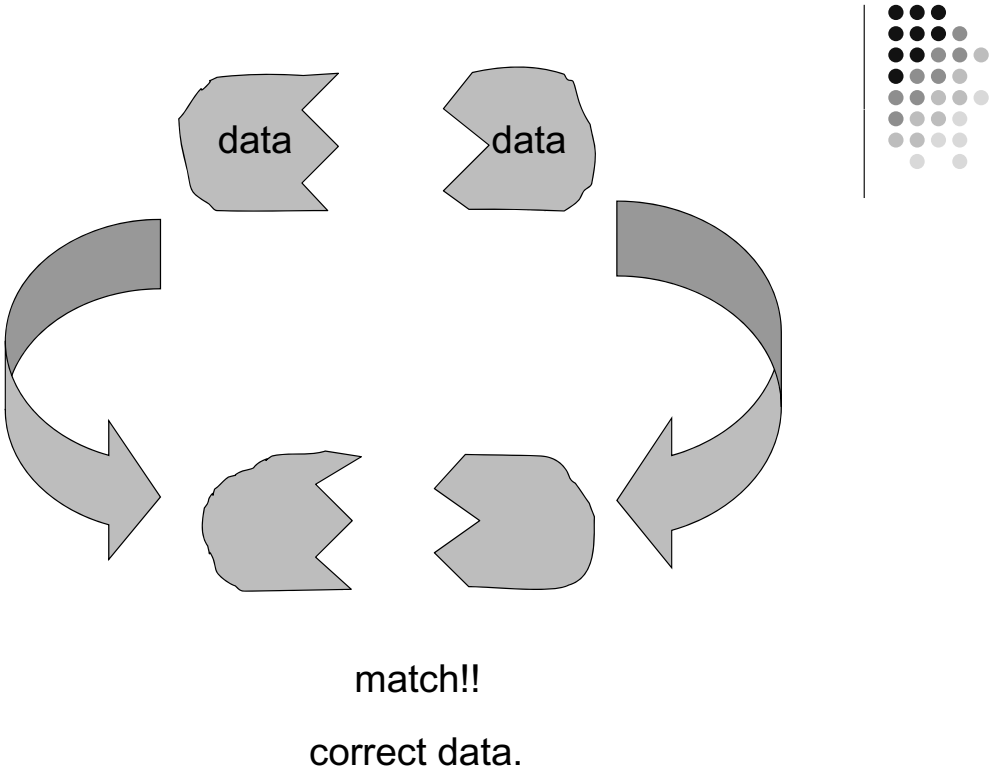
# Two ways transmit information

We divide the information in two and send each in different internet route. If someone falsifies an data and the combined data doesn't make sense, the receiver judges the information is wrong and don't trust the data.

**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**




**7.2 Domestic Applications: Transparency Between Domestic Regulator and Operators, Group1**



# State-to-State Transparency

Eri NAKATANI
Yoko KAWAKUBO
Hideaki FUTAGAMI

7.3 Bilateral Applications: State-to-State Transparency, Group2

## Index

7.3 Bilateral Applications: State-to-State Transparency, Group2

# 1.Assumption

- State: DPRK and Japan *in the FUTURE*
  Both countries have no intention of diversion

| | |
|---|---|
| DPRK | ➢Post six-party nuclear talks<br>➢On the process to get back to the international society<br>➢No intention of diversion any more<br>➢Nuclear activities are not banned<br>➢R&D reprocessing facility exists |
| JAPAN | ➢No intention of diversion<br>➢Present nuclear activities remain |

7.3 Bilateral Applications: State-to-State Transparency, Group2

# 2. Definition

- ***Both countries share sufficient information with which they can confirm that the other has no intention of diversion***

7.3 Bilateral Applications: State-to-State Transparency, Group2

# 3.CBMs and Goals of CBMs

- **CBMs**

**1. Transmission of operation information - Government level**

**2. Remote monitoring**

**3. Mutual Inspection**

**4. Transmission of operation information - Operator level**

- **Goal of CBMs**

*Each country acquire sufficient information which makes them assured that not more than significant quantity of material is missing in the other country*

7.3 Bilateral Applications: State-to-State Transparency, Group2

# 3.1 Transmission of operation information - Government level

- **Information should include**
  - ***Composition, Quantity and Location of nuclear material***
  - Operation/ Shipping Schedule
  - The image of facilities when reconstructing

- **Information of material accountancy should be transmitted *at Real Time, in ideal…..***

**7.3 Bilateral Applications: State-to-State Transparency, Group2**

# 3.2 Remote monitoring

- **As a complementary measure**
-

**7.3 Bilateral Applications: State-to-State Transparency, Group2**

# 3.3 Mutual Inspection

| Activities | Actors | Benefit |
|---|---|---|
| ●AP-based Inspection which includes<br>- Complementary access (together with IAEA) | ●Inspection Specialists | ●Verify that Information transmitted is correct<br>●Make sure that no other facilities are used for diversion |
| ●Mutually visit nuclear-related facilities (without IAEA) | ●Specialists +people from the government official | ●Give assurance to each other<br>●Both countries accumulate the knowledge of facilities in the oth[illegible] |

Strongly guide to

***Confidence Building***

7.3 Bilateral Applications: State-to-State Transparency, Group2

# 3.4 Transmission of operation information - Operator level

| Type of Information | From who to whom? | Benefit |
|---|---|---|
| ●Composition and Quantity of nuclear material(or more easy to understand images)<br>● Lug is needed<br>● Location should be kept confidential<br>(from the aspect of PP ) | ●From operators<br>●To the Public<br>- Whoever wants to acquire the information can access the website | ●***Confidence Building at public level*** |

7.3 Bilateral Applications: State-to-State Transparency, Group2

# 4.Primary Issues

| Present Issues | Possible solution |
|---|---|
| **Nuclear Activities in non-declared facilities** | **●Complementary access**<br>**●Satellite images** |
| **Import of nuclear material** | **●Exchange trading record** |
| **Leak of technology/ knowledge to other countries/ terrorists** | **●?** |

7.3 Bilateral Applications: State-to-State Transparency, Group2

## 5. Designing a transparency remote monitoring system


7.3 Bilateral Applications: State-to-State Transparency, Group2

## 5. Designing a transparency remote monitoring system

- Monitor the reprocessing site and every storage.
- Monitor while Plutonium is stocked, transported.
- Real time
- Encrypted, transferred by the Internet.
- Scanned randomly, any time.

7.3 Bilateral Applications: State-to-State Transparency, Group2

# 6. A new technology that can enhance the transparency design scenario

- A technology that can be used to detect the composition of the material in real time.

  eg) laser dispersion

⇨ will not allow DPRK to divert Pu to nuclear weapons

7.3 Bilateral Applications: State-to-State Transparency, Group2

# 7. Conclusion

- we define Transparency as

  ***Both countries share sufficient information with which they can confirm that the other has no intention of diversion***
- Possible CBMs

  1. Transmission of operation information - Government level
  2. Remote monitoring
  3. Mutual Inspection
  4. Transmission of operation information - Operator level
- A remote monitoring system
  - Monitor while nuclear material is stocked and transported.
  - Real time, encrypted and transferred by the Internet.
- A real-time detection of nuclear material

# Regional Applications : State-to Multilateral / Public

Kazumasa Shimada
Lisa Kokaji
Mikio Watanabe
Soichiro Katsumura

7.4 Regional Applications: State-to-Multilateral/Public, Group3

## Outline

1. State to Multilateral
   Advanced Transparency Tool

2. Transparency for Public Communication

# Confidence Building Measure

- 1.Image data available in the interested area inside and outside facility

- 2. Emergency response system including technology (Information sharing necessary for response)
- Cooperation among the states: region and effective information exchange

7.4 Regional Applications: State-to-Multilateral/Public, Group3

# Definition

- The availability of information that allow;

- 1. Nuclear material and technology limited in legitimate purpose
- 2. Nuclear Activity based on the adequate environmental assessment.

- Establish the Confidence of regarding Nuclear Activity in the Asia region

7.4 Regional Applications: State-to-Multilateral/Public, Group3

# Issues

- Advantages
  - Building the regional confidence
  - Reduction of man power
- Disadvantages
  - Expense of installation
  - Information leak (Sensitive and managed information)
    - Facility structure
    - Material location

7.4 Regional Applications: State-to-Multilateral/Public, Group3

# Sensitive & Managed Information

- Facility image (depending on location )
- Material location and quantity (depending on material type)
- Transportation nuclear material

7.4 Regional Applications: State-to-Multilateral/Public, Group3

# Required data

- Direct data
  - Facility image
  - Material location and quantity
  - Operation schedule as planned
  - Transportation nuclear material
- Indirect data
  - Additional information may contribute confidence building in nuclear nonproliferation
    - The suspected place in facility
      - EX) Knowledge continuity, Space to make Pu
    - Clandestine facilities

7.4 Regional Applications: State-to-Multilateral/Public, Group3

# Design

- Application of 3D Virtual Remote Monitoring
  - Real time graphic Processing
  - Progressing interface technology
    - EX) Tangible Bits
  - Practical Realization of Rescue Robot
    - Ability to access to dangerous and narrow space, etc..
    - Remote Control with monitor
- Integration of the interface technology and Robot technology
- Remote Monitoring and Controled Robot

# Benefits

- Dynamic and flexible monitoring
- Limited access view by the computer programing
- Reducing manpower
- High-Radiation / Temperature area
- Applicable to maintenance work / Emergency work

Advanced Transparency Tool

7.4 Regional Applications: State-to-Multilateral/Public, Group3

For public

**7.4 Regional Applications: State-to-Multilateral/Public, Group3**

# My image of Transparency

Yasuo Tanaka
Governor of Nagano prefecture

His office wall ⇒Glass
It is Transparency

It looks like zoo.

**7.4 Regional Applications: State-to-Multilateral/Public, Group3**

# Nuclear material is like animal?

- Nuclear material is not like panda but beast.
- Beast must be enter in strong cage.
- Nuclear material must be enter in radiation shielding

# Is it familiar with zoo on web?

- We are familiar with seeing something with our own eyes.
- It is impossible for all people to attend nuclear facility.
- Make the interesting TV program

7.4 Regional Applications: State-to-Multilateral/Public, Group3

# My idea of transparency to public

- To make a documentary TV program.
- On ~~animal planet~~ Discovery channel
- Discovery Channel can be watched many country.

# Transparency using TV program

- Very famous people (movie star, musician)

Attend to nuclear facility.

- Viewer study about atomic energy with TV host.
- Using Computer Graphic to explain nuclear energy.
- Atomic energy, radiation cannot be see.
- To spread two-way communication TV (wanseg) we can estimate the affect of this TV program by questionnaire survey

7.4 Regional Applications: State-to-Multilateral/Public, Group3

# Instance of TV title

- GO to Nuclear facility!
- 「突撃！隣の原子力施設」
- Famous person visit nuclear facility with video camera
- Trace for spent fuel！
- 「使用済み燃料を追え！」
- To trace spent fuel from generate to disposal.

