From: Timothy Johnson
To: INTERNET:dggreen01@mchsi.com; Internet:Rkrich@nefnm.com
Date: 4/29/05 3:08PM
Subject: Fwd: Enrichment Safeguards Meeting summary

Attached is a summary of Bruce Moran's meeting in Vienna on IAEA safeguards. He will get back to me with a convenient time for a conference call to discuss the meeting further.

CC: Bruce Moran; BWS1; Joel Klein

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Subject: Fwd: Enrichment Safeguards Meeting summary
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From: Timothy Johnson

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Subject: Enrichment Safeguards Meeting summary
Creation Date: 4/29/05 2:56PM
From: Bruce Moran

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From: Bruce Moran
To: Faraz, Yawar; Johnson, Timothy
Date: 4/29/05 2:56PM
Subject: Enrichment Safeguards Meeting summary

Yawar and Tim,

The following is my summary of the Enrichment Safeguards Meeting held at the International Atomic Energy Agency on April 18-22, 2005. A report of the meeting will be made publicly available by the IAEA after completion by the meeting and working group chairmen. In the last section of the summary, I have tried to identify the potential impacts of the meeting on the licensees.

Please share the summary with the licensees, or, if you desire, I can send it directly to them. If the licensees wish to meet to discuss the proceedings of the meeting after reviewing the summary, I will be available to do so.

Bruce

On April 18-22, 2005, in Vienna, Austria, the IAEA held a meeting of uranium enrichment technology experts, IAEA safeguards specialists, and enrichment technology detection experts to discuss techniques for IAEA verification of uranium enrichment activities. The meeting was attended by 65 participants representing 15 countries, 2 regional safeguards authorities, and the IAEA. The participants were asked to address the following general issues:

1. What does the IAEA need to meet current and future inspection requirements?

2. Do safeguards effectiveness gaps exist between current enrichment safeguards effectiveness and IAEA inspection goals?

3. What new techniques and instruments exist that meet the IAEA's needs for functionality, reliability, security, cost-effectiveness, and ruggedness in the safeguards environment.

4. What new research and development tasks should the IAEA undertake, including their priority and time schedules.

The meeting was initiated with presentations on the existing status of IAEA verification of enrichment plants and on new technologies applicable to safeguarding and detecting enrichment plants. To address the identified issues, the participants were divided into the following three working groups:

1. Timely detection of natural uranium, depleted uranium or low-enriched uranium (LEU) diversion from a plant's declared material flow and facility mis-use to produce significant quantities of undeclared LEU, at enrichment levels no greater that the declared maximum, for undeclared feed.

2. Timely detection of the misuse of the facility to produce UF6 enrichments higher than the declared maximum, in particular highly enriched uranium (HEU), and the deterrence of such misuse by the risk of early detection.

3. Techniques for the detection of undeclared enrichment activities and safeguarding of enrichment research and development facilities.

<u>Working Group I recommendations</u>:

Working Group I was responsible for determining measures for the timely detection of diversion of nuclear materials and the production of product beyond declared quantities. The working

group was composed of technology and safeguards experts from Brazil, Japan, France, Netherlands, and the U.S., and inspection staff from Argentina-Brazil Commission for Accounting and Control (ABACC), the European Commission, and the IAEA. The working group participants identified that the safeguards measures currently being applied to verify nuclear material balances under the current IAEA safeguards approach included initial and periodic design information verification; the verification of the quantity of nuclear materials received at, shipped from, and in inventory at the enrichment plant through the use of destructive and nondestructive analysis techniques; and short-notice random access to the facility for the detection of undeclared activities.

The working group identified that a safeguards approach must be facility specific for centrifuge enrichment plants if it is to satisfy the safeguards objectives and provide sufficiently timely detection and deterrence of diversion. They also identified that combinations of safeguards systems should be used to establish a layered safeguards approach that provides defense in depth. The working group identified that continuity of knowledge of the nuclear materials and facility operations could be enhanced by the following:

1. Using a resident inspector to verify all nuclear material transactions.

2. Using unannounced and short-notice random inspections to verify facility declarations.

Using an electronic "mailbox" system to record declared changes to the inventory of nuclear materials at the facility, the contents of which would be verified during unannounced or short-notice random inspections.

3. Sealing of valves on the process pipework to which cylinders are or could be attached to detect undeclared operations, or the substitution or diversion of containers.

4. Using improved surveillance and monitoring systems (including smart tags) to observe and record cylinder feed and withdrawal activities.

