U.S. DEPARTMENT OF ENERGY

HSS
Office of Health, Safety and Security

Department of Energy Consolidated Audit Program

Risk Management
Cost Reduction
Efficiency
Quality
Safety

Systematic Planning and Data Assessment
SPADAT
Tools and Training Program

MAPEP

Analytical Services Program Fiscal Year 2010 Report

U.S. Department of Energy
Office of Health, Safety, and Security

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Acronyms

ASP	Analytical Services Program
ARSA	American Radiation Services Analytical
CDC	Centers for Disease Control
CHPRC	CH2M Hill Hanford Plateau Remediation Company
DHS	Department of Homeland Security
DoD	Department of Defense
DOE	Department of Energy
DOECAP	Department of Energy Consolidated Audit Program
EM	Office of Environmental Management
EPA	Environmental Protection Agency
FY	Fiscal Year
HSS	Office of Health, Safety and Security
IAEA	International Atomic Energy Agency
LANL	Los Alamos National Laboratory
LBNL	Lawrence Berkeley National Laboratory
LLNL	Lawrence Livermore National Laboratory
LM	Office of Legacy Management
LOC	Letter of Concern
MAPEP	Mixed Analyte Performance Evaluation Program
NIST	National Institute of Standards and Technology
NNSS	Nevada National Security Site
POC	Point of Contact
PT	Proficiency Testing
RESL	Radiological and Environmental Sciences Laboratory
RTP	Radiological Traceability Program
SNL	Sandia National Laboratories
TNI	The National Environmental Laboratory Accreditation Conference Institute
US	United States
VSP	Visual Sample Plan

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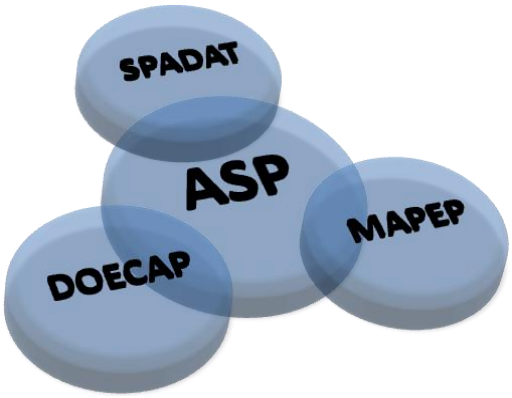
Executive Summary

This report provides an overview of the Department of Energy (DOE) Analytical Services Program (ASP) activities for Fiscal Year (FY) 2010. The ASP is managed through the Office of Health, Safety and Security (HSS), Office of Corporate Safety Analysis, Office of Corporate Safety Programs. Component elements of the ASP are the:



- Systematic Planning and Data Assessment Tools and Training (SPADAT) Program;
- DOE Consolidated Audit Program (DOECAP); and
- Mixed Analyte Performance Evaluation Program (MAPEP).

These planning, auditing, and performance testing activities are key vehicles for assuring quality and reliable data are available for decision-making to support on-going mission critical operations; environmental remediation; clean-up projects; and long term legacy management surveillance. Annual auditing of commercial waste vendors provides increased accountability for the disposition of radioactive and chemical waste from DOE sites. Audit quality, risk management, safety, data quality, cost reduction, and efficiency are attributes promoted through effective implementation of the ASP components.

With over 5000 users world-wide, the SPADAT Visual Sample Plan (VSP) software tool continues to be widely recognized as the tool of choice for systematic planning and Data Quality Objectives process implementation. VSP is currently focused on design and analysis in support of major field activities for the following applications:

- Environmental characterization and remediation;
- Environmental monitoring and stewardship;
- Response and recovery of chemical/biological/radiation terrorist events;
- Footprint reduction and remediation of unexploded ordnance sites; and
- Sampling of soils, buildings, groundwater, sediments, surface waters, and subsurface layers.

DOE leverages financial investments made by the United States (US) Environmental Protection Agency (EPA), Department of Defense (DoD), Department of Homeland Security (DHS), United Kingdom Atomic Weapons Establishment, and Centers for Disease Control (CDC) to develop the VSP software to support statistical sampling design and data decision assessments. The DOE Office of Legacy Management (LM) has also partnered with HSS to jointly sponsor several VSP improvements focused on trend modeling, well redundancy evaluations, analyte redundancy assessments, and upgrading geospatial plume modeling and mapping. Continuing advances were made during the year to enhance and extend VSP application for facility management, design, and security. Sampling for beryllium and radiological contamination within building structures was especially enhanced to assist DOE's effort to reduce work place exposure.

HSS, DOE field site, and intergovernmental agency personnel attended five VSP training sessions. Sessions were held at Lawrence Livermore National Laboratory, the Hanford Site (2), the Nevada National Security Site (NNSS), and in conjunction with the ASP Annual Workshop. Each session utilized leveraged interagency cost sharing approaches between the various participants.

In FY10, a total of 38 DOECAP audits were conducted at analytical environmental laboratories and commercial waste treatment, storage and disposal facilities (TSDF). These audits identified a total of 227 findings leading facilities to take corrective actions and make performance related improvements. Throughout the year the Program validated closure of over 87% of all open findings from FY09 and documented improved performance by the laboratories and waste facilities. Notable improvements were found in instrument calibration processes, continuous refrigerator monitoring to document sample preservation, sample tracking, data reporting, self assessment review, and waste inventory reduction. However, new findings identified risks associated with: Quality Assurance (QA) programs at radiological and non-radiological TSDFs; chemical processing outside the scope of incineration permit allowances; facility safety hazards; and accounting for radiological waste shipments.

In conjunction with these audit activities, the DOECAP identified significant Departmental liabilities in relation to the abrupt closure of two analytical laboratories, handled Freedom of Information Act requests for audit reports, increased opportunities for auditor training, and continued interactions with National consensus standard and interagency quality assurance working groups. As a result of DOECAP FY10 consolidated activities, the necessity for an estimated 90 additional independent field audits was eliminated, resulting in an estimated annual cost savings to the Department in excess of $3.5M, along with additional savings to the audited facilities.

The DOECAP still faces a challenge to increase the pool of qualified volunteer auditors participating in audits and increase involvement of DOE site Points of Contact (POCs). Through participation in the Program, site managers have the opportunity to leverage their resources with other managers and minimize their overall expenditures while achieving DOE goals to investigate, remediate, dispose, and monitor current and legacy issues within the Complex. As funding challenges continue, new options to

the Program's approach may be required. In order to sustain the Program's current level of excellence, innovations and efficiencies will continue to be explored.

The MAPEP provides critical quality assurance testing for environmental analytical services. Radiological and non-radiological (organic and inorganic) constituents are evaluated by performing semiannual Proficiency Testing (PT) of onsite DOE laboratories, other federal laboratories, state laboratories, commercial laboratories, and international laboratories. MAPEP PTs help ensure the accuracy of analytical results reported to DOE and other stakeholders while also providing an efficient means for laboratories to demonstrate analytical proficiency. The validity and reliability of environmental data translates into more confident decision-making relative to environmental remediation, clean-up projects, regulatory compliance, and protection of the general public. Performance data for all matrices (soil, water, air filter, vegetation) from a MAPEP test session (i.e., Series) are also reported to Headquarters' Program Offices, DOE Field Offices, Sample Management Offices or contractors, participating laboratories, and DOECAP audit personnel to support quality assurance oversight and quality improvement.

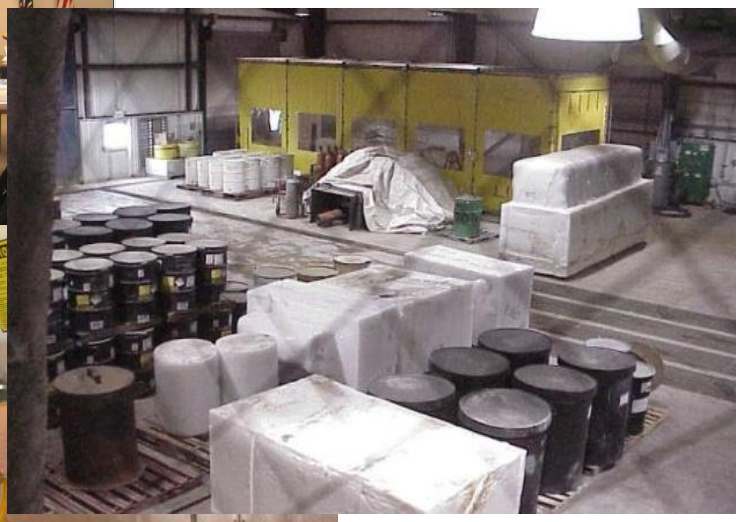
Over the year MAPEP distributed PT samples to more than 100 domestic laboratories and 25 foreign laboratories which resulted in over 12,500 analyses being reported and evaluated. The participants included international laboratories supporting radiological cross-calibration within the Middle East in cooperation with the US State Department, the International Atomic Energy Agency (IAEA), Nuclear Test Ban Treaty participants, and laboratories supporting the monitoring of radiological conditions at the Chernobyl reactor site and surrounding vicinity. Examples of MAPEP enhancements included: improved antimony testing results; guidance to reduce false-positive/false-negative testing; and specially prepared PT samples for radium and uranium isotopes found in Middle Eastern gas field pipe scaling activities. Through direction and funding by the DOE Office of Nuclear Engineering and the Radiological and Environmental Sciences Laboratory (RESL), the MAPEP has recently expanded the opportunity to participate beyond those laboratories supporting DOE missions to those federal, state government, international, or commercial laboratories supporting various homeland security, public defense, environmental protection, nuclear waste, and worker protection programs. The intent is to increase the Program's utility and encompass a broader spectrum of support to protection of the health, safety, and environment of the general public.

Conclusion

The ASP supports the development of quality information DOE decision-makers require to confidently make risk decisions that affect the health and safety of DOE workers, the public, and the environment. SPADAT, DOECAP, and MAPEP assist site personnel in establishing statistically defensible sampling, optimum data collection, quality analyses, data confidence, and assured subcontract support to make good decisions and meet regulatory acceptance.

In 2010, ASP supported all Departmental elements with a corporate environmental data quality assurance approach in a cost-effective manner. In coordination with several other Federal agencies, the ASP continued to: develop software toolkits supporting sampling plans and data assessment; participate on national standards laboratory accreditation committees, interagency task forces, and intergovernmental audits; provide input from DOE to national consensus standards for auditing analytical laboratories; and strengthen the Program's recognition and credibility throughout the United States. Refer to the following websites for additional information: http://vsp.pnl.gov/; https://doecap.oro.doe.gov/; and http://www.inl.gov/resl/mapep/ .

Instruction and Training



On-Site Auditing

Performance Testing

1.0 Systematic Planning and Data Assessment Tools and Training (SPADAT) Program

Data gathered through sampling are used across the DOE complex to support key decisions. This process incorporates a planned sampling strategy to ensure reduced data uncertainty and include rigorous statistical data analyses. By employing systematic planning, sampling design, and statistical analysis tools developed within the SPADAT program, DOE practitioners collect the right sample data the first time resulting in significant cost and time savings.