# Problems

- What is the limitation to be able to take a TV?
- To trace Translation of spent fuel is to give the information for terrorist

7.4 Regional Applications: State-to-Multilateral/Public, Group3

Thank you for your kind attention!

## *7.5 Group Design Exercise Session Discussion Notes*

## Group Design Exercise

## University Students and International Experts Jointly Design a Hypothetical, Regional Transparency Network for Three Different Scenarios

Marius Stein, Secretary

**Group 1 – Domestic Applications: Operator to Regulator/Inspector**
Presentations by Murakami-san and Shiba-san.

Comments/Questions
Hierarchical approach as presented (domestic–bilateral–regional) should include international aspects: Japan – IAEA (as stakeholder of many countries) as top-level regional participants

Transparency between operator and domestic (national) regulator… is this really transparency? Or rather a duty?

Regulator enforces the law. Safeguards starts from mistrust and calls for verification.

Transparency of information; or rather, transparency about the relationship between Regulator and Operator? Public as actual recipient of information (as third stakeholder)?

Industry – voluntary measures possible. Not necessarily to support national safeguards but for other reasons (business).

Establishing a culture of openness and trust is more beneficial than enforced compliance.

Need to build respect and understand each other's functions – knowledge enhances trust. Partnership approach.

Operators are not equal – need to distinguish factions and work towards common understanding. Vision on how to promote safeguards is missing – suitable, complete infrastructure exists, does it need to be enhanced? Where do we take action?

Education is critical (university system is playing a strong role). In general, in the field of physics there are many visions and dreams of promising and exciting research which are missing in the nuclear sector (which has a more commercial focus).

Two proliferation scenarios (sale to terrorists, rogue state) – are there others? Others risks exist, not necessarily proliferation related, such as nuclear accidents (safety).

Proposed Technical Ideas and Approaches
GPS to track fuel rods and prevent export.

Proposals for tracking separated plutonium? Could be used by terrorist groups or rogue countries. In general other risk areas exist that should be addressed in similar ways as those presented in the presentation.

Dual-use monitoring technology idea is important! Cost effectiveness should be a realized goal.

Proposals – How to prevent unauthorized access to data? How to defend data? Common data protection mechanisms are already in place, but the hackers are getting smarter. Suggested methods to complement the existing regime.

**Group 2 – Bilateral Applications: State-to-State**
Presentation by Nakatani-san, Kawakubo-san, Futogami-san

Comments/Questions
Wide range of activities covered (from no trust to full trust) during the Workshop, but one aspect is missing: how to go about disarmament of (presumed) nuclear weapons in DPRK. What measures would be needed to assure complete disarmament? US-Russian disarmament efforts verification could serve as an example.

Practical transparency measures – What can be done today, in general (also applicable to other countries in the region) regarding transparency and transportation. Specifically, what kind of transport monitoring measures are in place already today? How can these measures be enhanced, or used, for regional transparency and public assurance?

Public transparency can have downsides, as well (protests, etc.).

An important dimension of transparency was elaborated in the presentation – that is the measure of time related to the success of a transparency measure. What is the longer/long-term perspective of transparency goals?

Proposed Technical Ideas and Approaches
Important to explore public information and education efforts and opportunities to increase transparency, understanding, and openness.

Mutual inspections: The NPT, Safeguards, and the Additional Protocol already exist – thus bilateral involvement in Complementary Access inspections, or mutual inspections in general, might not be cost-effective due to the disruption on plant operation. This is one of the main reasons the IAEA exists since it limits transparency building through inspectors to a single party. Peer review of information, however, might be better than actual inspections by a third party.

Could personnel exchanges be an alternative to mutual inspections? Yes, the informal aspect of personnel exchanges by parties visiting each other is a very important aspect that would not be realized by formal mutual inspections. Mutual inspections could not just happen overnight – little steps are needed to slowly build up the trust.

Need to identify the level of willingness regarding what data should and can be shared, given other sensitivity concerns.

Technology idea – Laser Dispersion technology: method to detect trace signatures from nuclear processes.

**Group 3 – Regional Applications: State to Multilateral/Public/NGOs**
Presentation by Shimada-san, Kokaji-san, Watanabe-san, Soichiro-san

Comments/Questions
"I want to see with my own eyes" is important and will never go away.

Information needs to be transmitted to the public! As early as possible. Dedicated TV channel might not be realistic, and the Internet medium is more easily accessible, *but* TV is a much stronger medium!

Public relations activities on the operator side is equally important. Visitor centers, educational programs, science programs.

What kind of information should go to the public? Make public familiar with nuclear energy issues and industry to understand the nature of procedures, also of challenges/problems, and especially the benefits (energy, medical, food irradiation, etc.)

What is the long-term goal of information? What is the public interested in on a regular basis? Public doesn't need real-time data, but rather a way to be and stay informed about the general status of things whenever they desire.

Does the public need insight into the real, safeguards-relevant data stream?

Proposed Technical Ideas and Approaches
Joint work on emergency response might build up transparency between multiple parties.

Remote monitoring data to be used to construct 3D models. Can input/sensor data be included in the model? Yes, but might not be cost-effective/efficient.

Robot-Inspector: Very interesting idea for Safeguards/IAEA for use in areas not easily accessible for humans – future tool. "Radiation hardened humans are harder to build than radiation hardened instrumentation or robots."

In addition, robots could use LIDAR technology to scan facilities as they move about. Robots are already used to collect samples and transport them to analysis.

Not every detail might be needed for public view, perhaps knowledge of changes or occurrence of problems might be sufficient. Robots could be designed to only collect such "indicator" data rather than sensitive data about general operation of the facility.

**Suggested Outreach Opportunities for University Students, Public, etc.**
Student conferences, workshops
INMM Japan Chapter
Education
Student seminars on a monthly/bi-monthly basis
Blog/Forum format via the Internet

**Closing Comments by the University Students**
Universally, the nuclear energy students expressed their pleasure and appreciation for inclusion and active participation in the Workshop. For many, this was the first opportunity that they were able to participate as a "full member" of a professional meeting of experts, asked for their input and opinion, and able to express their ideas in an open forum. They reported that they gained useful knowledge and insights, not only regarding the technical aspects of the Workshop subject, but also valuable experience in the conduct and self-participation in such events.

## *8. Final Workshop Summary Notes and Combined Group Discussions from Days 2 & 3*

## "Issues and Technologies to Achieve Transparency Cooperation"

David Saltiel, Session Secretary (Day 2)
Susan Pickett, Session Secretary (Day 3)

**Roundtable Group Discussions and Workshop Summary**

The concluding session included an informal Roundtable Discussion and Summary of the entire Workshop by the assembled Group. The key ideas, notes, and comments over the course of the Workshop were used to encourage discussions and dialog during the Group Discussion. The focus was to summarize the goals of Cooperative Transparency, identify the key issues of Stakeholders, and to identify the high-priority areas for research, development, and application of technology needed to address those issues and promote regional cooperation and confidence building for nuclear energy development in the Asia Pacific.

A synthesis of the Workshop by the participants is presented below.

**Problem/ Goal/ Mission Statement**
Identify mechanisms, *in addition to and complementary to traditional international safeguards*, to reduce concerns about state proliferation involving the misuse of technology, facilities, or diversion of material from civilian nuclear energy programs in the Asia Pacific region.

And also, reduce concerns that there are no undeclared activities.

**Stakeholders**

- States in the Asia Pacific region
    - The concern of one or more state(s) regarding the intentions and behavior of another state, or group of states.
    - States are not monolithic. There are many interests groups within states, each with potentially different types of concerns.
- Operators of civilian nuclear facilities
    - Operators may be affected by the concerns of other stakeholders and the mechanisms employed to address those concerns.
- Research and development (R&D) and educational organizations
    - R&D and educational organizations may be asked to develop mechanisms to address concerns.
- International Atomic Energy Agency (IAEA)
    - Concerns by stakeholders may undermine the credibility of the IAEA.
    - Mechanisms, such as nontraditional or cooperative transparency, to address such concerns may also help IAEA perform its function.
- Public – "Who" are the public? Multiple groups or opinion leaders?
- Future stakeholders, for example an Asia version of ESARDA, etc.

**Concerns of Stakeholders – What is driving concerns regarding Proliferation?**

- The unknown or suspected capabilities, technologies, and intentions or other entities or states.

- Possession of sensitive technologies by other states.
- Possession of sensitive material (especially Pu, separated Pu, inventories) by other states
- The existence of factors which may increase the demand for nuclear weapons by other states. (For example, the possession of nuclear weapons by the DPRK may be so threatening that it drives other states to seek nuclear weapons. Or, potential military activities, political changes, or other factors that may increase tensions in the region.)
- Broader geopolitical and historical tensions can also increase suspicions.
- Insufficient provision of information to address nonproliferation concerns (communication exchanges).
- Lack of trust (Comment – perhaps unfounded, but persistent; what are the specifics of this lack of trust?).

**Approaches to Addressing Concerns**

- Improve understanding of the roles and functions of the IAEA (the concerns of some stakeholders may be reduced through a deeper understanding of what the IAEA does to ensure peaceful use of nuclear energy capabilities).
    - Education about IAEA
    - TV shows, media
- Increase transparency about the current and future fuel-cycle activities and their rationale (certain activities may raise fewer concerns if there are reasonable explanations for them or if they are not surprises to other stakeholders).
    - More robust technical collaboration among states may have a similar effect
- Interactions between states
    - Personnel exchanges
    - Joint research
    - Educational exchanges
- Strengthening IAEA safeguards system
    - Resources
    - Capabilities
    - Timely release of information to member states
- Raise public awareness

**Questions and Comments**

- What do we need to do to move member states to allow the IAEA to release safeguard relevant data to states?
- The ability to draw independent conclusions cannot be impacted.
- All data can be shared if the ability to draw independent conclusions is not impacted – if the state agrees. (IAEA protects the interest of the state so that the State will continue to provide the information).
- If we introduce the probability/possibility that the transparency information is not complete we could possibly create more issues.
- Strengthening efficiency and effectiveness of the present safeguard system will automatically increase transparency.

**Future Technology and Directions**

- Includes hardware, software, and combinations thereof.
- Further work is needed to evaluate the needs of stakeholders before technology requirements can be identified.

- Current technologies exist in different areas – evaluate new applications for existing technology or new approaches/ modifications for the use of existing technology.
- New technologies are needed as well.
- Enhanced detection technologies
    - Laser based detection systems
    - Material tracking systems
- Satellite
- Robots – reduce inspector days, can access difficult areas
- Integrated remote monitoring systems
- Education technologies
    - Internet
    - Video conferences
    - Transparency blog
    - PC conference (use of multiple computers to record participants comments during workshop)

**Considerations**

- Cost – Can cooperative transparency help to offset traditional costs? Dual use monitoring?
- Practical concerns – How can the IAEA operate under resource constraints and also adequately address the future nuclear renaissance? Added value – is the state/ host country willing to pay for additional activities?
- Type of information – What is needed/ adequate for the various stakeholders? Case-by-case basis.
- The availability of technologies and capabilities within each country and technology infrastructure.
- Sovereignty.
- Note: Spent fuel management was mentioned as part of the discussions, but not elaborated upon.

