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2007 Annual Health Physics Report for the HEU Transparency Program

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2007 Annual Health Physics Report for the HEU Transparency Program

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During the 2007 calendar year, Lawrence Livermore National Laboratory (LLNL) provided health physics support for the Highly Enriched Uranium (HEU) Transparency Program for external and internal radiation protection and technical expertise related to BDMS radioactive sources and Russian radiation safety regulatory compliance. For the calendar year 2007, there were 172 person-trips that required dose monitoring of the U.S. monitors. Of the 172 person-trips, 160 person-trips were SMVs and 12 person-trips were Transparency Monitoring Office (TMO) trips. There were 12 monitoring visits by TMO monitors to facilities other than UEIE and 10 to UEIE itself. There were two monitoring visits (source changes) that were back to back with 14 monitors. LLNL's Hazard Control Division laboratories provided the dosimetry services for the HEU Transparency monitors.

External Dosimetry

LLNL provided 882 TLD dosimeters in 2006 for monitoring potential external dose: 438 personal dosimeters, 224 control dosimeters and 220 spares to Pragma and TMC in Moscow. Approximately 500 of the dosimeters supplied were returned and were not read. This number includes the unused spare dosimeters from Pragma and Moscow and both the personal and control arbitration TLDs left in Russia until a post trip dose letter is provided. However, both read and unread TLDs needed to be zeroed and re-calibrated before subsequent use.

In 2007, all HEU Transparency monitors went on assignments in Russia with a complete set of personal and control dosimeters. In order to avoid a failure of a trip mission due to lost dosimeters at customs, a pool of 60 spare dosimeters was maintained at TMC in Moscow, in addition to the 50 spare TLDs at the Pragma office. The spare dosimeters are exchanged semi-annually. Customs letters for both the U.S. and Russian customs were included in the dosimeters packages for each trip to facilitate customs inspections if needed. LLNL retrieved all 2007 arbitration dosimeters from the monitored Russian nuclear facilities. The TLDs from the last trips in 2007 were retrieved by the first trips in 2008.

In 2007 we received the external dose readings from the Russian TLDs supplied to the U.S. monitors by the plants as follows:

- SChE – for all SMVs and all monitors
- MPA – for all SMVs and all monitors
- ECP – for all SMVs and all monitors
- UEIE - none

In 2007 LLNL provided DOE's HEU Transparency Program management with post trip dose reports after each trip. All HEU monitors received zero doses from external radiation exposure in 2007.

External dose investigations
For any dosimeter reading above 10 mrem, the arbitration TLD was analyzed together with the reported dose from the Russian TLD, when available, in order to evaluate if the monitor has/has not received an occupational dose from the HEU assignment in Russia. The accumulated personal dose history, the arbitration and Russian TLDs, and the radiological data from the plants are used to resolve exposure investigations. The Russian plants report different minimum dose recording levels from the Russian TLDs: MPA – 10 mrem, ECP – 5 mrem and SChE – 5 mrem.

No external dose concerns were raised during the 2007 calendar year.

Internal Dosimetry

A total of 156 bioassay samples were submitted in 2007: 150 post-trip (for uranium) and six baseline samples (for uranium and plutonium). All HEU Transparency monitors who participated in assignments in Russian uranium processing facilities have provided baseline bioassay samples. All post trip bioassay samples from the 2007 calendar year were analyzed. Two of the post trip bioassay samples showed results slightly above the investigation level. The subsequent investigations showed results that were below or at the normal background level and resulted in no internal dose assigned. One of the cases included both additional alpha spectroscopy analysis of the sample and request and analysis of additional follow-up bioassay sample. The second case was resolved on the basis of subsequent alpha spectroscopy analysis only. There were no other internal dose concerns.

The internal dose is assigned based on the bioassay result (content of uranium compounds in urine), appropriate biokinetic models, chemical and physical form of uranium compounds, and other pertinent information. The minimum detectable internal dose (MDD) from uranium bioassays depends on several factors, two of which are the chemical and physical form of the uranium compound and the time elapsed between a potential uranium intake and the time the bioassay sample was provided. We cannot control the first parameter, however we can try to shorten the time the bioassay sample is collected by obtaining it as close as possible to the day of the return to the USA. This

allows lower uranium intakes and doses to be detected and will improve the reliability of the internal dose assessment.

The established bioassay procedure requires each monitor to provide a post trip bioassay sample within three days of arrival in the USA. For 2007 calendar year, 87% of the samples were in compliance with this requirement, with the average time interval between the arrival of the monitors in the USA and the providing of the post trip bioassay sample being 1.85 days. Only seven monitors have provided bioassay sample more than 10 days after their return to the U.S.A. Appendix A of this report has a chart providing information on the bioassay sample compliance for 2007 calendar year.