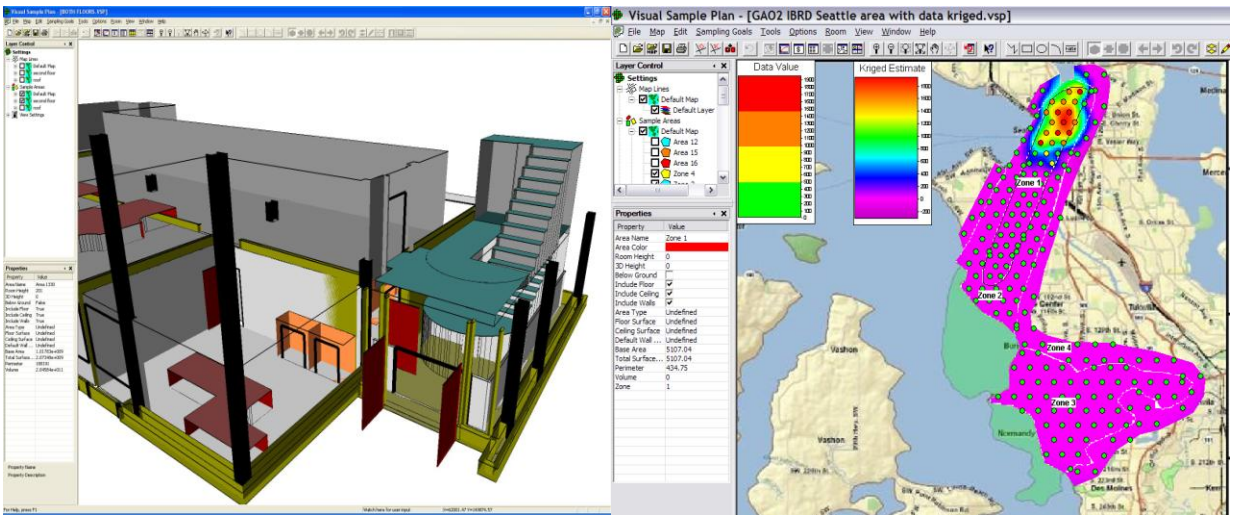


Figure 1.1 – Interior and Exterior Sampling and Data Assessment Tools

Through SPADAT DOE supports the development of Data Quality Objective based unique methods and tools, and provides training to facilitate better, faster, and cheaper approaches to meet regulator requirements while minimizing data gathering and assessment burdens and costs for DOE.

1.1 Scope and Challenges

DOE sites are faced with numerous data-driven decisions. Budget, time, and feasibility constraints limit the number of samples that can be obtained. Optimizing sample collection strategies using VSP tool kits provides appropriate information to assess risk levels. The SPADAT program helps DOE site managers and contractors minimize sampling costs, streamline regulator acceptance, and maintain desired confidence in decision making. The SPADAT program develops tools and training for sampling design and statistical evaluation for a variety of DOE applications including environmental remediation,

environmental compliance, decontamination of buildings, or long-term monitoring. DOE has embraced the concept of systematic planning for data gathering efforts prior to sampling to ensure the data will support the decisions that must be made with sufficient confidence.

Balancing confidence in decisions against increased costs is a challenge and DOE recognizes the need to account for all inherent sampling and analytical uncertainties using valid statistical techniques when arriving at decisions based on sample results. The SPADAT program provides a mechanism to help determine that balance. Sophisticated statistical methods for designing defensible sampling plans and performing pre- and post-sampling statistical analyses in a visually appealing environment are provided within the freely-distributed VSP software. The VSP software is available via the web, while intensive hands-on training sessions provide the know-how. Tools from the SPADAT Program are being employed at every major DOE site.

1.1.1 Benefit and Value to DOE

DOE sites benefit greatly from significant VSP investments by EPA, DoD, DHS, United Kingdom Atomic Weapons Establishment, and CDC. Likewise, those agencies also benefit from the DOE investment. There are many examples of such leveraging of other agency sponsored VSP modules and capabilities for use on DOE accelerated cleanup, legacy management, and decommissioning applications. The value to DOE is demonstrated through:

- New hotspot delineation and costing routines that leverage off methods sponsored by DoD for unexploded ordnance site characterization;
- Radiological survey design and geostatistical analysis that leverages DoD investments in transect survey designs and analyses;
- Drum or item sampling sponsored by United Kingdom;
- VSP validation and QA testing sponsored by DHS and DoD;
- Displaying and sampling across multiple floors within a building sponsored by DHS and EPA; and
- Building drawing, room delineation, and furniture design/placement sponsored by CDC.

1.1.2 Example Applications and Benefits

There are many VSP applications across the DOE complex and other participating agencies. Three examples that illustrate the benefit of VSP follow.

At **Lawrence Livermore National Laboratory (LLNL)**, VSP is an important characterization strategy tool in its beryllium safety program. Utilized to characterize facilities with known or unknown beryllium-use, VSP provided a basis to adjust certain controls associated with beryllium activities. It has also been used successfully in large scale beryllium decontamination projects as part of the acceptance criteria for cleanliness.

At **Jackson Park, in Ostrich Bay, Washington**, the Navy used VSP to develop a sampling plan to support ecological risk related to munitions constituents. Using historical mercury samples, the site was divided into regions of relative homogeneity. Using VSP, the sample size needed to determine if mercury exceeded screening levels was determined. Real time adjustments to error constraints were made during a meeting with EPA and the Tribes, enabling the Navy to propose a design that would meet the needs of all decision-makers.

At the **CH2M Hill Hanford Plateau Remediation project (CHPRC),** VSP is being used to statistically evaluate the radiological contamination conditions of large outdoor areas and to select sample locations to confirm the effectiveness of soil remediation activities. CHPRC uses VSP to design effective survey and sampling strategies to evaluate contaminated outdoor areas. In particular, the judgmental/random statistical method is useful in determining appropriate radiological controls for their outdoor areas. Survey plans based on this method have reduced remediation crew mobilization times by as much as 80% with associated cost savings. CHPRC plans to use VSP-based survey/sample plans to support all future outdoor area remediation activities.

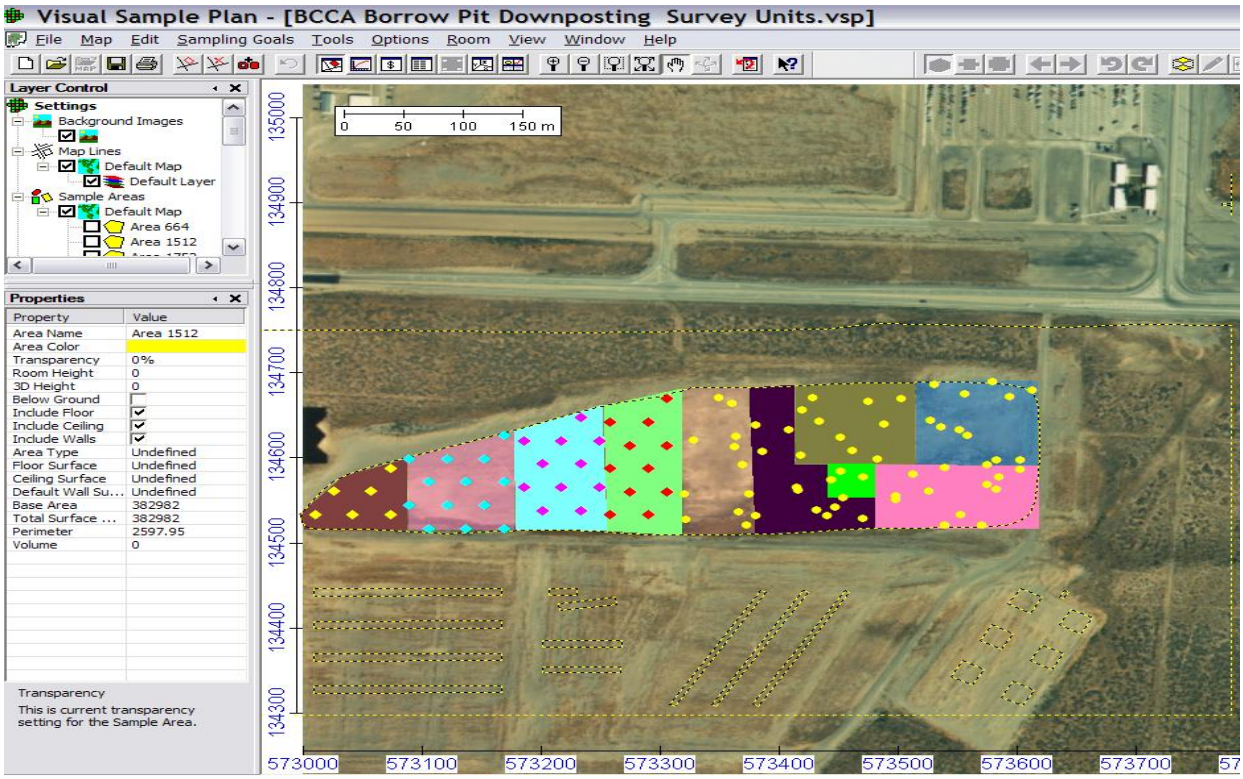


Figure 1.2 – Soil Sampling Options at the Borrow Pit Survey Site, Hanford

1.1.3 FY11 SPADAT Program

In the coming years, DOE will continue to require sampling and data analysis to support environmental, waste management, decontamination/decommissioning, and long-term monitoring. Primary SPADAT goals include: continuing to provide a valuable service to reduce costs, streamline timelines, and gain regulatory approval; provide new VSP toolkit capabilities to support DOE missions; and rollout new targeted training to DOE's benefit. In support of these goals, new additions to VSP will provide DOE users requested enhancements and adjustments. The following additions to VSP will be supported during the FY11 DOE sponsored SPADAT program:

- Multi-increment sampling for hotspot algorithms in VSP;
- Multiple analytes capabilities added;
- Unaligned rid sampling;
- Sequential designs with revise cost savings calculations;
- Complete switchover to sentence style dialogs; and
- Add calculation of standard error to stratified sampling analysis.

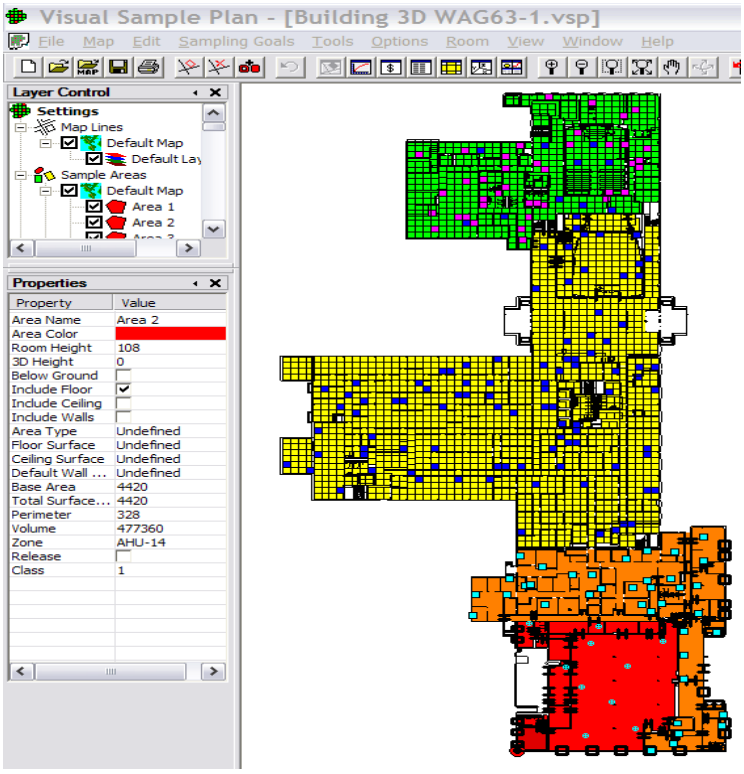


Figure 1.3 – Example of VSP Building Sampling Plan Options

In addition, leveraging other agency investments will provide DOE users with the following capabilities.