5. Using or sharing authenticated data from operator's measurement equipment (e.g., load cell and accountancy scales and on-line mass spectrometers).

6. Monitoring of tails assays to detect abnormal operational trends.

7. Improving the quality of UF6 cylinder measurements by taking samples from homogenized cylinders, although this was recognized as operationally difficult for tails cylinders.

8. Developing improved nondestructive assay (NDA) and load-cell weighing systems for verifying the contents of full and empty UF6 cylinders and for verifying in-process inventory.

Working Group II recommendations:

Working Group II was responsible for determining measures for the timely detection of facility misuse for the production of HEU and the deterrence of such misuse by the risk of early detection. The working group was composed of technology and safeguards experts from Argentina, Brazil, China, Japan, Germany, France, U.K., and U.S., all of which, except Argentina, are currently operating or building centrifuge enrichment plants. Inspection staff from the European Commission and IAEA, also participated on the working group.

The working group identified that the safeguards measures currently being applied for HEU detection at the existing plants under the current IAEA safeguards approach included design information verification; limited frequency-unannounced access (LFUA) performing of visual observation, environmental sampling, and, potentially, gas sampling; portable enrichment monitoring; on-line continuous enrichment monitoring, containment and surveillance; and location-specific environmental sampling outside the cascade hall.

The working group identified that one combination of safeguards measures is effective for all centrifuge enrichment plants because of differences in plant design and operations. Thus, a tool kit of safeguards techniques would be needed from which the IAEA would select measures to provide effective safeguards with detection in depth. Options and improvements to the safeguards technologies included the following:

1. DIV - use of a 3-D laser range finder and ground penetrating radar to confirm declared design information. The laser range finder was identified to have limitations within a cascade hall because of centrifuge arrangements and limitations on inspector access between the cascades. The effectiveness of ground penetrating radar to identify small pipes in or under concrete floors also needs to be evaluated.

2. On-line continuous enrichment measurements - use of transmission corrected gamma measurements, passive gamma measurements (including use of a slip stream), passive neutron, or authenticated on-line operator mass spectrometer to continuously monitor the enrichment of UF6 gas in product pipes.ffeguards objectives and provide suff

3. Continuous area neutron measurements - use of plastic scintillators, doped fiber-optic glass, Helium-3, or other neutron sensors to perform neutron totals counting within the cascade hall (corrected against independent background measurements) to detect changes in the neutron flux resulting from HEU production or introduction of UF6 containers in the cascade hall.

4. Portable enrichment measurement systems - use of portable gamma or neutron measurement systems to identify potential locations of HEU. The Cascade Header Enrichment Monitor (CHEM) and the Passive Neutron Uranium Holdup (PNUH) systems are examples that could be further developed.

5. Destructive analysis (DA) - use of on-site laboratory or portable measurement instruments to reduce the need for sample shipments and to increase speed of sample analysis. Destructive analysis samples would be used primarily to authenticate and calibrate other monitoring systems and to resolve anomalies.

6. Monitoring of cold traps and chemical traps - use of nondestructive assay (NDA) and DA measurements of evacuation system cold traps and chemical trap materials to detect indications of the production of HEU.

7. Environmental sampling - identification of additional locations (e.g., building exhaust and evacuation systems) where HEU particles might concentrate if present and revision of analytical procedures to increase the speed of sample analysis. In addition, environmental samples could be taken from on-site locations where rainwater would flow and concentrate.

8. Containment and surveillance - use of cameras or seals at potential UF6 gas take off locations (if limited in number) or of door monitors based on cameras coupled to radiation sensors (or other triggers) to detect UF6 container movements through the perimeter doors.

9. Operator systems - use of authenticated operator measurement systems, when possible, to monitor the enrichment process. Non-authenticated signals could be used on certain operator systems to evaluate consistency of operation of the plant with declarations.

10. Separative work balance - use of the separative work calculation as an independent check on nuclear material flows through comparison to the operator's statement of separative work output. The separative capability of the plant is not verifiable; however, because the separative work calculation weights the feed, product and tails enrichment values differently than the nuclear material balance, the ability to change nuclear material numbers without creating an anomaly becomes more difficult.

11. Short-notice random inspections - use of an electronic "mail box" to receive operational

declarations as to use of the facility, including cascade status and running estimates of the separative work produced.

Working Group III recommendations:

Working Group III was responsible for determining measures for the detection of undeclared enrichment of uranium. The working group was composed of technology and safeguards experts from Australia, Canada, France, Japan, Republic of Korea, Russia, Sweden, and U.S., and staff from the ABACC, the European Commission, and the IAEA. The working group did not identify any new technologies that were not already being considered or used by the IAEA.