**Outstanding Questions**

- Do all transparency mechanisms need to be formal and institutionalized? Do we need a formal framework? Is an informal approach acceptable for cooperative transparency?
- Will more information about technical activities address concerns or are concerns more political in nature?
- How to measure success? What are performance indicators? Opinion survey of stakeholders useful?

**Closing Discussions**

Beyond IAEA safeguards, there remains the opinion that more needs to be done – there is still a perception of lack of trust and openness – what are the methods, technologies, and steps that can assist this?

As an example, the discussion between scientists and researchers in Korea and Japan has been going on for more than 10 years, but at a very low level and frequency. This conversation should be continued at a higher level to promote progress. Perhaps it is not technology itself, but a type of policy or transparency area has to start the process.
Perhaps it can start with information exchange – but it has to be two-ways. And it has to be mutually beneficial to both parties. Maybe Korea and Japanese participants to the workshop could take this suggestion to upper management as a next step?

Overall, we need to start with one, small step at a time. Do not rush; just move slowly and steadily.

How important and how effective is it to develop collaboration between Asia countries?

- it was noted that it is not always easy to explain the importance of this type of transparency and cooperation to government entities
- there is a need to deepen mutual understanding at the international level

A practical example of challenges facing progress – the situation of Indonesia

- have a critical need for energy, and are awaiting the presidential decree for nuclear energy development
- for now, regarding the discussion of cooperative transparency, Indonesia can only listen and stay informed and involved at a low level of participation
- for traditional nonproliferation itself, Indonesia complies with the IAEA safeguards system. If such a framework needs additional measures, there would be time and cost (technology) considerations. In principle, Indonesia agrees with confidence building using transparency. But for now, considering the current focus on achieving and maintaining IAEA compliance, these supplemental types of transparency approaches cannot be high-priority issues.
- Comment – Can Indonesia possibly include nontraditional transparency activities in the early planning of nuclear power? Answer – For the present, Indonesia will comply with the IAEA system and observe developments in cooperative transparency. Unfortunately, additional measures carry a cost and may not be a high priority at this time.

Technology is needed to fulfill current and future cooperative transparency need to address methods or technology to fulfill the needs of the timeliness of information.

JAEA and the representative from KAERI had discussions regarding possible information exchanges. A possible area of cooperation would be a JAEA-Sandia-KAERI information exchange of remote monitoring information at a suitable location.

Note during Discussion: Issue with process information that goes to the IAEA

- information is SG confidential.
- most of the information at some facilities is proprietary information and is under seal and on-site at the facility.
- alternatively, could the state inspectorate share the information? The challenge is that higher level of government does not necessarily see/understand the benefit of transparency.

Future Activities and Direction

- Take “baby steps” at first and focus on non-sensitive topics.
- Start with bi-lateral activities since these are perhaps easier to implement. This could be the role model for cooperative transparency in Asia.
- Acknowledge the long-term interactions between Japan and Korea.
- It is important to maintain interactions between Japan and Korea even if there is no specific technical project they are jointly working together upon at the moment.

## Acknowledgements

The editors sincerely thank the numerous people that ensured the International Workshop on Transparency Technology for Nonproliferation Cooperation in the Asia Pacific was a success and provided maximum benefit to all participants. These include many staff members from JAEA and Tokyo University who worked tirelessly behind the scenes.

Special thanks also go the Session Leaders and Moderators for their professional conduction of the various sessions of the Workshop. And, of course, a very hearty appreciation and thank-you goes to the Session Secretaries, all of whom provided exceptional efforts and keen notes and observations that captured the essence of the daily and group Sessions. The Secretaries' notes provided a foundation for the Workshop and Session summaries expanded upon in this conference report, with particular appreciation to those provided by George Baldwin and David Saltiel.

The university students, our next generation of nuclear energy experts, are very much appreciated for provided a refreshing view of the nonproliferation topic and a look to the future. And finally, the Workshop could not have been successful without the commitment of the co-hosts and sponsors, and the wholehearted participation and involvement of all the Participants and Attendees who simultaneously contributed and benefited from the event.

Our hope is that, through everyone's continued involvement, this Workshop builds upon past efforts and provides future seeds for further technology development and increased confidence among regional neighbors in the safe, peaceful, and secure advancement of nuclear energy in the Asia Pacific region.

# *Appendix*

## *Workshop Materials*

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**Appendix A**

# Workshop on Transparency Technology for Nonproliferation Cooperation in the Asia Pacific

## – Applications of Remote Monitoring and Secure Communications for Regional Confidence Building –

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*Special Present from Dr. John Olsen*

**Co-Sponsored by JAEA/NPSTC and**
**The University of Tokyo GLOBAL-COE**
**Nuclear Education and Research Initiative (NERI)**

**20-22 February 2008**

**Sanjo Conference Hall, Hango Campus**
**The University of Tokyo**

**Appendix B**

*Final Announcement*

# International Workshop on Transparency Technology for Nonproliferation Cooperation in the Asia Pacific

## – Applications of Remote Monitoring and Secure Communications for Regional Confidence Building –

Tokyo, Japan
20-22 February 2008

Co-Sponsored by JAEA/NPSTC and
the University of Tokyo GLOBAL-COE

This is the Second Announcement to individuals with professional interests in remote monitoring and transparency technology for use in nonproliferation and regional confidence building at nuclear energy facilities. This Workshop is aimed at invited Participants currently working on regional nonproliferation issues, with an emphasis on the Asia Pacific. A limited set of papers and discussion topics have been solicited and Speaker slots are filling. Interested individuals who would like to participate as part of the audience interaction are also welcome and invited to attend the opening day sessions.

**Workshop Scope and Objectives**

This international Workshop is designed to be practical and interactive. It will provide an opportunity for Expert Participants to explore, discuss, create, and share ideas on transparency technology, remote monitoring, secure communications, and confidence building measures (CBMs) as applied to regional nonproliferation cooperation. The focus of the Workshop will address practical technical applications, issues, and problems associated with remote monitoring transparency when used as a confidence building measure. Participants in an Expert working group will also be invited to design and create a hypothetical regional transparency network as part of a tabletop exercise during Expert working sessions.

Objectives of this practical, hands-on Workshop are to:

- Discuss the various definitions and contexts used for transparency in regards to nonproliferation between interested parties (e.g., State-to-State, Operator-State/ Inspector, Operator-Operator, Operator-Public, etc.)
- Present and demonstrate examples of transparency technology development and applications
- Explore the intersection of transparency, technology, and regional confidence building
- Provide an opportunity and venue for interactive, technical expert discussions having a regional focus and application
- Increase confidence in traditional safeguards and the NPT regime through technology and cooperation using confidence building transparency measures
- Support and encourage regional cooperation opportunities
- Promote appropriate technology development, exchange, and transfer
- Develop a hypothetical regional transparency network for future application via a tabletop exercise, and addressing technical and pragmatic issues as they arise
- Promote University graduate student participation and leadership in nuclear energy and nonproliferation.

**Audience**

This Workshop will be of interest to experts, individuals, and organizations concerned with technology development and applications for regional nonproliferation transparency cooperation between States as well as the IAEA. Invited participation is sought from related government agencies and ministries, research laboratories, industry, facility operators, and academia that are within or involved with the East Asia region. Interested media and NGOs will also be invited as part of the audience on Day 1 of the Workshop.

**Topics of Interest**

- Technology and secure communication methods supportive of nonproliferation commitments and goals that further the development of peaceful nuclear energy
- The role and interrelationship of Technology & Transparency in nonproliferation cooperation
- Modes of regional nonproliferation cooperation & CBMs: Collaborations, training, and technology development and transfer
- Defining measures of success in Regional Cooperation for nonproliferation
- Demonstrations and examples of technology and systems used for regional nonproliferation transparency cooperation
- Information sharing: What is sufficient and acceptable to disclose, and to whom?
- Addressing and assisting concerns of States, Operators, Inspectors, and Public regarding nonproliferation transparency cooperation

**Workshop Format**
The Workshop will be a total of three days. Although related, each day will have a slightly different focus, format, goals, and attendance.

20 February: On Day 1, there are focused, invited presentations in the morning followed, by Panel discussions by the Speakers in the afternoon. The Panel participants will address "Transparency: Its Role, Type, Definitions, and Measures and Applications in Regional Cooperation." We expect attendance by Expert Participants and a broad audience from government, academia, research, and interest groups on this day. A total of 50 to 80 people are expected. There will be a hosted reception in the evening.

21 February: On Day 2 the focus is on Technology – presentations, technical demonstrations, and Expert group discussions. We expect a small, interactive working group of about 20 technical Experts drawn from Day 1 to focus on the practical and technological issues and solutions for nonproliferation transparency. There will be approximately five to seven invited presentations and demonstrations from this working group, followed by group discussions.

22 February: On Day 3 the group of Experts will apply their skills and ideas during a tabletop exercise to design a future, hypothetical regional transparency network that is acceptable to Stakeholders of nuclear nonproliferation and confidence building transparency. The outcome of this exercise will help to define the functional requirements of a hypothetical regional transparency network. Enhanced awareness, new ideas, and potential solutions to complex, interrelated issues applicable to nonproliferation transparency will be additional results.

There will also be participation in Workshop and the tabletop exercise by graduate students from the University of Tokyo GLOBAL-COE on Nuclear Energy Education & Research Initiative.

**Abstracts and Presentations**
This Workshop is aimed at invited Participants currently working on regional nonproliferation issues. A limited set of papers and discussion topics are solicited. Presenters agree to provide a 1-2 page *Abstract* and a final copy of their PowerPoint *Presentation*. Panelists are requested to provide a 1-2 page summary of their *Comments* after the conclusion of the Workshop. These materials will be compiled into Workshop proceedings, and published and distributed by JAEA to the participants and attendees.

**Key Dates:**
The request for Presentations is still open to interested Speakers.

- Final 1-2 Page Abstract – 11 February 2008
- Final PowerPoint *Presentations* – 15 February 2008
- *Workshop* – 20-22 February 2008
- Summary of Panelist *Comments* – 9 March 2008

**Workshop Location and Logistics**

The Workshop is co-hosted by JAEA/NPSTC and the University of Tokyo GLOBAL-Center of Excellence (COE). It will be held at the University of Tokyo, Todai Hongo Campus, Sanjo Conference Hall. The venue will be equipped with standard audio-visual equipment for presentations, and high-speed Internet access for use with technology demonstrations. Additional logistical information will be forwarded to participants in February.