- Stratified sampling routines for various surfaces within buildings;
- Proportional allocation of samples based on some criteria (less samples in areas less likely to be contaminated);
- Training course materials expansion;
- Dispersion model guided sampling
- Multi-stage adaptive sampling
- Collaborative sampling for Upper Threshold Limits (UTLs)
- Sampling designs that account for false detection rates
- 3-D Kriging and visualization
- Nearest Neighbor and Inverse Distance Spatial Modeling

There are many new VSP users that require introduction to the basic VSP functions, while more experienced proficient long-time VSP users need assistance learning system modifications and enhancements for field applications. As evidenced by the very high demand, there continues to be a significant need for both the general and the advanced training sessions. In FY11, the 3.5 day VSP course will be offered at two DOE site locations. Cost sharing options are being implemented to benefit DOE program offices, as well as other governmental agencies, through communication with both line management, field site management, and various federal agencies (e.g., EPA, DoD, etc.). Courses sponsored by DoD, NRC, and the United Kingdom are also planned in FY11.

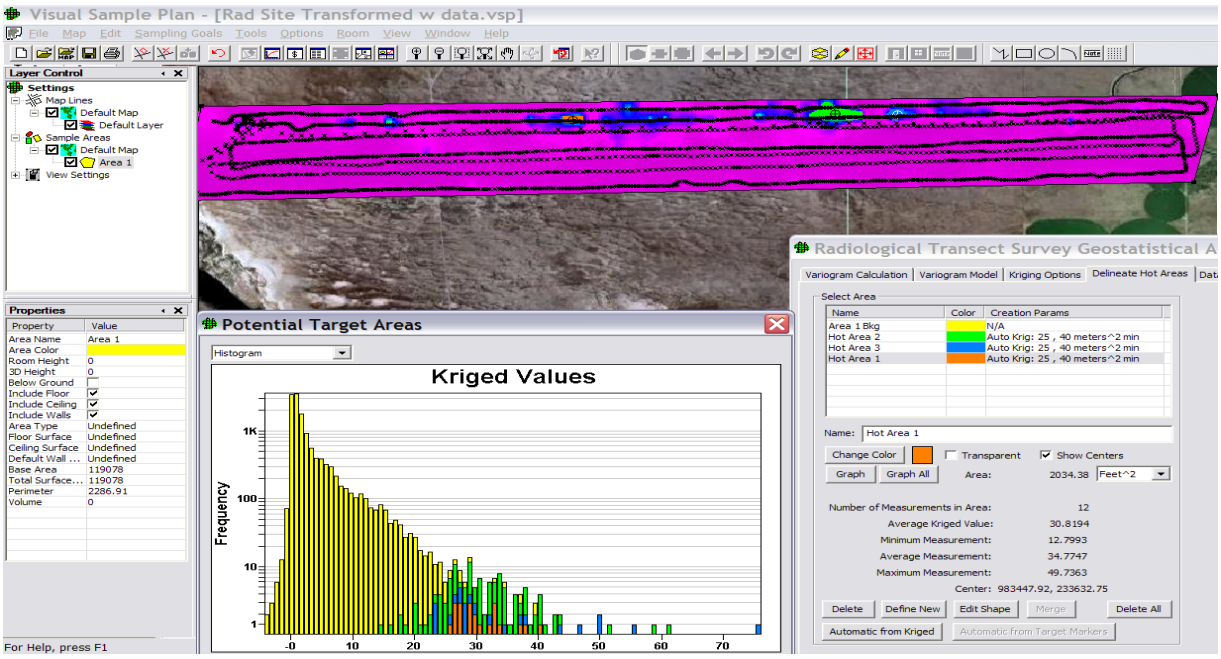


Figure 1.4 – Geostatistical Kriging Evaluation for a Radiological Transect Survey

1.2 FY10 SPADAT Activities and Accomplishments

1.2.1 VSP New Developments

Culminating 3 years of new methods development and significant enhancements, VSP 6.0 was released on June 4, 2010. By far the most extensive QA testing program was performed and over 250 inconsistencies in the VSP code were fixed. The final QA testing effort was a multi-agency effort with support from DHS, DoD, and DOE. All online help, automatically generated reports, and the VSP users' manual were updated. The software is freely distributed on the Pacific Northwest National Laboratory (PNNL) website (http://vsp.pnl.gov) along with the users manual and technical documents that provide

detailed background and mathematics on the statistical methodologies. The FY10 new VSP developments and major accomplishments are outlined and illustrated below.

- ***DOE Users Highest Priority Requested Improvements***

During DOE VSP user training and throughout the year, many incremental enhancements in VSP are requested. In FY10, several of these improvements were completed including the following.

- Default sample placement to quasi-random instead of pseudo-random
- Add log-transform option to data entry and statistical analyses
- Allow systematic sampling for X%/Y% based sample designs
- Put actual and calculated "n" on user dialogs for grid/hotspot modules
- Resolve data entry options when existing sample design locations are present
- Change old user dialogs to sentence structure input

The most substantial improvement was changing the user dialogs from table-like inputs to sentence structure inputs. This significantly improved the DOE user ability to understand the meaning and implications of the input parameters and will greatly reduce miss-use of the software.

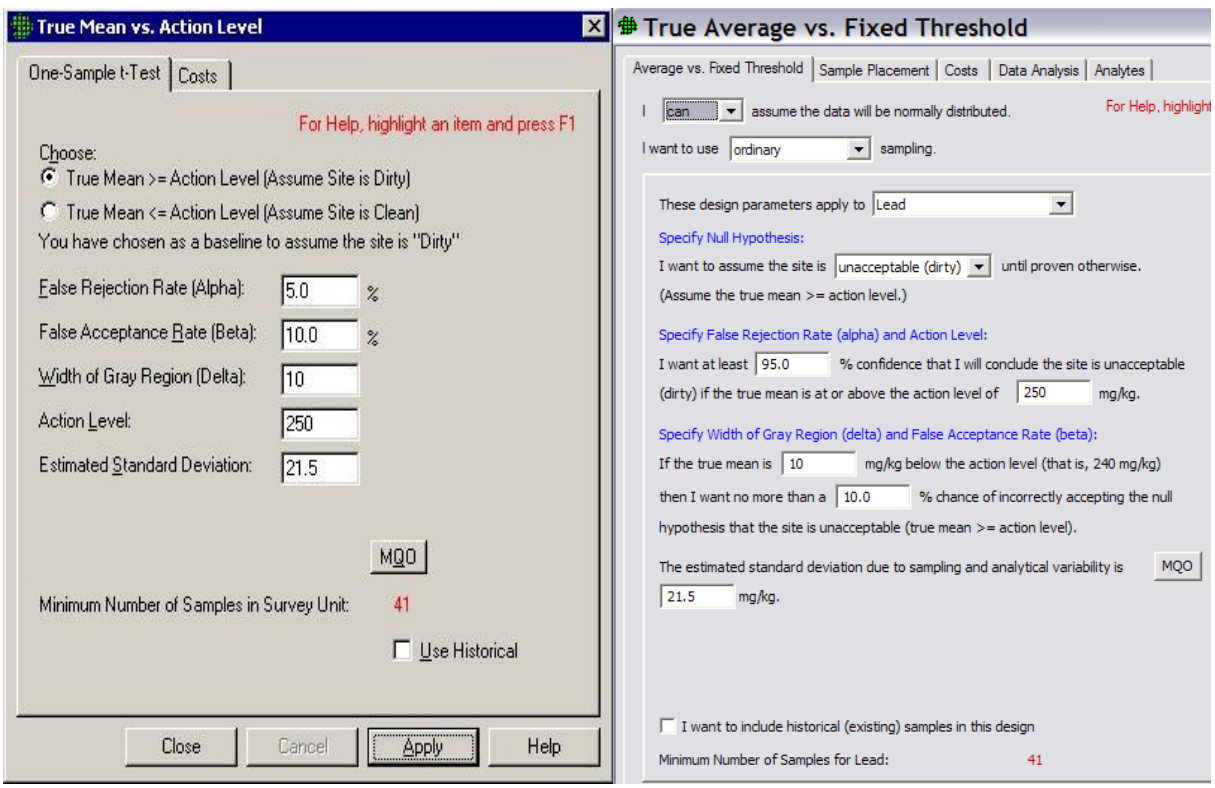


Figure 1.5 – Old VSP Dialog Box (left) versus New Sentence Structured Dialog (right)

- ***Building Features Additions and Improvements***

In decontamination efforts or when releasing a building for other uses, samples from all surfaces including table tops, chairs, walls, floors, and ceilings need to be obtained. Furniture libraries and placement options have now been added with options for sampling the furniture surfaces. Tools have also been added to support 3-dimensional zooming and panning using the mouse. When placing doors, a door is automatically placed in the adjacent room. These improvements make the process of setting up and sampling a building with many rooms and furniture much quicker for the DOE user.

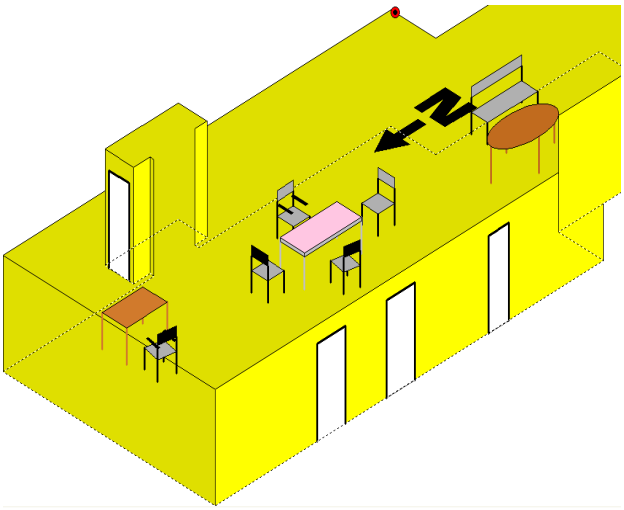


Figure 1.6 – VSP Screen Shot of Placement

- ***Radiological Survey Hotspot Delineation and Analysis***

DOE VSP users identified the need for a method and tools for designing and analyzing radiological transect survey data. Once a survey is performed, they needed a tool to reproducibly, automatically delineate apparent hotspots. By leveraging methods that were developed for DoD's unexploded ordnance program, a new method for radiological survey design, analysis, and hotspot delineation was added to VSP without a large DOE investment.

