WIPP CERTIFICATION OF A NEW SUPERHENC AT HANFORD FOR ASSAY OF TRANSURANIC WASTE IN STANDARD WASTE BOXES

Naeem M. Abdurrahman[1], Fluor Hanford
PO Box 1000, Mail Stop T4-52, Richland, WA 99352, Email: Naeem_Abdurrahman@RL.gov

Alan P. Simpson and Steve Barber, BIL Solutions, Inc.
4001 Office Court Drive, Santa Fe, NM 87507

For submission to the
American Nuclear Society Winter Meeting, Washington, DC, November 13-17, 2005

The Super High Efficiency Neutron Coincidence (SuperHENC) technology was originally developed by BIL Solutions, Inc[2], Los Alamos National Laboratory (LANL) and Rocky Flats Environmental Site (RFETS) for assay of transuranic (TRU) waste in Standard Waste Boxes (SWB) at Rocky Flats. This mobile system was certified in 2001 to assay TRU waste for disposal at the Waste Isolation Pilot Plant (WIPP) in New Mexico. The system was operated at RFETS for four years and was a key component in the shipment of over 4,000 SWBs to WIPP. The success of the first SuperHENC led to the order of two new units, delivered to Hanford in 2004 and 2005 for the Waste Receiving and Processing (WRAP) Facility and the Plutonium Finishing Plant (PFP), respectively.

The Hanford SuperHENC is a passive neutron counter combined with high resolution gamma spectrometer. The neutron counter consists of arrays of He-3 detectors embedded in all six sides of the neutron counting chamber thus providing a high efficiency 4π neutron detector. The gamma spectrometer consists of a single HPGe detector and a turntable to allow viewing different sides of the SWB. The turntable also serves as a scale for weighing the SWB during the gamma measurement. The neutron system runs under a derivative of the LANL INCC software [1]. The neutron coincidence circuitry uses the Advanced Multiplicity Shift Register (AMSR 150) which is fully supported by the INCC program. The neutron counter uses the Add-A-Source method for performing matrix correction and normalization. The AAS is a Cf-252 source that travels through a Teleflex cable and stops at pre-selected positions above the floor of the assay chamber. For the matrix correction part, the INCC software calculates the measured response to the AAS, compares this to a reference count and calculates the matrix correction factor. The normalization is a simple and quick check on the empty neutron chamber counting efficiency compared to a reference initial source measurement. The gamma spectrometer uses the DSPEC jr Digital Spectrometer with MAESTRO-32 software package. In addition, PC-FRAM software [2] has been added to the gamma system, providing a robust isotopic measurement capability. Finally a new software package (NGI) has been developed that integrates the neutron and gamma data to provide a final analysis report. The SWB is first loaded on the gamma turntable using a fork lift fitted with special handling attachment (See Figure 1) where it's weighed and measured with the gamma spectrometer. Then it's transferred to the neutron chamber where neutron assay

---

[1] Corresponding author.
[2] Formerly BNFL Instruments, Inc.

is performed. Using the gamma spectrum, PC-FRAM is used to determine and isotopic distribution which then is folded with the neutron data using NGI to produce a radio assay report.

Several new challenges were faced at Hanford: For example, the original RFETS system was calibrated for segregated waste streams such that metals, plastics, wet combustibles and dry combustibles were separated by “Item Description Code” prior to assay. Furthermore, the RFETS mission of handling only weapons grade plutonium enabled the original SuperHENC to benefit from the use of known Pu isotopics. Operations at Hanford and most other DOE sites generate non-segregated waste streams, with a wide diversity of Pu isotopics. Consequently, the new SuperHENCs are required to deal with the technical challenges presented by un-segregated waste matrices and also perform a determination of isotopic grade for each box. The neutron system’s software and calibration methodology have been modified to encompass these new requirements. The new system’s performance has been rigorously tested and validated against WIPP quality requirements [3]. These modifications together with the mobile platform make the new SuperHENC far more robust to handle diverse waste streams and allow for rapid redeployment around the DOE complex.

The calibration program of the WRAP SuperHENC [4] consisted of extensive calibration measurements, calibration confirmation measurements with various matrices and Pu gram loadings, and Total Measurement Uncertainty (TMU) and Lower Limit of Detections (LLD) measurements. Figure 2 shows a typical test SWB used during the calibration confirmation. The calibration program which started in November 2004 was completed in March 2005. The calibration covered a range of LLD to 650 grams of Weapons Grade Pu. The LLD and consequently the Minimum Detection Concentration (MDC) are functions of the net matrix weight (See Figure 3.) The details of the calibration results [5] are being considered for publication in the near future. The WRAP SuperHENC went through initial WIPP Certification Audit and WIPP Performance Demonstration Program (PDP) and started assaying waste in June 2005.