**Language**

The Workshop language will be English.

**Registration**

There is no registration fee.

To reserve your place at the Workshop, or to give a presentation and/or technology demonstration, please send an email with your name, contact information, and the days of your attendance (Day 1, or Days 1-3) to the Workshop organizers and hosts as soon as possible.

npstc2008ws@jaea.go.jp

Mr. Yu Hashimoto
Dr. J. David Betsill

On-line information can be found at:
http://www.jaea.go.jp/04/np/en/shiryou/ttws2008/index.html .

**Appendix C**

# *AGENDA*

# International Workshop on Transparency Technology for Nonproliferation Cooperation in the Asia Pacific

## – Applications of Remote Monitoring and Secure Communications for Regional Confidence Building –

**Co-Sponsored by JAEA/NPSTC and the University of Tokyo GLOBAL-COE**

**20-22 February 2008**

## Day 1 – Conference (Open Participation & Invited Speakers)

***Focus*: Overview, Presentations, and Panel Discussions**

***Place*: Conference Room of Sanjo-kaikan (Tokyo University)**

**9:00-9:20** **Arrival and Registration**

**9:20-9:30** **Welcome**
- JAEA/NPSTC – Mr. Masao Senzaki, Director
- University of Tokyo Global COE – Professor Oka

**9:30-9:35** **Introduction - Outline and presentation of WS**
- Dr. Yusuke Kuno, NPSTC/Tokyo Univ.

**9:35-11:35** **Overview and Presentations**
- Moderated by Dr. Yusuke Kuno, NPSTC/Tokyo Univ.
- 20 minute Presentations followed by 5 minutes Q&A. Additional discussion will be available with the Presenters during the afternoon Panel Session

**9:35-10:00** **Presentation 1 - East Asia Regional Technology Cooperation Efforts of the USDOE**
- Mr. John McClellan-Kerr, USDOE (as delivered by Dr. George Baldwin, SNL)

**10:00-10:25** **Presentation 2 - Technology Based "Built-in" Transparency Approach**
- Dr. Wan-Ki Yoon, KINAC, ROK

**10:25-10:50** **Presentation 3 - Perspectives on Transparency and Nuclear Energy Development in Indonesia**
- Dr. HS Karyono, BATAN, Indonesia

**10:50-11:15 Presentation 4 - Strengthening Nonproliferation Transparency and Building Regional Cooperation in the Asia Pacific**
- Dr. Doan Phac Le, VAEC, Vietnam

**11:15-11:30 Presentation 5 - Transparency and Openness**
- Dr. Stephan Bayer, ASNO (as delivered by Dr. David Betsill, JAEA)

**11:30-11:40 Announcements**

**11:40-13:30 Lunch**

**13:30-13:55 Presentation 6 - IAEA Perspectives and the Use of Transparency in Nonproliferation**
- Dr. Manfred Zendel, IAEA, Vienna

**13:55-14:20 Presentation 7 - Transparency in East Asia and the Pacific Rim: A Nongovernmental Organization's Perspective**
- Mr. Brad Glosserman, CSIS/ PacForum

**14:20-14:40 Introduction of Panel Session and Topic: Concept of Transparency for Nuclear Non-Proliferation – Discussion on Current & Future Direction**
- Dr. Yusuke Kuno, JAEA/NPSTC

**14:40-15:10 Coffee Break**

**15:10-16:50 Panel Discussions – Transparency: Its Role, Type, Definitions, Measures, and Applications in Regional Cooperation**
- Moderator: Mr. Masato Hori, JAEA/NPSTC
- Select Questions submitted to Panelists, followed by audience Q&A
- Panelists:
    - Dr. Yusuke Kuno, JAEA/NPSTC
    - Dr. Wan-Ki Yoon, KINAC, ROK
    - Dr. HS Karyono, BATAN, Indonesia
    - Mr. Doan Phac Le, VAEC, Vietnam
    - Dr. Manfred Zendel, IAEA, Vienna
    - Mr. Brad Glosserman, CSIS/ PacForum
    - Dr. Jor-Shan Choi, Project Professor Univ. of Tokyo
    - Mr. David Saltiel, SNL

**16:50-17:00 Closing Remarks**
- Mr. Masao Senzaki, JAEA/NPSTC

**17:30-19:30 Evening Reception**

# Day 2 – Technical Sessions (Invited Participants)

***Focus*: Transparency Technology Presentations, Technical Demonstrations, and Expert Group Discussions**

***Place*: Meeting Room 201/202 of Sanjo-kaikan (Tokyo University)**
**(~20 Participants plus Observers)**

**9:00** **Opening Remarks**
- All Sessions Moderated by Dr. Mitsutoshi Suzuki, JAEA/NPSTC

**9:00-9:30** **Presentation 1 - Overview of Transparency Measures & Methods**
- Ms. Kazuko Hamada, JAEA/NPSTC

**9:30-10:00** **Presentation 2 - Assessing and Addressing Increased Stakeholder and Operator Information Needs to Support the Safe, Secure, and Peaceful Expansion of Nuclear Energy**
- Mr. David Saltiel, SNL

**10:00- 10:30** **Presentation 3 - Remote Monitoring and Secure Communications for Transparency Applications**
- Dr. George Baldwin, SNL

**10:30- 11:00** **Presentation 4 - Containment & Surveillance System Development for the Safeguards of the Advanced Spent Fuel Conditioning Process Facility (ACPF)**
- Mr. Chul-Yong Lee, KAERI

**11:00-11:30** **Presentation 5 - Operational Monitoring Technology for Transparency Scenarios**
- Mr. Marius Stein, CANBERRA

**11:30-12:00** **Presentation 6 - Remote Monitoring Implementation in Japan**
- Mr. Max Aparo, IAEA, Tokyo

**12:00-13:30** **Lunch**

**13:30- 14:00** **Technology Demonstration 1 - A Demonstration of Advanced Transparency at the Monju Fast Breeder Reactor Model**
- Mr. Gary Rochau, SNL

**14:00-14:30** **Technology Demonstration 2 –** Cooperative Transparency for Nonproliferation – Technology Demonstrations at the Joyo Test Bed for Advanced Remote Monitoring
- Dr. David Betsill, JAEA/NPSTC

**14:30-15:00 Technology Demonstration 3 – Transparency and Technology – Applications across Industries**
- Dr. Susan E. Pickett, Ludlum Measurements, Inc.

**15:00-15:30 Coffee Break**

**15:30- 16:50 Group Discussions - Issues and Technologies to Achieve Transparency Cooperation**
- Moderated by Dr. Jor-Shan Choi, Project Professor Univ. of Tokyo
- Session Secretary: Dr. David Saltiel, SNL

**16:50-17:00 Brief Introduction to Design Exercise for Day 3**
- Dr. David Betsill, JAEA/NPSTC

**17:00 Closing Remarks**
- Dr. Yusuke Kuno, NPSTC/Tokyo Univ.

# Day 3 – Technical Sessions (Invited Participants)

***Focus*: Morning – Group Tabletop Exercise – Experts and G-COE Graduate Students Design Future, Hypothetical, Regional Transparency Network**
**Afternoon – Workshop Discussions and Summary – Key Issues Identified During the Workshop and Technical Solutions for Transparency Applications**

***Place*: Meeting Room 201/202 of Sanjo-kaikan (Tokyo University)**
**(~20 Participants plus Observers)**

**9:00** **Opening Remarks**
- Dr. Yusuke Kuno, NPSTC/Tokyo Univ.
- Group Sessions Coordinated by Dr. David Betsill, JAEA/NPSTC

**9:00-12:00** **Interactive Design of Hypothetical, Regional Transparency Network by Global-COE Students and International Expert Group**
- Co-Moderation & Facilitation by Dr. Manfred Zendel, IAEA, and Mr. Gary Rochau, SNL
- Session Secretary: Mr. Marius Stein, CANBERRA

**12:00-13:30** **Lunch**

**13:30-15:00** **Roundtable Group Discussions and Summary – Key Issues Identified During the Workshop and Technical Solutions for Transparency Applications**
- Co-Moderation & Facilitation by Dr. George Baldwin, SNL, and Dr. Mitsutoshi Suzuki, JAEA/NPSTC
- Session Secretary: Dr. Susan E. Pickett, Ludlum Measurements, Inc.

**15:00-15:30** **Coffee Break**

**15:30-16:30** **Roundtable Group Discussions and Summary** (conclusion)

**16:30** **Closing Remarks, Wrap Up, and Farewell**
- Dr. Yusuke Kuno, NPSTC/Tokyo Univ.
- Dr. David Betsill, JAEA/NPSTC

# Appendix D

| Participants List | | | | | | |
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## Appendix D

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## Appendix D

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# Appendix D

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| 62 | Watanabe<br>渡辺 | Mikio<br>幹生 | Japan | Faculty of Science and Engineering<br>Waseda University | Department of Electrical Engineering and Bioscience<br>School of Advanced Acience and Engineering | secret-wing@moegi.waseda.jp |
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| 65 | Yamazaki<br>山崎 | Motoyasu<br>元泰 | Japan | Graduate School of Engineering<br>The University of Tokyo | Department of Nuclear Engineering and Management<br><br>Lecturer | m_yamazaki@nuclear.jp |
| 66 | Yoon<br>尹 | Wan-Ki<br>完基 | Korea | Korea Institute of Nuclear Nonproliferation and Contorl<br>（KINAC） | Director<br>Division of Nuclear Control Implementation | wkyoon@kinac.re.kr |
| 67 | Zendel | Manfred | IAEA | Department of Safeguards<br>IAEA | Division of Safeguards Technical Supprot | M.Zendel@iaea.org |

**Appendix E**

# Biographical Sketches of Workshop Presenters

## Massimo Aparo

Mr. Massimo Aparo obtained a degree in Nuclear Engineering from the University of Roma in 1981. Since then he has been working in the area of NDA measurements at the Italian Nuclear Energy Agency, and the European Space Agency and at Silena (a private company designing and manufacturing nuclear instruments). Mr. Aparo also worked as Associated Professor for the University of Rome (Italy), and he spent a year as Visiting Scientist at Los Alamos National Laboratory in the Safeguards Technology Group.

In 1997 he joined IAEA as Head of the Equipment Development Section in the Department of Safeguards. In April 2006 he was transferred to the Division of Operations A as Section Head in OA1, and in September to 2006 he moved to Tokyo as Head of the IAEA Regional Office.

## George Baldwin

Dr. George Baldwin is a member of the technical staff in Global Security Programs at Sandia National Laboratories. His professional interests involve technical verification and confidence building measures for nonproliferation, including international nuclear safeguards, the Additional Protocol, fissile material cutoff, disposition of excess materials, and related issues. He manages Sandia technical projects under the U.S. Department of Energy international Safeguards cooperation agreements and the U.S. program of technical assistance to the International Atomic Energy Agency.