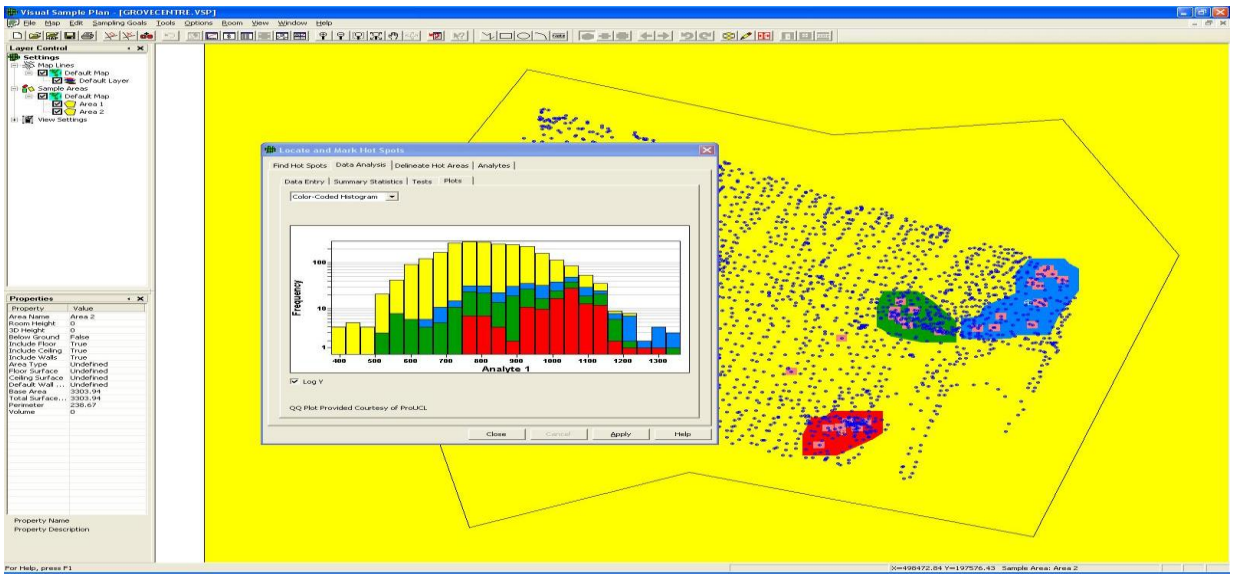


Figure 1.7 – Radiological Survey Hotspot Delineation and Analysis

- ***Hotspot Delineation and Cost of Remediation Tools***

When DOE users identify areas of elevated contamination (hotspots), they usually need to delineate them and derive a cost estimate for remediation based on volumes and layers. With FY10 resources, a hotspot delineation tool has been added that allows the user to manually delineate the hotspot or have VSP automatically delineate it, given user entered tolerances. Total remediation costs are also calculated based on the number of layers, volume of material per layer, and cost of remediation per unit volume. New online help and an automatically generated report are also available.

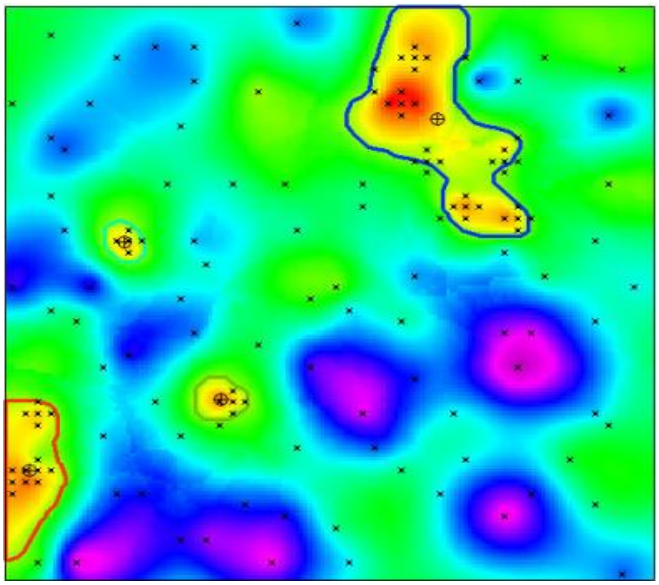


Figure 1.8 – VSP Kriging Option Hotspot Delineation

- ***Real-Time Effluent Monitoring Methods***

DOE users need methods to quickly detect a change in a monitored variable, such as concentration of a contaminant in an effluent stream. In FY10, change detection methods (statistical process control) such as Shewhart and CUSUM charts for detecting changes over time are being added. This will benefit environmental remediation, waste management, and long-term monitoring programs at DOE.

1.2.2 Training at DOE Sites

To facilitate transfer of technology and ensure that the tools are useful and are being applied across the DOE complex, several training courses have been developed and provided. The objective is to get the tools into the hands of DOE site practitioners and ensure that they are sufficiently trained to maximize benefits and protect against miss-use. As new methods are added additional training materials are added. The current 3.5 day training course consists of a 2 day general course directly followed by a 1.5 day more advanced section. These courses are paid for by the benefitting DOE site or cost shared with the site or another government agency, such as EPA. The hands-on 3.5 day VSP course provides the participants an opportunity to work through over 30+ case studies using various VSP modules and gives them experience in manipulating and visualizing results.

Training has been conducted previously at the Idaho National Laboratory, Paducah/Portsmouth Sites, the Oak Ridge National Laboratory, Los Alamos National Laboratory, Sandia National Laboratories (Albuquerque), Lawrence Livermore National Laboratory, the Hanford Site, Pantex, NNSS, the Grand

Junction Field Office, Savannah River Site, Mound Plant, and Argonne National Laboratory. For some of these DOE sites, multiple training courses have been offered as additional VSP capability is added. The training offerings rotate around the DOE Complex depending on needs and time since previous offerings at that site. With the continual additions and updates to VSP, it is envisioned that training will be required.

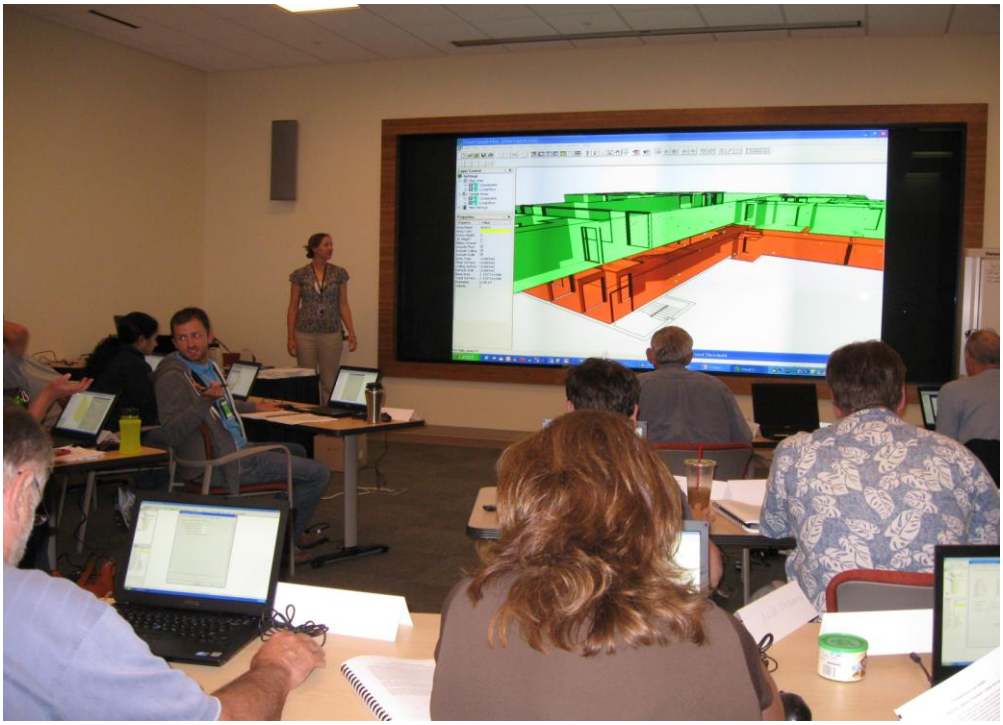


Photo 1.1 – VSP Class Working Through Case Studies

The courses offered at DOE sites in FY10 included one at LLNL (cost shared with EPA), two at Hanford (funded by separate entities on the Hanford Site), and one at the NNSS (EPA provided the facility). Each of these courses was filled to capacity and people were turned away from some of the training sessions due to limited seating. In addition to these regular VSP courses in FY10, a one-day course was offered at the Annual DOE Analytical Services Program Workshop held in Seattle, WA in September 2010. The courses involve not only DOE staff and contractors, but also state and EPA regulators. Course evaluations continue to be extremely positive with many participants stating this has been the best, most useful training they have received in some time.

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2.0 Department of Energy Consolidated Audit Program (DOECAP)

DOE subcontracted analytical laboratory and treatment, storage, and waste disposal vendors are critical components of the Department's missions. Analytical laboratories must provide quality and defensible environmental data and services in support of environmental remediation, site environmental monitoring, and waste management activities. TSDFs are responsible for proper transport, treatment, and disposal of the government's hazardous and radiological waste materials. The DOECAP conducts annual audits of analytical laboratories and commercial waste TSDFs that have contracts or agreements to provide services to DOE sites and projects. DOECAP provides DOE environmental and waste managers confidence that the services are enhanced; risks and liabilities are reduced; continuous improvement is promoted; and regulatory acceptance is improved. DOE Program Offices and sites (i.e., laboratory and TSDF contract holders) participate voluntarily in the DOECAP by providing lead auditors, auditors, and POCs to support the Program. This voluntary participation continues to be vital to the success and viability of the Program. Additional Program information is available on the DOECAP Electronic Data System at **https://doecap.oro.doe.gov/.**

Annual audits motivate laboratories and TSDFs to maintain an awareness of DOE contractual requirements; redouble their efforts to meet local, state, and federal regulations; be consistent with state and federal programmatic requirements; ensure data quality; and competently treat and dispose of DOE waste.

Photo 2.1– DOECAP Laboratory Audit

2.1 Scope and Challenges

The DOECAP has been supporting DOE for the past ten years in response to the DOE Office of the Inspector General and General Accounting Office reports citing inefficiency, redundancy, and ineffectiveness regarding previous audits conducted by the Department. The DOECAP integrated multi-site participation program: standardizes audit criteria, processes, and administration; establishes a cadre of technically competent and trained auditors; establishes a uniform system to track and document

completion of corrective actions; provides a mechanism to disseminate information and lessons learned; and reduces audit redundancy.

The keys to achieve continuing sustainability during the coming years will include initiatives to:

- Identify mechanisms and process improvements to cost effectively implement the Program, while maintaining adequate review of laboratories and TSDFs;
- Promote DOECAP participation throughout the DOE Complex and encourage Complex-wide involvement, including participation from Program Secretarial Offices, with emphasis toward the Office of Environmental Management (EM), the National Nuclear Security Administration, the Office of Science, and LM; and
- Enlist individuals as DOE site POCs who will actively promote the Program and educate each site regarding the benefits and importance of the Program.

2.1.1 Benefit and Value to DOE

Specific cross-cutting value added benefits derived through effective implementation of the DOECAP include:

- Risk Management – Reduced risks and liabilities for the Department based on quality analytical data being used in environmental decision making, and the proper disposition of low-level mixed radioactive waste and chemical waste.