In 2007, LLNL provided the HEU Transparency Program management with quarterly internal dose reports (bioassay reports) containing information on the internal dose, the baseline bioassays, the procedure compliance and the status of bioassay samples received, analyzed and in process of being analyzed.

HEU health physics information database

LLNL maintains a confidential database for the HEU radiation protection data. The database contains historical external and internal dose information for every HEU Transparency monitor, as well as specific information for each trip, TLDs supplied, returned or left in Russia, baseline bioassays, submitted signed exposure release form and monitor's data. The health physics database is essential for generating the post trip and the annual dose reports. The HEU health physics database was updated in 2007 to track the quarterly bioassay reports and the annual reports to DOE and individual monitors. In order to comply with the provisions of the Privacy Act of 1984, we have obtained and keep on file signed Radiation Exposure Release forms for all HEU Transparency monitors that had assignments in the calendar year 2007.

The individual annual occupational dose information for each monitor for 2007, detailing the total dose as well as the external and internal doses from each monitoring assignment, was mailed to each monitor in January 2008.

2007 Radiological data from the Russian plants

The 2007 radiological data, received from the Russian uranium processing plants under the HEU agreement, do not indicate that there are radiological concerns for the U.S. monitors working in Russia who follow the work and personnel protection guidelines. The plant radiological data include gamma exposure rates, airborne and removable surface contamination levels in the areas visited by the U.S. monitors. This data supplements the information from the U.S. dosimeters and the bioassay sample analysis. The annexes have provisions for all plants that the radiological environment data be provided to the U.S. for the areas visited by the U.S. monitors. However, the annexes do not specify what data, in what format, over what time intervals averaged or any other details to be provided to the U.S. For example, a provision for sharing contamination or radiological accident data affecting the U.S. monitors is not specified in the annexes.

In 2007 we received the following radiological data from the plants:

- ECP – gamma exposure rates, surface alpha contamination, and airborne alpha contamination for each day of the SMV and for all SMVs;
- MPA –gamma exposure rates, surface alpha contamination, and airborne alpha contamination for each day of the SMV and for all SMVs;
- SChE –gamma exposure rates, surface alpha contamination, and airborne alpha contamination averaged for the 5 days of each SMV;
- UEIE –gamma exposure rates, surface alpha contamination, airborne alpha contamination, and neutron dose rates at the BDMS room averaged over a one-month period with August-September averaged together over two-month period.

The graphs in Appendix B (Appendix B is a separate C/FGI-MOD document) provide the gamma exposure levels and the airborne and surface contamination at the monitoring points and guiding action levels for each of the plants in 2007.

The gamma exposure rates at all plants were about 10 times or more below the "Low Dose" action level. The highest gamma exposure rates (up to 30 μSv/hr) are encountered in the U3O8 storage facility at ECP. This may be due to the measurement practice at ECP. Exposure rates from the U3O8 containers are measured upon a new shipment arrival when the storage facility is full.

The surface alpha contamination levels in general are below the "Low Dose" action level and vary greatly among plants and locations. The surface contamination levels are the lowest at UEIE and the highest at SChE. At the SChE Conversion Plant's fluorination facility and at the Chemical and Metallurgical (C&M) Plant's purification glove box and withdrawal station the surface contamination levels exceed the "Low Dose" action levels which provides further emphasis to the requirement that monitors use personal protective equipment (lab coats, gloves, etc.) and avoid touching Russian equipment.

The airborne contamination is below the "Low Dose" action level in all plants. The lowest reporting levels are in UEIE and ECP, and the highest levels are in the SChE Conversion Plant's withdrawal station and UF6 storage room, in the SChE Chemical and Metallurgical (C&M) Plant's purification glovebox and HEU chips and components storage room, and in MPA's oxidation facility.

Detailed plant radiological data along with the action levels and the recommended precautions are included in each trip's Team Instructions Book.

Health physics support of the BDMS activities

During CY 2007 LLNL provided health physics support during the BDMS sources replacement at ECP and UEIE. The sources at SChE were not replaced in 2007 since Am-241 has a very long half-life while the Cf-252 sources will be replaced in 2008. LLNL provided support for the dose rate measurements around the Blend Down Monitoring Systems (BDMSs) for Russian regulatory compliance and support for neutron dosimetry to UEIE, the Russian Federal Nuclear Center - Institute of Technical Physics (VNIITF, C-70), and ECP.