He had previously worked for the IAEA Safeguards Department in Vienna in the early 1990s. He holds a B.A. degree in physics from Kalamazoo College and Ph.D. in nuclear engineering from the University of Michigan.

## Stephan Bayer

Stephan Bayer attended the Australian National University in Canberra studying physics and mathematics, and by 1998 had received a PhD in Physics, specializing in nuclear spectroscopy and structure. After leaving university Stephan first worked at the Department of Defense as a research officer until 1991. He obtained a position at the Australian Safeguards and Non-Proliferation Office as a safeguards officer. In 2006 he was promoted to Director of the Nuclear Accountancy and Control where he regulates nuclear safeguards and security in Australia and manages Australia's bilateral nuclear safeguards agreements.

## J. David Betsill

Dr. Betsill has been working in the monitoring and transparency field for many years. He joined the Nonproliferation Science and Technology Center staff at the Japan Atomic Energy Agency in June 2006 as an International Research Fellow for regional transparency and remote monitoring projects.

Prior to coming to JAEA, he worked as a Senior Member of the Technical Staff at Sandia National Laboratories in the Global Security Engagement and International Safeguards Department at the Cooperative Monitoring Center (CMC). The Center works with domestic and foreign participants to explore ways that technology can facilitate global security and confidence building processes in such areas as arms control, nonproliferation, safeguards, arms control, and maritime and environmental security.

While at the CMC, he led many research projects to increase transparency and confidence regarding maritime and environmental security in various regions of the world that have nonproliferation issues. Dr. Betsill holds a PhD in Civil Engineering.

## Jor-Shan Choi

Dr. Jor-Shan Choi is a Project Professor for the Global Center-of-Excellence (G-COE) Program of the Department of Nuclear Engineering and Management at Tokyo University. His teaching and research interests involve nonproliferation policy, proliferation-resistant technologies, international safeguards, international and regional cooperation on peaceful use of nuclear energy. Before he joined the faculty at Tokyo University, Dr. Choi was the associated program leader for the high-performance corrosion-resistant material program at Lawrence Livermore National Laboratory (LLNL) in California, USA. He was also project leader for the proliferation-resistant fuel cycle technologies project, involving in the proliferation-resistance and physical-protection (PR&PP) working group, transparency monitoring for the US-Russian HEU blend-down program, the US-Russian weapons-plutonium disposition program, and others.

Dr. Choi was a Science Fellow at the Center for International Security and Cooperation (CISAC) at Stanford University. He also held a 3-year assignment at the International Atomic Energy Agency (IAEA) from 1998-2001. Prior to joining LLNL in 1987, Dr. Choi had 13 years of industrial experience. He has a BS in Electrical Engineering and Computer Sciences, MS and PhD in Nuclear Engineering, all from the University of California at Berkeley. He is also a registered Professional Nuclear and Mechanical Engineer (PE) in the State of California.

## Brad Glosserman

Mr. Brad Glosserman is Executive Director of the Pacific Forum CSIS in Honolulu, a nonprofit, foreign policy research institute affiliated with the Center for Strategic and International Affairs (CSIS) in Washington, D.C. He oversees all Pacific Forum programs and publications. He directed the Nuclear Energy Expert Group, runs the CSCAP WMD study group and chairs the Export Controls Experts Group, all of which focus on transparency concerns.

Prior to joining Pacific Forum, Mr. Glosserman was, for 10 years, a member of The Japan Times editorial board, and he continues to serve as a contributing editor for the newspaper.

Mr. Glosserman has a JD from George Washington University, an MA from Johns Hopkins University's School of Advanced International Studies (SAIS) and a BA from Reed College.

## Kazuko Hamada

Ms. Kazuko Hamada works for the Policy Research Office of Nuclear Nonproliferation Science & Technology Center (NPSTC) at the Japan Atomic Energy Agency (JAEA). Currently, she is in charge of the two projects on Asia – "The Survey on Nuclear Nonproliferation Situations in Asia" and "Nuclear Nonproliferation, Transparency and Confidence-building in Peaceful Nuclear Use in the Asian Region," as well as North Korean and Iranian nuclear issues.

Previously, she served as a Vasey Fellow in 2003 at Pacific Forum CSIS, where she engaged in the Nuclear Energy Transparency Project in the Asia-Pacific Nuclear Energy Expert Group (NEEP) of the Council for Security Cooperation in the Asia Pacific (CSCAP) with the cooperation of the Cooperative Monitoring Center of the Sandia National Laboratories. Ms. Hamada received her MA in International Policy Studies from the Monterey Institute of International Studies (MIIS) in 2004 and a BA in International Relations from MIIS in 2001.

## HS Karyono

Dr. Karyono is the deputy chairman for development of nuclear material technology and engineering at the National Nuclear Energy Agency of Indonesia (BATAN), a position he has held since 2003. He began his long career at BATAN in 1977 as the Head of the Development Section of the Directorate of Geological Survey. From 1981-1984, he served as the Head of the Geochemical Section of the BATAN Center for Nuclear Materials Exploration and Processing, prior to serving as the Head of the Center's Exploration Division. In 1989 he began ten years of service at the BATAN Nuclear Minerals Development Center, where he served as Head of the Geological Research Division (1989-1990) and Director

(1990-1999). Subsequently, he moved to the BATAN Planning Bureau, where he served as Head for four years before moving into his current position as Deputy Chairman.

Dr. Karyono has a degree in geology from Gadjah Mada University in Yogyakarta, Indonesia. He has also studied at the Institut de Géologie at the Université Louis Pasteur in Strasbourg, France, where he received a Diplôme d'Etude Approfondie (DEA) in Geochemistry and a Doctorate in Tectonic and Structural Geology.

## John McClelland-Kerr

Mr. John McClelland-Kerr is currently a Foreign Affairs Specialist in the Office of Global Security Engagement and Cooperation, U.S. Department of Energy, National Nuclear Security Administration (DOE/NNSA). He is the Director of the International Nuclear Safeguards and Engagement Program (INSEP) and as such oversees the strategic direction of all INSEP activities, including safeguards cooperation agreements with foreign partner countries, peaceful nuclear engagement programs worldwide, and training courses conducted jointly with the IAEA.

He has worked at DOE for over eleven years, five of which have been as a Federal employee. His career at DOE has included activities related to nuclear material protection, control and accounting; physical security; training; international cooperation; federal budget activities; and program management. In 1997, Mr. McClelland-Kerr received a meritorious service award from DOE for his contributions to nuclear materials security, and was presented with a special service award from the DOE/NNSA in 2004 for his work in international cooperation. Mr. McClelland-Kerr holds an M.S. degree from Johns Hopkins University, Baltimore, Maryland, USA.

## Yusuke Kuno

Dr. Yusuke Kuno worked for the Japan Atomic Energy Agency Tokai Reprocessing Plant for 20 years, particularly in the area of Safeguards Analysis, as General Manager of Tokai Reprocessing Analytical Laboratory. He was appointed the Head of Safeguards Analytical Laboratory SAL (Seibersdorf) of the IAEA in 1999, and worked there for seven years, engaged in nuclear verification measurement and environmental sampling program.

His present position is Deputy Director and Prime Scientist, Nuclear Nonproliferation Science and Technology Center of the Japan Atomic Energy Agency (JAEA), managing development of Safeguards and other non-proliferation technologies, such as proliferation resistance and transparency for future nuclear fuel cycle. He is also Professor of the Nuclear Engineering and Management, the University of Tokyo, lecturing on nuclear non-proliferation technologies and international Safeguards.

Dr. Kuno received a PhD in nuclear chemistry from the University of Tokyo.

## Doan Phac LE

Mr. Doan Phac LE is the Director of Department of International Cooperation at the Vietnam Atomic Energy Commission (VAEC). The VAEC always recognizes that nonproliferation transparency is one of the factors ensuring successful implementation of nuclear energy development in Viet Nam.

Mr. LE is responsible for the VAEC international cooperation activities on technical cooperation, nuclear security, and nonproliferation. He has participated in the MOST working group for ratification of the CTBT and signing of Additional Protocol. He is the coordinator of MOST/VAEC and USDOE/NNSA cooperation on peaceful uses of nuclear energy and nuclear security.

Mr. LE has an education background in applied mathematics engineering, and holds a Master of Science and Technology Policies.

## Chul Yong Lee

Mr. Chul Yong Lee is a principal researcher on the safeguards technology R&D team. For the Korea Atomic Energy Research Institute (KAERI ). His research is on the safeguards technology development of the Pyroprocess. His work is under the charge of the containment and surveillance of ACPF and DFDF. Mr. Lee's primary interests are the advanced containment and surveillance for international safeguards application and also interest in the advanced NDA system. His specific fields are advanced containment and surveillance system, on-line process monitoring systems, hold-up image process, advanced NDA system, technology of neutron signal measurement, etc.

He holds a M.S. in communication and control engineering Lab., Department of Electronics Engineering, Chungnam National University, Korea.

## Susan E. Pickett

Dr. Susan Pickett is currently the Director of Ludlum Measurements, Inc., Japan Branch Office. She has experience in nuclear energy and environmental policy, safeguards technology, and radiation detection technologies. Dr. Pickett received her Ph.D. from the University of Tokyo in 2000, and her Masters of Science from Massachusetts Institute of Technology in 1997.

## Gary Rochau

Mr. Gary Rochau is manager of the Fuel Cycle Experiments and Analysis Department in the Nuclear Energy and Global Security Technologies Center at Sandia National Laboratories. Mr. Rochau has been at Sandia for 31 years. His department's portfolio includes advanced nuclear fuel cycle transparency, advanced computational modeling, modeling of nuclear fuel cycles for proliferation risk, and nuclear safety experimentation.

He is currently a member of the Generation IV Proliferation Resistance and Physical Protection Expert Group with expertise in threat definition and physical protection analysis. Current research interests include application of advanced technology to the transparent operation of new nuclear installations. Mr. Rochau holds a MA in Nuclear Physics from Western Michigan University.

## David H. Saltiel

Mr. David H. Saltiel is a Senior Member of the Technical Staff and Manager of East Asia Programs and the Studies and Analysis group in the Global Security Engagement and International Safeguards Department of the Global Security Programs Center at Sandia National Laboratories. He directs work on the civilian nuclear fuel cycle, nuclear nonproliferation, and other security-related topics in East Asia and other regions.

Prior to joining Sandia, Mr. Saltiel was the Manager of Federal Affairs and Analysis in the Washington, DC office of AREVA, a global energy company. Mr. Saltiel holds an M.Sc. from the University of Oxford.

## Marius Stein

Mr. Marius Stein is Key Account Manager for Safeguards at Canberra, including Containment/Surveillance and Non-Destructive Assay activities. He additionally provides monitoring, analysis, and forecasting of Safeguards and Homeland Defense efforts for Canberra's Business Development Department.