- Cost Reduction – Consistent savings to the Department and taxpayer through audit consolidation and reducing the number of DOE audits in half.

- Efficiency – Increased efficiency through the use of centralized DOECAP program management functions and established uniform technical and analytical quality standards.

- Audit Quality – Improved audit quality and consistency as a result of drawing from a large highly qualified pool of technical experts from across the DOE Complex and using standardized DOECAP processes (e.g., checklists).

- Data Quality – Improved analytical laboratory performance and data quality resulting from resolution of audit findings through implementation of the DOECAP corrective action process.

- Safety – Improved handling of DOE environmental samples and waste through verification of compliance with applicable standards and regulations, including conduct of DOECAP regulatory agency reviews as part of TSDF audits.

2.1.2 Example Applications and Benefits

The following are a few examples where the DOECAP has provided beneficial information or made a significant impact toward improving and safeguarding DOE interests.

The DOECAP identified and took action on laboratory facility closures. The DOECAP Operations Team was the first to identify and respond to two different laboratory closures during the year. These included American Radiation Services Analytical (ARSA), Albuquerque, New Mexico and Centauri Laboratories Inc., Montgomery, Alabama. DOECAP immediately made contact with the principals of these organizations, determined their operational status, conducted an on-site review at ARSA, and notified the DOE community. The primary concern regarding closed facilities is to secure and document the return or disposal of all DOE sample residuals and associated wastes, thus minimizing any potential liability or risk to DOE. Contacts and conferences with site project management and DOE General Counsel resulted in National Nuclear Security Administration program line management taking responsibility to complete actions and secure proper disposition of materials.

The DOECAP identified the need for critical QA elements at non-radiological TSDFs. In response to multiple DOE field requests the DOECAP added three primary use non-radiological TSDFs to its audit calendar. Based on these reviews the audit teams identified the need for these operations to develop and adopt more formal QA processes. These operations lacked QA implementation, and key elements such as training, document control, and assessments requirements were deficient or ineffective at the sites. As a result, Clean Harbors, the single corporate entity managing these facilities, is developing a plan to implement an Environmental Management System for its incineration facilities that will incorporate applicable QA requirements.

The DOECAP identified a significant safety issue at one TSDF. A high voltage electrical panel was found damaged. The handle was missing and the panel door was ajar. An attempt had been made to close the panel using a wire hanger and electrical tape. Once identified by the audit, facility personnel took immediate action to correct the situation.

The DOECAP elevated a continuing aged waste concern to a Priority I Finding. The facility's volume of radiological contaminated hazardous waste exceeded treatment and disposal timelines, and was not in conformance with existing DOE contract requirements. The DOECAP documented the concern through a Priority I Finding and notified the DOE community. Actions by the facility have now resulted

in substantial reductions in their aged waste inventory. Although the reduced backlog of legacy waste remains an issue, there has already been a reduction in liability and risk for the DOE. Actions through the DOECAP fostered improved communications between the facility and the state regulator; encouraged significant progress in facility actions to reduce waste inventories; and helped establish a firm schedule to remove aged waste materials.

2.2 FY10 DOECAP Activities and Accomplishments

2.2.1 Audit Performance

In FY10, a total of 38 DOECAP audits were conducted: 27 at environmental analytical laboratories; 8 at commercial TSDFs accepting DOE mixed and low-level radioactive waste and chemical waste; and 3 at commercial TSDFs accepting DOE hazardous chemical non-radioactive waste. Figure 2.1 depicts the approximate locations of the various audited facilities.

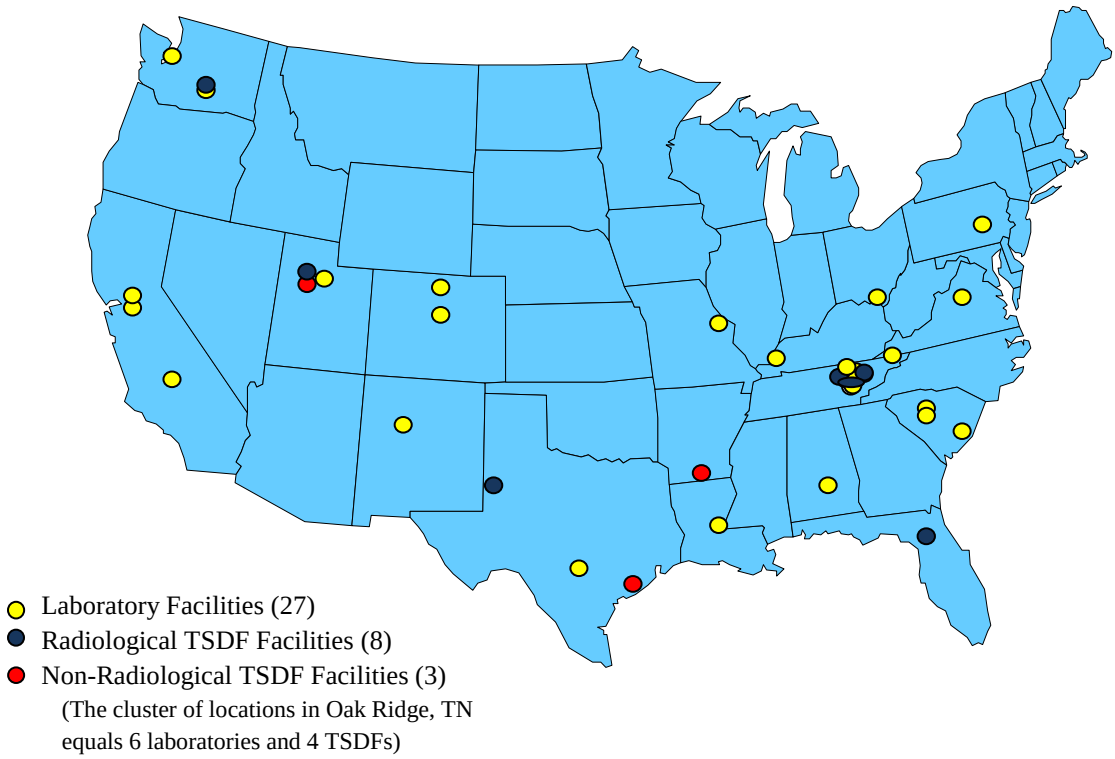

Figure 2.1 FY10 – DOECAP Evaluated Laboratories and TSDFs

While these audits were primarily initial and continuing audits, one was conducted as a closure audit to remove a laboratory from the process. The 27 FY10 DOECAP laboratory audits were conducted by teams filling a total of 151 audit positions, provided by 12 separate DOE sites, for a total of 400 auditor-days on site at the audited laboratories. The 11 FY10 DOECAP TSDF audits were conducted by teams comprising a total of 80 audit positions, provided by 15 different DOE sites, for a total of 240 auditor-

days on site at the audited TSDFs. A complete listing of laboratories and TSDFs audited by the DOECAP in FY10 is provided in Appendix B of this report.

A total of 167 laboratory audit findings were issued. Five were Priority I findings related to multiple PT failures for the same analyte on sequential rounds of testing. Most have been adequately addressed and corrected by the impacted facilities during the course of the audit cycle. However, a few still remain open at two laboratories. During the course of the TSDF audits, 59 Priority II findings were issued along with one Priority I finding. It is anticipated the single Priority I issue will be resolved shortly, without disrupting facility or DOE waste activities. The FY10 audit cycle was also able to document closure of 88 percent of previously issued DOECAP laboratory findings and 82 percent of previously issued TSDF findings. All active facilities in the Program have demonstrated acceptable performance and have quality systems to support DOE site activities and needs. The following paragraphs generalize audit findings illustrating the continuing effort required by all participants to strive for continuous improvement.

Common TSDF Findings

Figure 2.2 illustrates the percent distribution of FY10 TSDF findings by audit area. Evaluation of Priority II findings issued to TSDFs in FY10 identified common deficiencies and demonstrated an audit area distribution that will be helpful in developing a focus for next year's reviews.

The two audit areas where most findings were identified in FY10 were Industrial & Chemical Safety and QA. FY11 auditing will increase attention toward these areas in order to determine effective implementation of corrective actions while ensuring facilities have taken measures to prevent recurrence.

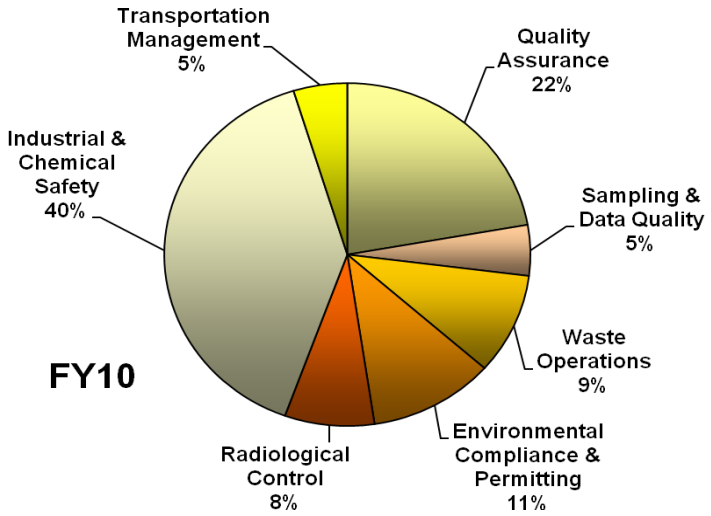

Figure 2.2 – TSDF Finding Distribution by Audit Area

Common Laboratory Findings

Evaluation of laboratory findings issued or left open in FY10 similarly reveal several common deficiencies across the facilities and provide trending data that will be used for planning future audits. Figure 2.3 illustrates the percent distribution of FY10 laboratory findings by audit area. The two audit areas where most findings were identified in FY10 were Hazardous & Radioactive Materials Management and QA.

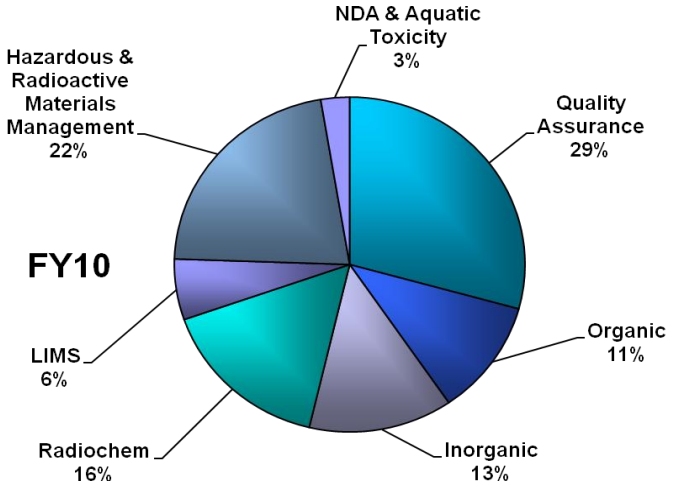

Figure 2.3 – Laboratory Finding Distribution by Audit Area

The result of implementing a consistent auditing program in conjunction with consistent application of quality requirements is demonstrated through years of implementation. Figure 2.4 illustrates the overall improvement of the participating facilities ability to implement quality systems. A reduction in overall total findings and observation rates from 69.9 per facility FY2001 to 26.9 per facility in FY2010 is noted. This reflects the Program's ability to achieve process improvement in the services being provided. The intensive annual auditing sets standards that the facilities achieve and in the process improves their operational capabilities to provide DOE the quality services required to reduce DOE liability and risk associated with environmental programs and waste disposal activities.