Neutron and gamma dose rate measurements for regulatory compliance and radiation safety reports for the BDMS source replacement
A consistent dose rate measurement methodology for regulatory compliance is used in all Russian plants. This methodology improves the accuracy and allows a better comparison of measurement results from different years and different sources. The quality and the accuracy of the measurement results provide additional confidence in the source characteristics and their proper installation and manipulation. During the ECP and UEIE source replacement visits, detailed gamma and neutron dose rate measurements were performed at the surface and at one meter from all BDMS units with the assistance and in the presence of the U.S. HEU health physicist. The measurement results were included in the radiation safety reports for the BDMS sources replacements. The radiation safety reports indicate that during and after source replacement the individual doses, as well as the gamma and neutron dose rates around the BDMS, did not exceed the Russian radiation safety limits. We applied (with ECP and UEIE concurrence) less stringent regulatory limits that are based on the lower occupancy levels (less than 8 hr/day and 40 hr/week) in the BDMS premises. These less stringent limits allow six times higher radiation dose rates at 1 meter from the BDMS units and allow the use of stronger sources that can improve the accuracy of the mass flow measurement and can increase the time between source changes resulting in substantial savings to the HEU Transparency Program. The new regulatory limits are reflected in the BDMS radiation safety reports.

The UEIE annex does not mention any radiation safety report or dose rate measurements during the BDMS source replacement. ECP and SChE annexes were negotiated after the difficulties experienced with obtaining a detailed radiation safety report from UEIE. Both ECP and SChE annexes state that upon U.S. request the plant shall provide "….the results of dosimetric confirmation measurements at the HEU-LEU blending area during the replacement of radioactive sources." In 2007 we received the following BDMS radiation safety reports:

- ECP - the report includes the data from each measurement and it was signed by the ECP Radiation Safety and the U.S. HEU health physicist. Air monitoring data for alpha and beta contamination as well as for surface contamination at the blend point during the visit were below Russian and US regulatory limits and were included in the report. We obtained the signed radiation safety report at the end of the source change visit.

- UEIE - the report includes the averaged (over all six FM and EM modules) and the maximum dose rates as in the 2005 and 2006 reports, contrary to the detailed data in the 2002-2004 reports. The report is signed by the UEIE radiation safety as in 2005-2006, contrary to the previous practice when both UEIE and U.S. health physicist signed the report. The report was provided to the U.S. at the end of the source change visit.

The BDMS radiation safety reports document that during and after source replacement the individual doses to all Russian and U.S. personnel involved, as well as the gamma and neutron dose rates around the BDMS, did not exceed the Russian radiation safety limits and that all source replacement operations were conducted adhering to the ALARA (As Low As Reasonably Achievable) principle.

BDMS sources specifications
The source specifications were developed in earlier years in a manner to maximize the output and the reliability of the BDMS measurements and, in the same time, to comply with the Russian Federation radiation safety regulatory limits. The specifics of the dose rate measurement instrumentation and treatment of measurement errors were taken into account in the development of the source specifications.

Bubble dosimeters
During CY 2007 LLNL shipped 110 bubble dosimeters with high sensitivity (~ 20-30 bubbles per mrem) to ECP and UEIE to support the BDMS sources changes (55 dosimeters per campaign). Prior to shipment of the bubble dosimeters to Russia, LLNL tested their calibration with Cf-252 source (The manufacturer calibrates them with Am-Be source.) and, if needed, excluded or exchanged any dosimeters out of tolerance. The bubble dosimeters are used to measure the personal neutron doses for the involved plant, VNIITF and U.S. personnel, as well as, for area monitoring around BDMS. The bubble dosimeter information is valuable for the U.S. monitors and the Russian personnel as an immediate indication in case of a significant neutron exposure or radiation leakage from the BDMS shielding. The current status of the mutually-agreed-to number of bubble dosimeters for the source replacement visits is shown in Table 1.

Table 1 – Current status of the number of bubble dosimeters

	Cf-252 source change	Co-57 only source change
UEIE	**40**	**20**
ECP	**30**	**20**
SChE	**40-50**	**0**

LLNL is exploring the possibility of further reducing the number of the supplied bubble dosimeters consistent with good radiation safety practice and the radiation safety measures and controls during source replacement and relative Cf sources measurements.

Information on DARTS
The available data on DARTS in the BDMS directory include two folders – BDMS Sources and Bubble Dosimeters for the use of the HEU community.