Currently stationed in Europe, Marius serves as the Regional Development Manager for Canberra's NPT Business Line. Mr. Stein received a Masters Degree in Economics from the University of Bonn.

# Wan Ki Yoon

Dr. Wan Ki Yoon has extensive experience over the last two decades in implementation, technical research and development, policy development, and international relations of safeguards and physical protection. For the last several years, he was deeply involved with negotiations on integrated safeguards with IAEA, which were recently concluded.

Dr. Yoon has played a pivotal role in remote monitoring for safeguards in Korea. He continues to work for possible applications of remote monitoring and other safeguards technology to transparency. He is also a Korean representative to the GEN IV PR&PP Working Group. His interest includes the integration of safeguards, physical protection, and export control to enhance nonproliferation, especially to new nuclear processes and technology-based regional transparency.

Currently he is the director of the nuclear control implementation division of the Korea Institute of Nuclear Nonproliferation and Control (KINAC). He earned a doctorate in chemical engineering from the University of Missouri.

# Manfred Zendel

Dr. Manfred Zendel is Section Head of Surveillance, Seals and Remote Monitoring in the Department of Safeguards of the International Atomic Energy Agency (IAEA).

He has worked as a Safeguards Inspector for more than 25 years, and as a Manager in the Division of Technical Support, providing safeguards equipment for the inspectorate. He has published several articles on safeguards-related issues, as well as scientific papers in the field of nuclear chemistry.

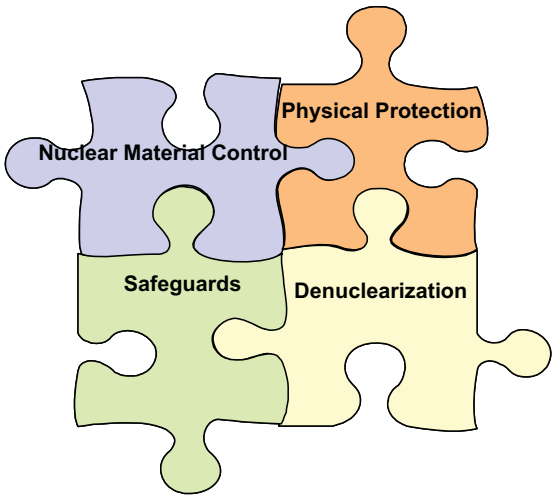
Dr. Zendel holds a PhD in nuclear chemistry.

**Appendix F**

Japan Atomic Energy Agency

# Nuclear Nonproliferation Science & Technology Center (NPSTC)

JAEA/NPSTC




Dear Madam/Sir,

The Japan Nuclear Energy Agency (JAEA) was established on 1st October 2005 by the merger of Japan Nuclear Cycle Development Institute (JNC) and Japan Atomic Energy Research Institute (JAERI). With this merger as a turning point, the Nuclear Nonproliferation Science & Technology Center, NPSTC was newly established within JAEA to contribute to development of nuclear material management technology in Japan, and to strengthening international nuclear nonproliferation regimes.

JAEA/NPSTC conducts development of advanced safeguards technology, transparency technology for the peaceful use of nuclear energy, and research on the future proliferation resistant nuclear fuel cycle. NPSTC collaborates with other R&D divisions in JAEA, as well as supports nuclear material management and transportation at JAEA facilities. Based on the Japanese government's requirements, JAEA/NPSTC also provides technical support for surplus plutonium disposition, operates international monitoring stations for CTBT verification, and develops ultra-trace analysis for detections of un-authorized nuclear activities.

In addition, JAEA/NPSTC conducts policy research and investigation on such topics as advanced safeguards systems and nuclear transparency in the Asian region, based on its technical knowledge and experience, while establishing close relationships with related domestic and international organizations. In order to contribute to human resources development in this field, JAEA/NPSTC sends visiting professors to the School of Engineering of The University of Tokyo.

We look forward to a continuing and successful relationship with you.

Masao Senzaki, Director
Nuclear Nonproliferation Science
& Technology Center (NPSTC)
Japan Atomic Energy Agency (JAEA)

## Appendix F

### NPSTC Missions

**Policy Research "Think Tank"**

- Comprehensive Policy Studies on Nuclear Nonproliferation Based on Technical Knowledge and Experience
- Support Japanese Government Policymaking
- Information Analysis and Distribution

**Nuclear Material Management**

- Management of Nuclear Material Control at JAEA Facilities and Transportation

**Research & Development**

- Nuclear Nonproliferation Technology including Advanced Safeguards Technology and Nuclear Security
- International & Technical Contribution and Cooperationto Strengthen Nuclear Nonproliferation Regimes

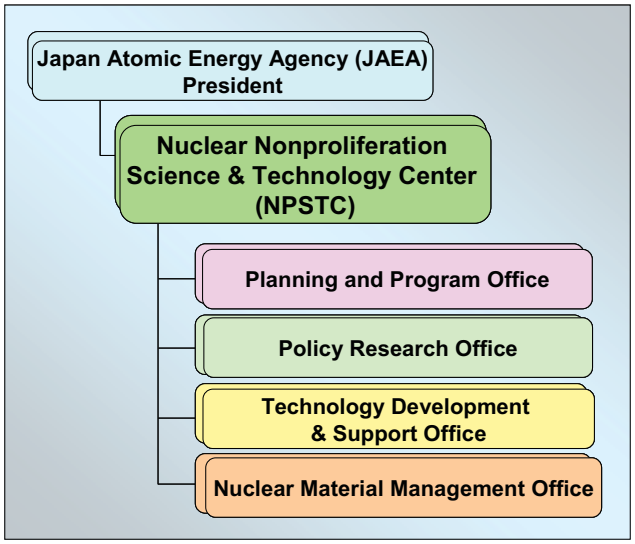
**Denuclearization**

- International Technical Contribution and Support of Nuclear Weapon Disarmament and Denuclearization

**Human Resource Development**

- Development of Experts in Collaboration with the University of Tokyo
- Visiting Professors
- Provide Experts to Japanese Government and International Authorities

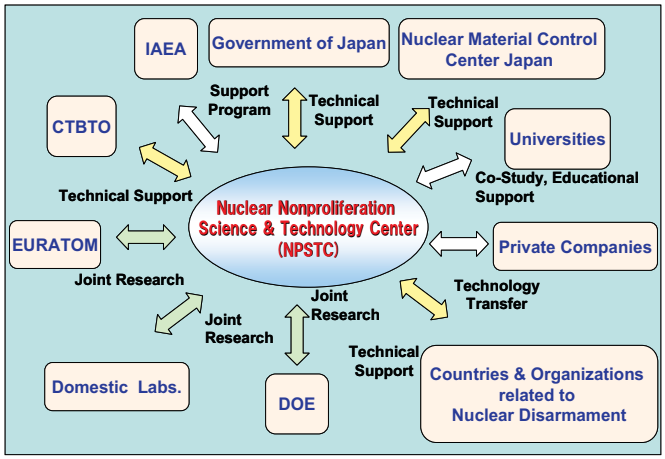
### Organization



## Appendix F

### Research Hub and Partnership Network

NPSTC Aims to be a Domestic and International Research Hub with an Extensive Partnership Network.




### NPSTC Offices

**Planning and Program Office**

- Center Administration
- Planning and Promotion of Center Tasks
- Publication

**Policy Research Office**

- Policy Research "Think Tank" on Nuclear Nonproliferation
- Information Collection, Analysis and Distribution
- Development of Human Resources

**Technology Development & Support Office**

- Advanced Safeguards Systems
- Ultra-trace Analysis
- Nuclear Transparency Technology
- Physical Protection of Nuclear Material
- Denuclearization Technology
  - Surplus W-Pu Disposition
  - CTBT Verification
- International Cooperation for Nuclear Nonproliferation Technology

**Nuclear Material Management Office**

Management of Nuclear Material Control Throughout JAEA, Including:

- Safeguards
- Material Control & Accountancy
- Physical Protection
- Transportation
- Demand, Supply, and Disposal of Nuclear Fuel for Research Reactors

## Appendix F

NPSTC Recent Events:

- Oarai International Symposium on Peaceful Use of Nuclear Energy (February 2006, Oarai, Japan)
  http://www.jaea.go.jp/04/np/en/shiryou/sympo2005/
- International Nuclear Nonproliferation Science and Technology Forum (May 2006, Tokyo, Japan)
  http://www.jaea.go.jp/04/np/en/shiryou/forum2006/



Contact Us
Nuclear Nonproliferation Science & Technology Center
(NPSTC), Japan Atomic Energy Agency (JAEA)
http://www.jaea.go.jp/04/np/en/index.html
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Policy Research Office:
7th floor, Sumitomo Fudosan Ueno Bldg. No. 8
6-9-3 Higashi Ueno, Taito-ku, 110-0015, Tokyo, Japan
Tel: +81-3-5246-2579/Fax: +81-3-5246-2558

**Appendix F**

## Global COE program (MEXT)

# Nuclear Education and Research Initiative

Program leader: Yoshiaki Oka, Ph. D,
Professor, Department of Nuclear Engineering and Management, Graduate School of Engineering

Mankind is having an increased effect on the environment through greenhouse gas emission; a very important and growing concern. Generally nuclear power is seen as a method for reducing greenhouse gas emission while still satisfying our modern society's high demand for energy. We are developing a well rounded research and education program in response to a variety of world-wide nuclear utilization subjects such as: protection of the global environment, supplying safe and stable nuclear energy, and applying radiation for healthy, productive and prosperous lives. The **first systematic education on nuclear energy** in the world is performed, incorporating the social, liberal arts and technical subjects as they relate to nuclear utilization.