References

1. W Harker, H Menlove and M Krick, SuperHENC Neutron Coincidence Counting Software User Manual v1.03, Los Alamos National Laboratory, Feb 21, 2001.
2. PC-FRAM (PC/FRAM-B32), Plutonium and Uranium Isotopic Analysis Software User’s Manual, Version 4.3, Manual Revision C, Sep 2002.
3. Contact-Handled Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant, DOE/WIPP-02-3122, Rev 3, Apr 2002.
4. Calibration and Validation Plan SuperHENC Mobile Assay System, HNF-22923, Rev. 0, Fluor Hanford, Richland, WA, November 2004.
5. Calibration and Validation Report for the WRAP Mobile Assay System A (SHENCA), HNF-26085, Rev. 0, May 2005, Fluor Hanford, Richland, WA.

Figure 1. Test SWB being loaded on the gamma turntable using a fork lift fitted with special attachment designed for handling SWBs.

Figure 2. Test SWB used during the SuperHENC calibration confirmation showing the interfering matrix material and a grid of insert tubes for loading of the Pu sources.

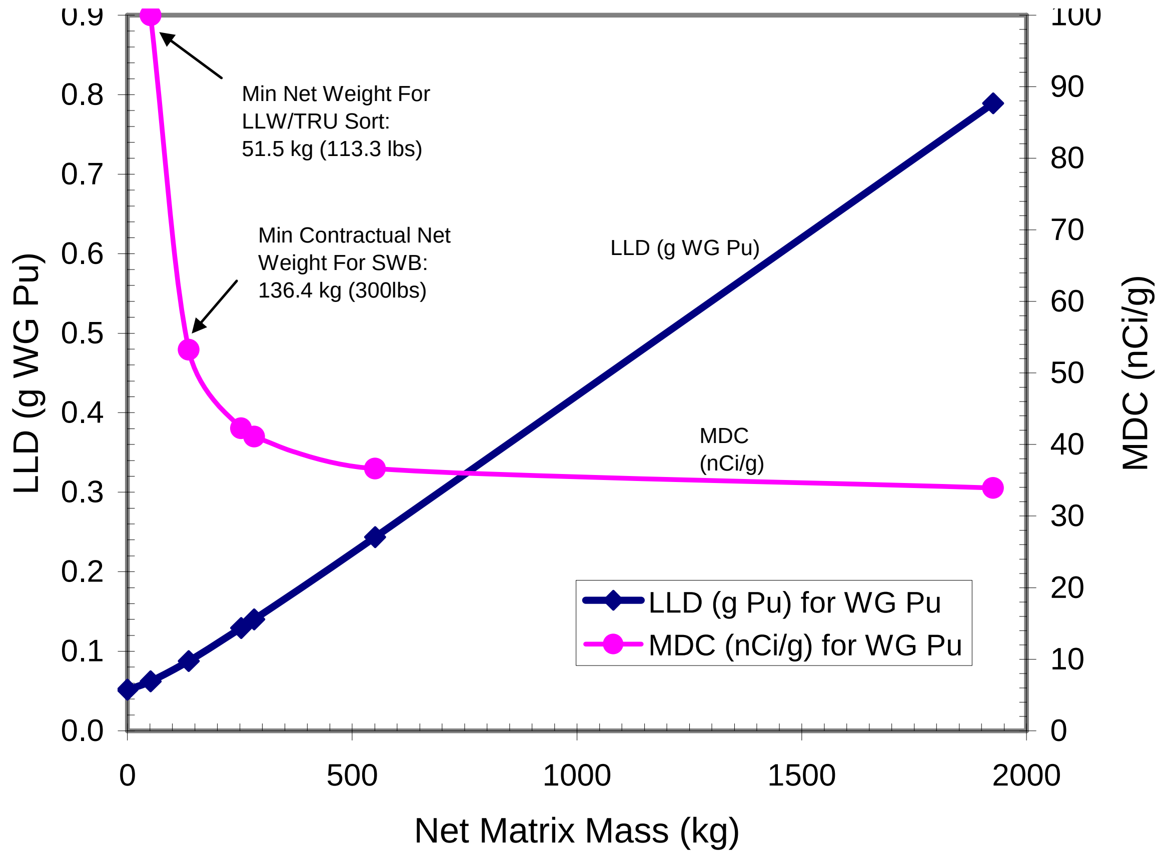

Figure 3. Neutron LLD and MDC plot against net matrix mass.