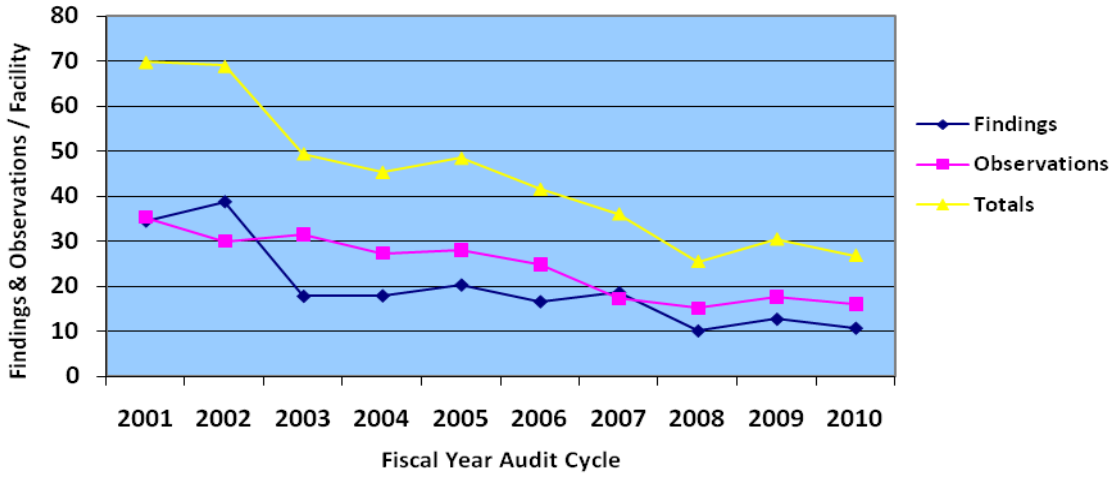

Figure 2.4 - Combined Laboratory and TSDF Audit Performance Statistics

2.2.2 Auditor Qualification and Training

Prospective DOECAP auditors and lead auditors are recommended for qualification by DOE sites in a particular audit area or areas. DOECAP Procedure AD-1, *DOECAP Policies and Practices*, establishes the requirements for auditor qualification documentation, evaluation and approval. Continuing certification is maintained by completing at least one DOECAP audit every two years and completing annual online required training. The Program was able to successfully train lead auditors and auditors during the period to maintain a consistent auditor pool. As illustrated in Table 2.1, the qualified DOECAP laboratory and TSDF auditor base remained steady during FY10.

	Lab	TSDF
Lead Auditors start of FY10	11	5
Lead Auditors ending FY10	10	6
Auditors start of FY10	50	55
Auditors ending FY10	53	54

Table 2.1 – FY10 DOECAP Lead Auditor and Auditor Qualification Status

Sites are encouraged to submit prospective auditors for qualification in all audit areas. Specific laboratory audit areas requiring additional qualified auditors are: Laboratory Information Management Systems and Electronic Data Management; Hazardous and Radioactive Materials Management; Radiochemistry; and Lead Auditor positions. Specific TSDF audit areas requiring additional qualified auditors include Radiological Control, Industrial and Chemical Safety, and Transportation. The Program needs more Federal employees participating as team leaders and auditors, and requires increased DOE line management and field resources to adequately support projected future Program activities. Participation on an equitably shared basis commensurate with analytical and TSDF contract volumes and usage is necessary to adequately implement the Program. The Program continues to be challenged to fully staff all disciplines for the number of audits being scheduled.

2.2.3 Program Participation and Support

The DOECAP is based on the fundamental premise that DOE sites will provide qualified auditors and the DOECAP Operations Team will coordinate these resources to organize Complex-wide assessment teams to execute combined laboratory and TSDF audits. This overall consolidation lowers cost to any given site, as well as to the Department. Past Program success has been enhanced by sites designating appropriate POCs and submitting technically qualified personnel for qualification as DOECAP auditors.

Active site participants are listed in Table 2.2 on the next page.

Brookhaven National Laboratory	Nevada National Security Site
East Tennessee Technology Park - Oak Ridge	Oak Ridge National Laboratory
EM Consolidated Business Center	Office of Legacy Management
Environmental Management Headquarters	Office of River Protection
HSS Headquarters	Pacific Northwest National Laboratory
Idaho Operations Office	Pantex Site Office
Lawrence Berkeley National Laboratory	Sandia National Laboratories
Lawrence Livermore National Laboratory	Savannah River Site
Lexington Field Office	Thomas Jefferson National Accelerator Facility
Los Alamos National Laboratory	Y-12 National Security Center

Table 2.2 – Active FY10 DOECAP Participants

Figures 2.5 and 2.6 on the next page illustrate DOE site participation in DOECAP audits of laboratories and TSDFs, respectively, for the past 3 years. Oak Ridge sites include participation from the East Tennessee Technology Park, Oak Ridge National Laboratory, and Y-12 Security Complex, while the Hanford sites include participation from PNNL, Richland Operations, and the Office of River Protection. These figures illustrate the continuing dependence of the Program for on-site auditing support from Oak Ridge Operations and Operations Team personnel. A portion of auditor losses is attributed to the closure of major DOE facilities at Rocky Flats, Fernald, and Mound. However, continuing pressure on sites to decrease costs has also caused reduction in support from various operations. In order to ensure continuing Program success, all sites need to maintain or increase their volunteer auditor contributions.

2.2.4 Program Achievements in FY10

The Program continues to provide DOE beneficial services through:

- Consolidating audit planning, scheduling, coordination, and implementation;
- Achieving cost savings for the Department, estimated at $3.5M for FY10 through the elimination of approximately 90 redundant audits;
- Maintaining standard audit procedures, including standardized audit reports;
- Implementing standard auditor qualification requirements;
- Maintaining a cadre of DOE and contractor auditors and POCs from across the DOE Complex;
- Coordinating and centralizing audit findings and corrective actions;
- Maintaining the Electronic Data System to consolidate and disseminate information; and
- Interacting with regulatory agencies to establish national consensus standards enabling increased uniformity, understanding, and consistency between oversight agencies (EPA, DoD, states, etc.).

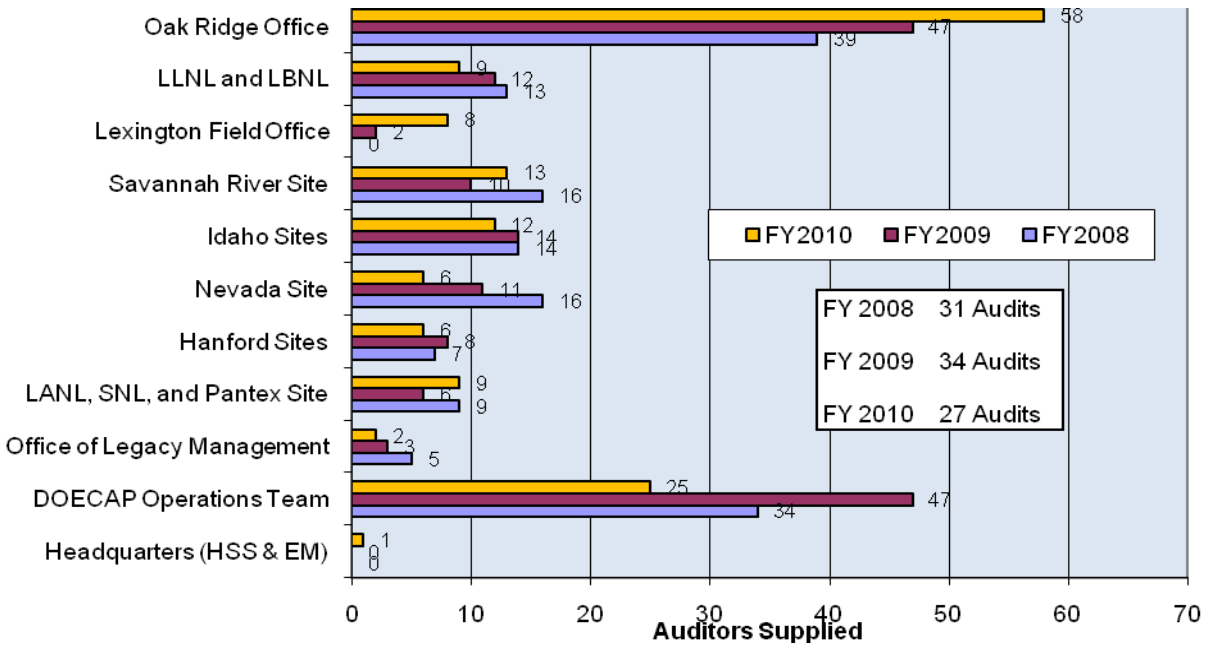

Figure 2.5 – DOECAP Laboratory Audit Participation for the Past Three Years

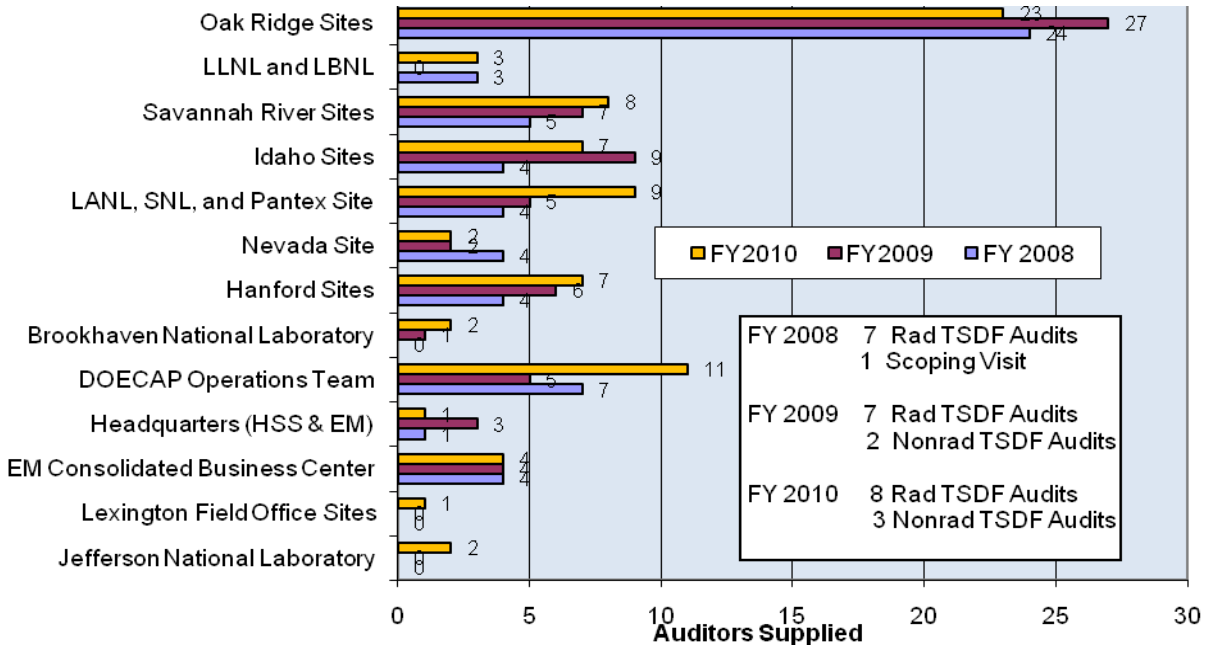

Figure 2.6 – DOECAP TSDF Audit Participation for the Past Three Years

The Program had a successful year with multiple initiatives interacting and contributing to traditional work efforts. The following table and discussions address the various FY10 achievements.