The working group identified that a combination of techniques is required for timely detection of undeclared activities and recommended the following for enhancing the IAEA's use of the monitoring technologies:

1. Information analysis - the working group identified that the IAEA needs greater access to scientific and engineering publications, and greater information on the industrial infrastructure and trade (including imports and exports) in goods and services relevant to uranium enrichment.

2. Satellite imagery - the working group identified that the IAEA needs access to state-of-the-art imaging technology as well as better imagery signatures for enrichment processes and a means to detect underground facilities.

3. Remote sensing techniques - the working group identified that the IAEA could monitor for acoustic or electromagnetic emanations or chemical species released from an enrichment facility

4. Wide-area monitoring - the working group identified that wide-area monitoring could take advantage of monitoring systems that use airborne, or other mobile, gamma-ray sensors and sampling systems.

5. Environmental sampling - the working group identified that the IAEA needed more information on enrichment-related particle formation processes, and enhanced technologies and procedures to reduce swipe sample analysis time and cost.

6. Inspection activities near suspected sites - the working group discussed a range of technologies for on-site nuclear forensic analysis (including portable instruments for particle analysis, tunable diode laser spectroscopy, trace-level chemical and elemental analysis systems, uranium enrichment monitors, and thermal and gamma-ray imaging).

The working group discussed two other issues regarding potential undeclared production of enrichment: (1) the verification of enrichment research and development facilities and (2) maintaining cognizance of enrichment equipment removed from shut down or refurbished facilities. The working group identified that research and development facilities frequently are operated on recycle and have very small uranium inventories. The small inventory and throughput of the facility require IAEA inspections on only an annual basis; thus, establishing the potential for undetected misuse of the facility for throughput operations during the remainder of the year. The safeguards agreement and the Additional Protocol do not cover verification of the destruction or storage of enrichment equipment. The concern was expressed that equipment removed from a closed facility could be used to build an undeclared enrichment facility in another location.

Next Steps:

The NRC has issued a license for operating the American Centrifuge Demonstration Facility (ACDF) and has received license applications for the National Enrichment Facility (NEF) and

the American Centrifuge Plant (ACP). The ACDF and NEF have been added to the U.S. list of facilities eligible for IAEA safeguards inspections and the ACP is being evaluated by the Executive Branch for placement on the next update of the list. A presentation was made to the IAEA on the ACDF in November 2004, and a presentation on the NEF is tentatively scheduled to be made in June 2005. The IAEA is expected to make a preselection visit to the ACDF during May 2005 and is expected to select the facility for inspections soon thereafter. The U.S. and IAEA are expected to initiate discussions during 2005 regarding safeguards approaches for the ACDF and NEF.

The IAEA has identified that there are weaknesses within the centrifuge enrichment plant safeguards approach developed in the early 1980s that was implemented in Europe and Japan, especially with respect to detection of undeclared activities. Although alternative safeguards approaches are being implemented in China and Brazil, it is also felt that these approaches could also be enhanced. The discussions held during the Technical Meeting on Techniques for the Verification of Enrichment Activities indicate that the safeguards approaches to be implemented at the ACP and NEF may be different than the safeguards approaches currently being implemented at the URENCO centrifuge plants in Europe in the following ways:

1. Systems for the real-time tracking of nuclear material transfer and handling activities may be used that could include an electronic "mail box" for operator declarations of facility operations and cylinder movements (including attachment to the cascade) and electronic tags, camera surveillance, and authenticated load cell scales to verify the "mail box" information and to detect undeclared operations.

2. Operator monitoring equipment (e.g., load cell scales, pressure indicators, flow monitors, and on-line mass spectrometers) may be authenticated and used to attain assurance that the plant is being operated as declared.

3. Real-time HEU detection monitoring may be used to detect undeclared activities. For a cascade hall without valves, the monitoring may be accomplished by a continuous on-line gamma or neutron monitor outside the cascade hall but between the cascade and the first cascade control valve. For a cascade hall containing valves with the potential for cascade isolation and undeclared feed and withdrawal, neutron area monitoring within the cascade hall and door monitoring may be used to detect nuclear material movements.

4. Cumulative HEU detection may also be used to detect signatures from undeclared activities that accumulate with time. Sampling from the building ventilation system and process evacuation system, as well as environmental swipe sampling, may be performed.

CC: Caldwell, Robert; Dembek, Stephen; Smith, Brian