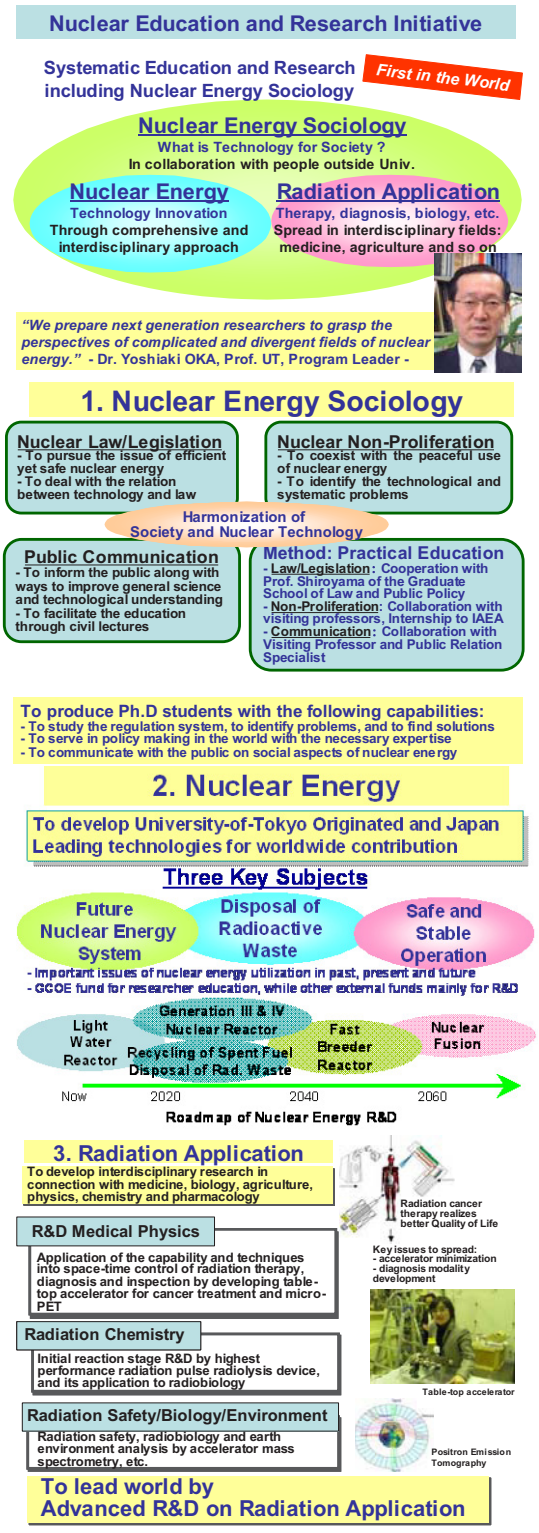
For **nuclear energy sociology**, we take up three major research subjects; nuclear law and regulation, nuclear non-proliferation and the harmonization of society and nuclear technology. These fields are explored in practical study and in collaboration with people outside the university.

For **nuclear energy**, our research program takes up three key subjects: future nuclear energy systems, radioactive waste and system maintenance engineering to obtain safe and stable nuclear power plant operation. We are developing a comprehensive, interdisciplinary approach, integrating nuclear related fields.

The research and development of **radiation application** is spread comprehensively in interdisciplinary fields such as medicine, biology etc. Human resources in frontier radiation application are cultivated with the development of medical physics.

Through these studies, we prepare the next generation of researchers to grasp the perspectives of these three complicated and sometimes divergent fields of nuclear energy. They will be able to understand the essential disciplines of nuclear energy, radiation application and nuclear sociology.

The research and education will be performed through a deep **cooperation with nuclear related research institutes, ministries, industries and agencies**. **Overseas offices** will be formed at The University of California at Berkeley. These offices will take a key role in the research and education through the exchange of information, graduate students and young researchers. This exchange will broaden the researchers thinking through the development of personal relationships and an international approach to research.



**Appendix F**

## 文部科学省：グローバルCOEプログラム

# 世界を先導する原子力教育研究イニシアチブ

拠点リーダー：
岡　芳明教授/工学系研究科原子力国際専攻

原子力利用の進展にともない、社会と原子力利用とのかかわりにおいて、個別断片的であった従来の原子力工学では解決できない多くの課題が生じています。理工学系の教育研究だけでは、この問題を正しく理解し対処できません。これは日本のみならず世界の原子力共通の問題です。

地球環境保護とエネルギー安全保障のために原子力エネルギーの利点が世界的に再認識され、多数の原子力発電所の建設計画がすすむなど、原子力ルネッサンスと呼ばれる時代が到来しています。特に日本の原子力産業と研究開発は海外進出・国際化という歴史的転回点にあります。社会の中の原子力問題の解決をはかり、原子力新世紀に対応し**世界をリードする人材を育成**する必要があります。

本拠点では文理の学際複合領域である原子力の特徴を**世界に先駆けて**教育研究に取り入れ、社会人文系科目を含む体系的原子力教育の基礎の上に次の3つのイニシアチブを一体的に推進し、豊かで安心な社会の実現に貢献します。

1. **原子力社会学**教育研究イニシアチブは学内外との連携により原子力法工学、核不拡散、技術と社会の調和を教育研究します。原子力法工学は原子力規制法体系のあるべき姿を追求します。行政庁では法規そのものの良否を議論できません。原子力規制体系の問題点の検討、その分類整理、課題解決方法を総合大学としての東大の利点を生かして学内外との連携により教育研究します。核不拡散は原子力平和利用にとって重要です.核不拡散の技術と制度の課題を国内外の機関と共同で教育研究します。技術と社会の調和は原子力の国民理解の問題を扱います。原子力コミュニケーションのあるべき姿を検討し、科学技術全般に対するリテラシー向上など解決策を探ります。市民講座などを開催して実践的に研究教育を行います。

2.**原子力エネルギー**は未来型原子力エネルギーと発電プラントの安定で安全な運転を目ざした原子力プラント保全工学、放射性廃棄物処理処分を重点課題としています。利用にともなって発生する使用済み燃料のリサイクル・放射性廃棄物の処理処分と多数の原子力発電所の安全安定運転は環境にやさしく競争力ある未来型原子力エネルギーシステムとともに原子力エルギー利用の最重要課題でありそのフロンティアを開拓します。

3. **放射線応用**はがん治療の普及のために加速器や診断設備の小型化など研究開発的医学物理の展開を図るとともに、それら技術の原子力プラントの保全・診断・検査への応用を図ります。原子力社会学と原子力エネルギー・放射線応用の教育研究との連携を進め、原子力と社会の問題の困難さや要点を俯瞰できる原子力科学技術のリーダーを育成します。

**<これから大学を目指す皆さんへ>**
原子力はニュースになることが多いですが、これは社会と科学技術との関係の問題を一番先取りしているからではないでしょうか？
原子力は環境問題のトリレンマの解決に役立ち、文理・理工の境界にある学際分野です。世界を変える学問と産業の新展開は学際・境界分野から発生します。皆様の挑戦を待っています。

**Appendix G**

Japan Atomic Energy Agency

東京大学 THE UNIVERSITY OF TOKYO

# Workshop on Transparency Technology for Nonproliferation Cooperation in the Asia Pacific

## -Applications of Remote Monitoring and Secure Communications for Regional Confidence Building-

## 20 – 22 February 2008

Sanjo Conference Hall,
Hongo Campus, The University of Tokyo

20 February 2008 : Conference (Open)
presentations, panel discussions
21-22 February 2008 : Technical Session (Invited):
presentations, tabletop exercise

**Workshop Aim**

Invited Participants currently working on regional nonproliferation issues.
Interested individuals who would like to participate as part of the audience interaction are also welcome and invited to attend.

**Workshop Scope**

Exploration/Creation of ideas on transparency technology, remote monitoring, secure communications, and confidence building measures as applied to regional nonproliferation cooperation.

**Co-Sponsored by JAEA/NPSTC and the University of Tokyo GLOBAL-COE Program Nuclear Education and Research Initiative**

JAEA/NPSTC

GCOE NERI Nuclear Education and Research Initiative

**Appendix G**

日本原子力研究開発機構　東京大学 THE UNIVERSITY OF TOKYO

# アジア・太平洋地域における核不拡散協力のための透明性技術に関するワークショップ

## Workshop on Transparency Technology for Nonproliferation Cooperation in the Asia Pacific

－ 信頼性醸成のための遠隔監視及びコミュニケーション技術応用 －

**平成20年2月20日(水)～22日(金)**

場所：東京大学 本郷キャンパス 山上会館　東京都文京区本郷7-3-1

平成20年2月20日 全体会議(一般公開):講演・パネル討論
平成20年2月21日・22日 技術セッション:発表・テーブルトップ演習

**内容:**
核不拡散協力のための透明性技術、遠隔監視・通信技術、信頼性醸成措置などについてアジア・太平洋地区核不拡散問題関係者による講演・パネル討論など

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# 国際単位系（SI）

表１．SI 基本単位

| 基本量 | SI 基本単位 | |
|---|---|---|
| | 名称 | 記号 |
| 長さ | メートル | m |
| 質量 | キログラム | kg |
| 時間 | 秒 | s |
| 電流 | アンペア | A |
| 熱力学温度 | ケルビン | K |
| 物質量 | モル | mol |
| 光度 | カンデラ | cd |

表２．基本単位を用いて表されるSI組立単位の例

| 組立量 | SI 基本単位 | |
|---|---|---|
| | 名称 | 記号 |
| 面積 | 平方メートル | $m^2$ |
| 体積 | 立法メートル | $m^3$ |
| 速さ，速度 | メートル毎秒 | m/s |
| 加速度 | メートル毎秒毎秒 | $m/s^2$ |
| 波数 | 毎メートル | $m^{-1}$ |
| 密度，質量密度 | キログラム毎立方メートル | $kg/m^3$ |
| 面積密度 | キログラム毎平方メートル | $kg/m^2$ |
| 比体積 | 立方メートル毎キログラム | $m^3/kg$ |
| 電流密度 | アンペア毎平方メートル | $A/m^2$ |
| 磁界の強さ | アンペア毎メートル | A/m |
| 量濃度[(a)]，濃度 | モル毎立方メートル | $mol/m^3$ |
| 質量濃度 | キログラム毎立法メートル | $kg/m^3$ |
| 輝度 | カンデラ毎平方メートル | $cd/m^2$ |
| 屈折率[(b)] | （数字の） 1 | 1 |
| 比透磁率[(b)] | （数字の） 1 | 1 |

(a) 量濃度（amount concentration）は臨床化学の分野では物質濃度（substance concentration）ともよばれる。
(b) これらは無次元量あるいは次元１をもつ量であるが、そのことを表す単位記号である数字の１は通常は表記しない。

表３．固有の名称と記号で表されるSI組立単位

| 組立量 | SI 組立単位 | | | |
|---|---|---|---|---|
| | 名称 | 記号 | 他のSI単位による表し方 | SI基本単位による表し方 |
| 平面角 | ラジアン[(b)] | rad | 1[(b)] | m/m |
| 立体角 | ステラジアン[(b)] | sr[(c)] | 1[(b)] | $m^2/m^2$ |
| 周波数 | ヘルツ[(d)] | Hz | | $s^{-1}$ |
| 力 | ニュートン | N | | m kg $s^{-2}$ |
| 圧力，応力 | パスカル | Pa | N/$m^2$ | $m^{-1}$ kg $s^{-2}$ |
| エネルギー，仕事，熱量 | ジュール | J | N m | $m^2$ kg $s^{-2}$ |
| 仕事率，工率，放射束 | ワット | W | J/s | $m^2$ kg $s^{-3}$ |
| 電荷，電気量 | クーロン | C | | s A |
| 電位差（電圧），起電力 | ボルト | V | W/A | $m^2$ kg $s^{-3}$ $A^{-1}$ |
| 静電容量 | ファラド | F | C/V | $m^{-2}$ $kg^{-1}$ $s^4$ $A^2$ |
| 電気抵抗 | オーム | Ω | V/A | $m^2$ kg $s^{-3}$ $A^{-2}$ |
| コンダクタンス | ジーメンス | S | A/V | $m^{-2}$ $kg^{-1}$ $s^3$ $A^2$ |
| 磁束 | ウエーバ | Wb | Vs | $m^2$ kg $s^{-2}$ $A^{-1}$ |
| 磁束密度 | テスラ | T | Wb/$m^2$ | kg $s^{-2}$ $A^{-1}$ |
| インダクタンス | ヘンリー | H | Wb/A | $m^2$ kg $s^{-2}$ $A^{-2}$ |
| セルシウス温度 | セルシウス度[(e)] | ℃ | | K |
| 光束 | ルーメン | lm | cd sr[(c)] | cd |
| 照度 | ルクス | lx | lm/$m^2$ | $m^{-2}$ cd |
| 放射性核種の放射能[(f)] | ベクレル[(d)] | Bq | | $s^{-1}$ |
| 吸収線量，比エネルギー分与，カーマ | グレイ | Gy | J/kg | $m^2$ $s^{-2}$ |
| 線量当量，周辺線量当量，方向性線量当量，個人線量当量 | シーベルト[(g)] | Sv | J/kg | $m^2$ $s^{-2}$ |
| 酸素活性 | カタール | kat | | $s^{-1}$ mol |