DOECAP Fiscal Year 2010 Goals & Initiatives	Achieved	Partially Achieved	Not Achieved
Implement Successful Laboratory and TSDF Audits	✓		
Implementation of Non-Radiological TSDF Audits	✓		
Implement Pre-Audit Scoping Visits	✓		
Continuing Utilization of Interim Findings		✓	
Maintain Program Processes and Procedures	✓		
Increase Program Participation, Auditors and Lead Auditors		✓	
Increase Program National Interactions	✓		
Upgrade Electronic Data System's Platform and Operation			✓

Laboratory and TSDF Audits

As indicated previously in Section 2.2.1 of this report, 38 DOECAP audits were successfully conducted in FY10, including 27 at analytical laboratories and 11 at TSDFs (radiological and non-radiological). Although the number of laboratory audits was reduced, TSDF audits saw an increase of approximately 22% over the FY09 audit cycle. Program accomplishments were performed within a constant administrative budget.

Non-Radiological TSDF Audits

The FY10 goal was to maintain the initiative to perform non-radiological TSDF audits. This goal was achieved through the review of Clean Harbors' facilities at Aragonite, Utah; El Dorado, Arkansas; and Deer Park, Texas. These were accomplished with full compliments of auditors from the various DOE field sites utilizing these operations. Conducting these continued to challenge auditors and facility personnel; however, all parties performed well, established good rapport, and completed the audit processes successfully.

Pre-Audit Scoping Visits

The Program continued to perform pre-audit scoping visits to new facilities being introduced to the process. During FY10 this included two new TSDF operations; the Clean Harbors' facility at Deer Park, Texas and the IMPACT, Inc. operation in Oak Ridge, Tennessee.

Interim Findings

An interim finding has been defined by the Program as a factual statement issued from the DOECAP to document a deficiency that is identified outside the scope of an on-site audit of a facility. This may occur during analytical data review processes, PT evaluation processes, interactions during waste shipment processes, etc.

Programmatic procedures to identify and issue these interim findings were established during FY09. Interim findings have been and are continuing to be identified relative to poor PT performance by analytical laboratories; however, the intent to have the DOECAP community utilize this mechanism on a broader scope has not been realized. The Program will continue to promote the use of this concept within the DOECAP community.

Program Processes and Procedures

Continuing initiatives were implemented during FY10 to improve the Program processes and procedures. These efforts focused on the following areas and concepts:

- Requiring facilities to include causal analysis as part of their Corrective Action Plans;
- Distribution of individual audit reports to principal DOE managers utilizing each facility;
- Continuing training for Auditor-in-Training mentors;
- Completion of Non-Destructive Assay auditing processes into the Program;
- EM review of TSDF Checklist information in relation to contract requirements; and
- Completing Activity Hazard Assessments in relation to auditing practices and activities.

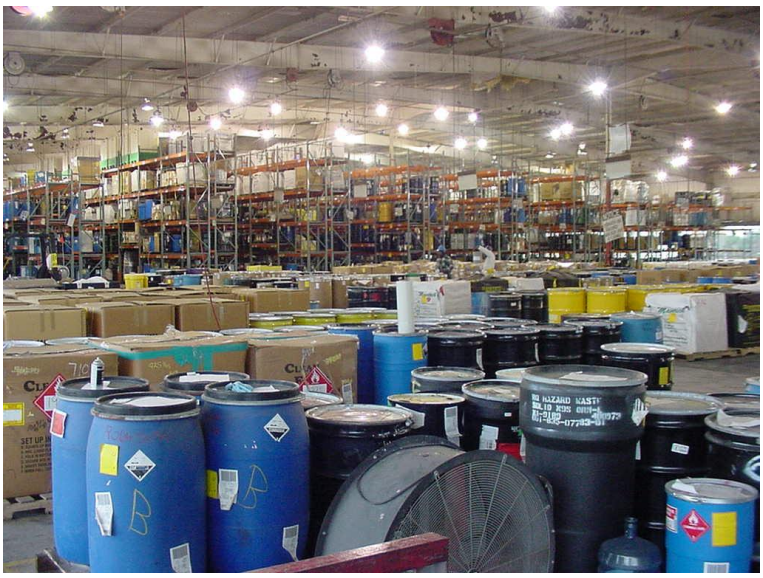

Photo 2.2– DOECAP TSDF Audit

Program Participation

The DOECAP continues to promote participation throughout the DOE Complex through coordination with the POCs and auditors. Continued support from the DOE sites including audit participation, conference call participation, and annual meeting participation has remained constant even though major DOE sites have been closed, site budgets have diminished, and there is an aging workforce.

The Program filled 97% of the laboratory audit positions and 98% of the TSDF audit positions during the course of the audit cycle. The Program was able to add new auditors and lead auditors during the year, unfortunately several auditors and leads were also lost due to retirements and work assignment changes,

leaving the program in basically a steady state in terms of available personnel resources. The continuing goal to recruit additional auditors in the coming year will be challenging.

Program National Interactions

The DOECAP increased its interactions within DOE and with other governmental agencies during FY10. Representatives participated in workshops and activities to promote the cooperation and sharing of lessons learned between various organizations. These activities included:

- The HSS ASP manager and DOECAP representatives met with several site management groups, including Lawrence Livermore National Laboratory, the Hanford Site, and the Oak Ridge Office, to discuss the benefits of the Program and gather feedback for improvements.
- Interaction with the EM Low Level/Mixed Low Level Waste Corporate board during their December 2009 Nashville meeting. This resulted in dissemination of DOECAP TSDF Checklists across the Complex for review and comment. Input received from these reviews demonstrated compliance with contract requirements and acceptance of the Program's approach.
- Participation in bi-weekly Mixed and Low Level Waste conference calls with EM-43 counterparts to obtain and contribute information regarding waste operations and audit activities.
- Individual scoping conference calls with EM counterparts for upcoming TSDF audits.
- Interaction with and response to the DOE General Accounting Office regarding requested information on perchlorate analysis and analytical capabilities in the Program laboratories.
- Attendance at The National Environmental Laboratory Accreditation Conference Institute (TNI) Meeting in January 2010, the DoD Data Quality Workshop in April 2010, the National Environmental Measurements Conference in August 2010, and the RadWaste Summit in September 2010. Participation continues to foster Program improvements, promote DOE interests toward National Standards, share lessons learned (EPA, DoD, etc.), and clarify the challenges and issues associated with analytical laboratories and waste operations.
- The DOECAP Technical Operations Coordinator continues to serve as a member of the TNI Environmental Laboratory Advisory Board and is part of the Measurement and Technology Workgroup, while the DOECAP Operation Team Lead serves as a member of the Onsite Assessment Committee. The ASP Manager is on the TNI Board of Directors as an ex-officio member and on the TNI Laboratory Accreditation Systems Committee.

Electronic Data System Platform

The current Electronic Data System is based on older technology, built on an old platform, and continuing patches have not been completely effective. During FY10 the Operations Team promoted transitioning the database to a new system's platform. Efforts were made during the year to initiate and complete this transition. Unfortunately little progress was made toward developing a prototype and moving records and operations to a new electronic platform. Discussions are underway to stimulate progress on this initiative, and it is now hoped a new system may be available sometime in calendar year 2011.

3.0 Mixed-Analyte Performance Evaluation Program (MAPEP)

3.1 Scope and Challenges

Photo 3.1 – Proficiency Testing Standards

The Mixed Analyte Performance Evaluation Program (MAPEP) is designed to help assure the quality and reliability of analytical data necessary for general public protection, environmental protection, regulatory compliance and DOE risk management decisions. The DOE's Radiological and Environmental Sciences Laboratory (RESL) under the management of the DOE-Idaho Office administers MAPEP in cooperation with HSS. The MAPEP targets identification and quantification of radiological and non-radiological constituents (i.e., mixed analytes) in the same sample for water and soil matrices. Air filter and vegetation matrices are also prepared for radiological constituents, and gross alpha/beta samples are provided for air filter and water matrices. Participation in MAPEP is required for laboratories performing environmental analytical services for the DOE and performance is a factor in awarding DOE service contracts. Laboratories participate in MAPEP based upon their application to RESL; a need to conduct analytical services in connection with DOE sites or programs; and a desire to produce high quality analytical data results. In addition, MAPEP has established cooperative agreements with international laboratories in an effort to promote regional and global environmental interests.

3.1.1 Benefit and Value to DOE

The MAPEP program challenges analytical laboratories supporting DOE and its missions. It is the only laboratory PT program that targets the performance of analytical laboratories based on low-level mixed-analyte matrices. This semi-annual testing of radiological, inorganic, and organic analytes helps assure the quality of environmental data for regulatory compliance and environmental management decision-making processes for DOE field sites.

MAPEP participants can effectively demonstrate their proficiency in radiological, stable inorganic and organic analyses from single-blind PT samples traceable to the National Institute of Standards & Technology (NIST). MAPEP is performance-based and does not specify the methodology to be used for the various sample analyses. MAPEP also provides a forum in which analytical deficiencies and areas for improvement can be identified, technical assistance can be requested, and various methodologies can be compared.

3.1.2 Example Applications and Benefits

The following are brief descriptions of a few instances where the MAPEP has provided beneficial information and made significant impact toward enhancing data quality.

Implementation of MAPEP has improved analytical laboratory performance. Participating laboratories have dramatically improved their analysis of parameters such as antimony and uranium. The majority of laboratories were not completing appropriate digestions for antimony, which the MAPEP PT samples clearly identified as the problem and corrections were implemented. Similarly, incomplete sample preparations were detected and corrected for uranium analysis through this blind PT program.

Photo 3.2 - RESL staff preparing MAPEP samples

The MAPEP identified poor analyte sensitivity performance through the reporting of false positive results. The MAPEP actively tests and evaluates analytical performance at or near the parameter detection limits. Early in the Program, close to 50% of the domestic laboratories were reporting statistically false positive results, while now they are rarely seen. This accuracy at the detection levels is critical to DOE's reporting creditability.

Semi-annual distribution promotes continuous attention to and responsibility for quality analysis at laboratories. Laboratories are challenged to properly perform and report these analyses with a frequency that requires their complete attention throughout the year. Considering the receipt protocol, analytical method execution, data reporting, and data evaluation, laboratories are involved with this Program on a routine basis.

The MAPEP has expanded availability and access beyond the immediate DOE Community. The opportunity for participation is now offered to all federal, state, and commercial laboratories supporting homeland security missions, general public defense, and emergency response. The intent is to increase the Program's utility and encompass a broader spectrum of support for protection of the health, safety, and environment of the general public.