The BDMS Sources folder contains:
- All current and past Cf-252, Co-57 and Am-241 passports for UEIE, ECP and SChE BDMS sources
- Co-57, Am-241, and Cf-252 source specifications
- All radiation safety reports for the source change activities in English and the Russian originals for UEIE, ECP and SChE
- Tables of the detailed dose rate (gamma+neutron) measurements at UEIE, ECP and SChE for regulatory compliance
- Tables of the relative californium source measurements of the new, old, and the reference sources with any pertinent information for source changes and installations at the three plants
- Tables of the Cf-252, Co-57, and Am-241 source positions at UEIE, ECP, and SChE

The bubble dosimeter folder on DARTS contains:
- Test results from the 2002 certification of the bubble dosimeters by Doza (in Russian)
- Bubble Dosimeter Accreditation certificate - original in Russian and the English translation
- Accreditation testing report and description - in Russian and in English

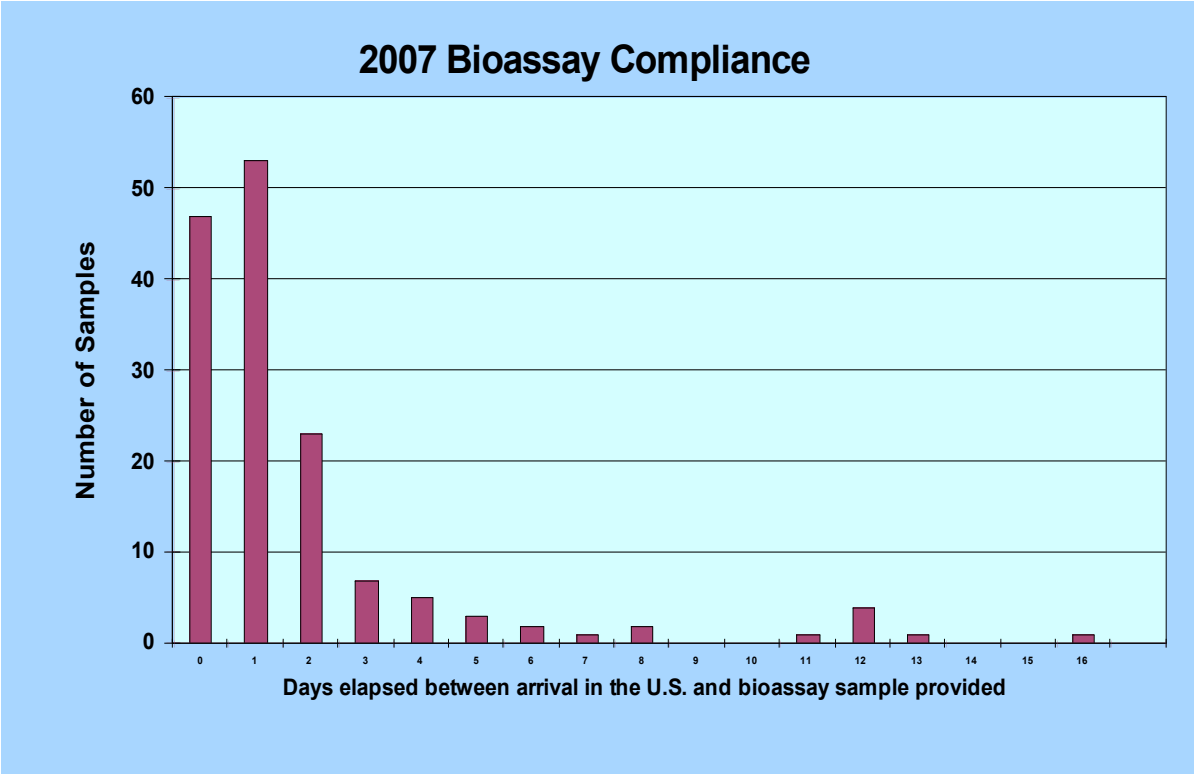
Reporting

In 2007 LLNL provided the following reports related to the health physics issues of the HEU Transparency Program activities:
- Post trip dose reports after each trip
- Quarterly bioassay (internal dosimetry) reports
- 2006 Annual Health Physics Report for the HEU Transparency Program
- 2006 Annual Occupational Dose Reports to each monitor that had a trip to Russia
- 2006 Annual Occupational Dose Reports to the POC for all monitors in his area
- U.S.-Russian radiation safety reports for regulatory compliance after the UEIE and ECP BDMS source replacement.
- Reports on various health physics topics requested by the HEU Transparency Program management

In 2007, the HEU Transparency activities in Russia were conducted in a radiologically safe manner for the HEU Transparency monitors in accordance with the expectations of the HEU Transparency staff, NNSA and DOE. The HEU Transparency now has twelve years of successful experience in developing and providing health and safety support in meeting its technical objectives.

Appendix A

2007 Timely Bioassay Sample Compliance



Appendix B

Appendix B is a separate document that is marked C/FGI-MOD