(a)SI接頭語は固有の名称と記号を持つ組立単位と組み合わせても使用できる。しかし接頭語を付した単位はもはやコヒーレントではない。
(b)ラジアンとステラジアンは数字の１に対する単位の特別な名称で、量についての情報をつたえるために使われる。実際には、使用する時には記号radおよびsrが用いられるが、習慣として組立単位としての記号である数字の１は明示されない。
(c)測光学ではステラジアンという名称と記号srを単位の表し方の中に、そのまま維持している。
(d)ヘルツは周期現象についてのみ、ベクレルは放射性核種の統計的過程についてのみ使用される。
(e)セルシウス度はケルビンの特別な名称で、セルシウス温度を表すために使用される。セルシウス度とケルビンの単位の大きさは同一である。したがって、温度差や温度間隔を表す数値はどちらの単位で表しても同じである。
(f)放射性核種の放射能（activity referred to a radionuclide）は、しばしば誤った用語で"radioactivity"と記される。
(g)単位シーベルト（PV,2002,70,205）についてはCIPM勧告2（CI-2002）を参照。

表４．単位の中に固有の名称と記号を含むSI組立単位の例

| 組立量 | SI 組立単位 | | |
|---|---|---|---|
| | 名称 | 記号 | SI 基本単位による表し方 |
| 粘度 | パスカル秒 | Pa s | $m^{-1}$ kg $s^{-1}$ |
| 力のモーメント | ニュートンメートル | N m | $m^2$ kg $s^{-2}$ |
| 表面張力 | ニュートン毎メートル | N/m | kg $s^{-2}$ |
| 角速度 | ラジアン毎秒 | rad/s | m $m^{-1}$ $s^{-1}$=$s^{-1}$ |
| 角加速度 | ラジアン毎秒毎秒 | rad/$s^2$ | m $m^{-1}$ $s^{-2}$=$s^{-2}$ |
| 熱流密度，放射照度 | ワット毎平方メートル | W/$m^2$ | kg $s^{-3}$ |
| 熱容量，エントロピー | ジュール毎ケルビン | J/K | $m^2$ kg $s^{-2}$ $K^{-1}$ |
| 比熱容量，比エントロピー | ジュール毎キログラム毎ケルビン | J/(kg K) | $m^2$ $s^{-2}$ $K^{-1}$ |
| 比エネルギー | ジュール毎キログラム | J/kg | $m^2$ $s^{-2}$ |
| 熱伝導率 | ワット毎メートル毎ケルビン | W/(m K) | m kg $s^{-3}$ $K^{-1}$ |
| 体積エネルギー | ジュール毎立方メートル | J/$m^3$ | $m^{-1}$ kg $s^{-2}$ |
| 電界の強さ | ボルト毎メートル | V/m | m kg $s^{-3}$ $A^{-1}$ |
| 電荷密度 | クーロン毎立方メートル | C/$m^3$ | $m^{-3}$ sA |
| 表面電荷 | クーロン毎平方メートル | C/$m^2$ | $m^{-2}$ sA |
| 電束密度，電気変位 | クーロン毎平方メートル | C/$m^2$ | $m^{-2}$ sA |
| 誘電率 | ファラド毎メートル | F/m | $m^{-3}$ $kg^{-1}$ $s^4$ $A^2$ |
| 透磁率 | ヘンリー毎メートル | H/m | m kg $s^{-2}$ $A^{-2}$ |
| モルエネルギー | ジュール毎モル | J/mol | $m^2$ kg $s^{-2}$ $mol^{-1}$ |
| モルエントロピー，モル熱容量 | ジュール毎モル毎ケルビン | J/(mol K) | $m^2$ kg $s^{-2}$ $K^{-1}$ $mol^{-1}$ |
| 照射線量（X線及びγ線） | クーロン毎キログラム | C/kg | $kg^{-1}$ sA |
| 吸収線量率 | グレイ毎秒 | Gy/s | $m^2$ $s^{-3}$ |
| 放射強度 | ワット毎ステラジアン | W/sr | $m^4$ $m^{-2}$ kg $s^{-3}$=$m^2$ kg $s^{-3}$ |
| 放射輝度 | ワット毎平方メートル毎ステラジアン | W/($m^2$ sr) | $m^2$ $m^{-2}$ kg $s^{-3}$=kg $s^{-3}$ |
| 酵素活性濃度 | カタール毎立方メートル | kat/$m^3$ | $m^{-3}$ $s^{-1}$ mol |

表５．SI 接頭語

| 乗数 | 接頭語 | 記号 | 乗数 | 接頭語 | 記号 |
|---|---|---|---|---|---|
| $10^{24}$ | ヨタ | Y | $10^{-1}$ | デシ | d |
| $10^{21}$ | ゼタ | Z | $10^{-2}$ | センチ | c |
| $10^{18}$ | エクサ | E | $10^{-3}$ | ミリ | m |
| $10^{15}$ | ペタ | P | $10^{-6}$ | マイクロ | μ |
| $10^{12}$ | テラ | T | $10^{-9}$ | ナノ | n |
| $10^{9}$ | ギガ | G | $10^{-12}$ | ピコ | p |
| $10^{6}$ | メガ | M | $10^{-15}$ | フェムト | f |
| $10^{3}$ | キロ | k | $10^{-18}$ | アト | a |
| $10^{2}$ | ヘクト | h | $10^{-21}$ | ゼプト | z |
| $10^{1}$ | デカ | da | $10^{-24}$ | ヨクト | y |

表６．SIに属さないが、SIと併用される単位

| 名称 | 記号 | SI 単位による値 |
|---|---|---|
| 分 | min | 1 min=60s |
| 時 | h | 1h =60 min=3600 s |
| 日 | d | 1 d=24 h=86 400 s |
| 度 | ° | 1°=(π/180) rad |
| 分 | ’ | 1’=(1/60)°=(π/10800) rad |
| 秒 | ” | 1”=(1/60)’=(π/648000) rad |
| ヘクタール | ha | 1ha=1$hm^2$=$10^4m^2$ |
| リットル | L，l | 1L=11=1$dm^3$=$10^3cm^3$=$10^{-3}m^3$ |
| トン | t | 1t=$10^3$ kg |

表７．SIに属さないが、SIと併用される単位で、SI単位で表される数値が実験的に得られるもの

| 名称 | 記号 | SI 単位で表される数値 |
|---|---|---|
| 電子ボルト | eV | 1eV=1.602 176 53(14)×$10^{-19}$J |
| ダルトン | Da | 1Da=1.660 538 86(28)×$10^{-27}$kg |
| 統一原子質量単位 | u | 1u=1 Da |
| 天文単位 | ua | 1ua=1.495 978 706 91(6)×$10^{11}$m |

表８．SIに属さないが、SIと併用されるその他の単位

| 名称 | 記号 | SI 単位で表される数値 |
|---|---|---|
| バール | bar | 1 bar=0.1MPa=100kPa=$10^5$Pa |
| 水銀柱ミリメートル | mmHg | 1mmHg=133.322Pa |
| オングストローム | Å | 1 Å=0.1nm=100pm=$10^{-10}$m |
| 海里 | M | 1 M=1852m |
| バーン | b | 1 b=100$fm^2$=($10^{-12}$cm)2=$10^{-28}m^2$ |
| ノット | kn | 1 kn=(1852/3600)m/s |
| ネーパ | Np | SI単位との数値的な関係は、対数量の定義に依存。 |
| ベル | B | |
| デジベル | dB | |

表９．固有の名称をもつCGS組立単位

| 名称 | 記号 | SI 単位で表される数値 |
|---|---|---|
| エルグ | erg | 1 erg=$10^{-7}$ J |
| ダイン | dyn | 1 dyn=$10^{-5}$N |
| ポアズ | P | 1 P=1 dyn s $cm^{-2}$=0.1Pa s |
| ストークス | St | 1 St =1$cm^2$ $s^{-1}$=$10^{-4}m^2$ $s^{-1}$ |
| スチルブ | sb | 1 sb =1cd $cm^{-2}$=$10^4$cd $m^{-2}$ |
| フォト | ph | 1 ph=1cd sr $cm^{-2}$ $10^4$lx |
| ガル | Gal | 1 Gal =1cm $s^{-2}$=$10^{-2}ms^{-2}$ |
| マクスウェル | Mx | 1 Mx = 1G $cm^2$=$10^{-8}$Wb |
| ガウス | G | 1 G =1Mx $cm^{-2}$ =$10^{-4}$T |
| エルステッド[(c)] | Oe | 1 Oe ≙ ($10^3$/4π)A $m^{-1}$ |

(c) ３元系のCGS単位系とSIでは直接比較できないため、等号「 ≙ 」は対応関係を示すものである。

表10．SIに属さないその他の単位の例

| 名称 | 記号 | SI 単位で表される数値 |
|---|---|---|
| キュリー | Ci | 1 Ci=3.7×$10^{10}$Bq |
| レントゲン | R | 1 R = 2.58×$10^{-4}$C/kg |
| ラド | rad | 1 rad=1cGy=$10^{-2}$Gy |
| レム | rem | 1 rem=1 cSv=$10^{-2}$Sv |
| ガンマ | γ | 1γ=1 nT=10-9T |
| フェルミ | | 1フェルミ=1 fm=10-15m |
| メートル系カラット | | 1メートル系カラット = 200 mg = 2×10-4kg |
| トル | Torr | 1 Torr = (101 325/760) Pa |
| 標準大気圧 | atm | 1 atm = 101 325 Pa |
| カロリー | cal | 1cal=4.1858J（「15℃」カロリー），4.1868J（「IT」カロリー）4.184J（「熱化学」カロリー） |
| ミクロン | μ | 1 μ =1μm=$10^{-6}$m |

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