The MAPEP reached out to international laboratories and interacted cooperatively with European and the Middle Eastern contacts. International connections were established to address regional and global radiological and non-radiological environmental issues of mutual interest. Interactions were specifically enhanced this year through participation in the Radiation Measurements Cross Calibration Conference held in Doha, Qatar (summary in Appendix D). Proficiency samples were specifically prepared containing radium and uranium isotopes that are found in oil and gas field pipe scaling in the Middle East. Test reporting periods were extended to accommodate international shipments and delivery requirements. In addition, the Program responded to international inquiries regarding the use and utility of false positive/negative testing (refer to communication Appendix E).

3.2 FY10 MAPEP Activities & Accomplishments

3.2.1 Sample Distribution and Program Expansion

MAPEP samples are distributed twice a year in test sessions identified as "Series". A MAPEP Series refers to the complete set of water, soil, vegetation, and air filters per distribution. Within a Series the specific Study refers to the particular matrix and compound classification (e.g., Mixed Analyte Soil [MaS], Radiological Vegetation [RdV]). Laboratory performance on these PT samples is reported by RESL as "Acceptable" (A), "Acceptable with Warning" (W), and "Not Acceptable" (N) according to criteria described in the MAPEP Handbook, found on-line at http://www.inl.gov/resl/mapep. Performance results are reported to the individual participants and to the appropriate DOE Field Offices, Sample Management Offices, HSS, and other MAPEP stakeholders. Auditors from the DOECAP consider the MAPEP PTs when conducting laboratory audits. Table 3.1 indicates total PT sample distribution by the MAPEP and analyses performed by participating laboratories.

Fiscal Year	Series	Number of MAPEP Samples	# of Analyses by Laboratories
FY09	20 & 21	1040	12,500
FY10	22 & 23	1360	12,700

Table 3.1 – Samples Distributed and Analyses by Laboratories

The MAPEP distributes seven sample types in four matrices: mixed-analyte soil, mixed-analyte water, semi-volatile organic water, gross alpha/beta water, radiological analyte vegetation, radiological analyte air filters, and gross alpha/beta air filters. In FY10 MAPEP expanded participation for government, state, and commercial laboratories. Additional international laboratories that support radiological cross-calibration with Middle Eastern laboratories in coordination with the US State Department, the International Atomic Energy Agency (IAEA), Nuclear Test Ban Treaty countries, and laboratories

monitoring Chernobyl increased international participation from 19 in FY09 to 25 in FY10. Figure 3.1 illustrates the distribution of PT samples to participating laboratories from MAPEP Series 19 through Series 23 by sample matrix. Table 3.1 and Figure 3.1 demonstrate the overall consistency in laboratory participation and matrix type distribution.

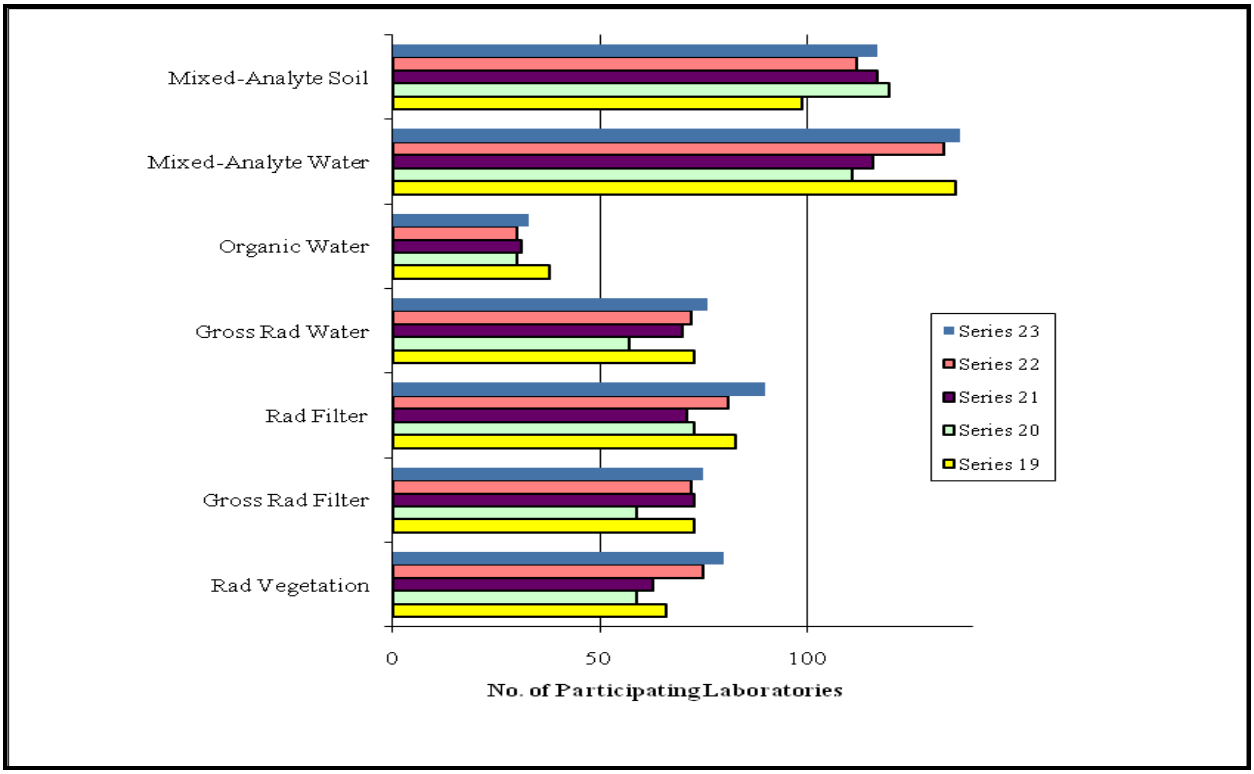

Figure 3.1 – MAPEP Distribution 2008 - 2010

The 1360 samples for the MAPEP Series 22 & 23 test sessions were distributed to over 120 laboratories in February/March and August/September of 2010 as seven distinct matrices (see Table 3.2 on the next page). Appendix C lists the participating laboratories in Series 23, including 25 foreign laboratories.

Foreign laboratories are using MAPEP to establish quality assurance and cross calibration of radiological measurements crucial to:

- Responding in the event of a terrorist attack (e.g., dirty bomb);
- Promoting and monitoring nuclear nonproliferation treaties; and
- Providing accurate environmental surveillance.

MAPEP Series 22 & 23	Matrix Id.	Total Samples	Foreign Labs' Samples
Mixed-Analyte Soil	MaS	229	49
Mixed-Analyte Water	MaW	270	45
Semi-volatile Organic Water	OrW	63	0
Radiological Vegetation	RdV	155	41
Radiological Air Filters	RdF	171	33
Gross alpha/beta Water	GrW	148	30
Gross alpha/beta Filter	GrF	147	19

Table 3.2 – Samples Distributed to Participating Laboratories, MAPEP Series 22 & 23

3.2.2 Quality Issues Identified by MAPEP Proficiency Testing

Laboratories participating in the MAPEP are continually reviewed and evaluated for their historical performance. Performance is evaluated over the last three test sessions and within each test session for each sample matrix. Reported analyses are evaluated for acceptable positive results, unreported analytes (false negative results), and false positive results or sensitivity evaluation. If an analytical data quality problem is identified, RESL issues a Letter of Concern (LOC) to help participants identify, investigate, and resolve potential quality issues.

Comparison of information over the last few years indicates a small percentage of concerns relative to the number of analyses being reported. There were 12,888 analyses performed for consecutive test sessions 21 and 22. Forty-three (43) LOCs were generated from the 12,888 analyses, which is approximately 0.3%. The number of LOCs has remained fairly consistent over time. HSS, DOE Field Offices, and the appropriate site contractor personnel are sent copies of LOCs to ensure all stakeholders are aware of the PT results. As part of the DOECAP - MAPEP interactive cooperation, when a DOECAP audited laboratory fails PTs

Photo 3.3 – Analyzing MAPEP PT Samples for Gamma Emitting Radionuclides

for the same analyte on sequential rounds of testing it is issued a Priority I Finding and immediate corrective actions are required. MAPEP plays a crucial role in identifying analytical problems that are otherwise difficult to recognize and assists laboratories in correcting issues before they become a liability to DOE.

A memo detailing the criteria used for issuing a LOC can be found at http://www.inl.gov/resl/mapep. The following paragraphs summarize the important quality issues identified by MAPEP during the Series 21 through 22 test sessions.

Misidentification of Isomers in Organic Compounds

A continuing concern for targeted organic components is the misidentification of isomers that exhibit chromatographic retention times close to one another. Laboratories that fail to accurately quantify and report these components receive Letters of Concern for misidentification of those isomers. While the number of letters issued has remained small, usually about one per sample distribution, the misidentification of these isomeric components can be significant for individual DOE sites.

False Positive and Sensitivity Special Tests

In addition to laboratories demonstrating the ability to accurately report analyte concentrations well above detection limits, they must also be able to detect and accurately measure analyte concentrations at or near detection limits without incorrectly reporting false-positive results. The MAPEP program uses false-positive testing on a routine basis to identify laboratory results that indicate the presence of a particular radionuclide when, in fact, the actual activity of the radionuclide is below the detection limit of the measurement. Table 3.3 shows the targeted analytes for false-positive and sensitivity tests included in MAPEP Series 22 and 23.

Series 22 Matrix	False Positive Test	Sensitivity Test
Soil	Sb, Am-241, Fe-55, Pu-239/240, Tc-99, Zn-65	None
Water	As, Ni, Ag, V,Cs-134, Co-60, Fe-55, Sr-90, Tc-99	Pu-239/240
Air Filter	Co-57, Sr-90, Zn-65	Pu-238
Vegetation	Co-57, Mn-54, Sr-90	Pu-239/240
Series 23 Matrix	**False Positive Test**	**Sensitivity Test**
Soil	Co-57, Sr-90	None
Water	Be, Pb, Am-241, Mn-54	None
Air Filter	Cs-137, Zn-65	None
Vegetation	Co-60, Pu-239/240	None

Table 3.3 – False-positive and Sensitivity Tests Included in MAPEP Series 22 and 23

In a sensitivity evaluation the radionuclide is present at or near the detection level, and the difference between the reported result and the MAPEP reference value is evaluated based on the combined total uncertainties. Laboratories that do not detect the targeted radionuclide fail a sensitivity evaluation by reporting a false-negative. The sensitivity evaluations work in tandem with the false-positive tests. If the laboratory fails false-positive or sensitivity evaluations for two or more consecutive test sessions, a LOC is forwarded to the laboratory. False-positive and sensitivity evaluation tests also evaluate total uncertainties at laboratory reporting levels.

Figure 3.2 graphically displays Series 21 False Positive Test results from the July 2009 timeframe. Results are designated as "Acceptable" (A) or "Not Acceptable" (N). Matrices are identified as "MaS" for soil, "MaW" for water and "RdV" for vegetation. The laboratories show improvement over earlier performance for false-positive and sensitivity tests. Initial MAPEP False Positive testing identified close to 50% of the laboratories reported false positive results, while now MAPEP laboratories rarely report false positives.

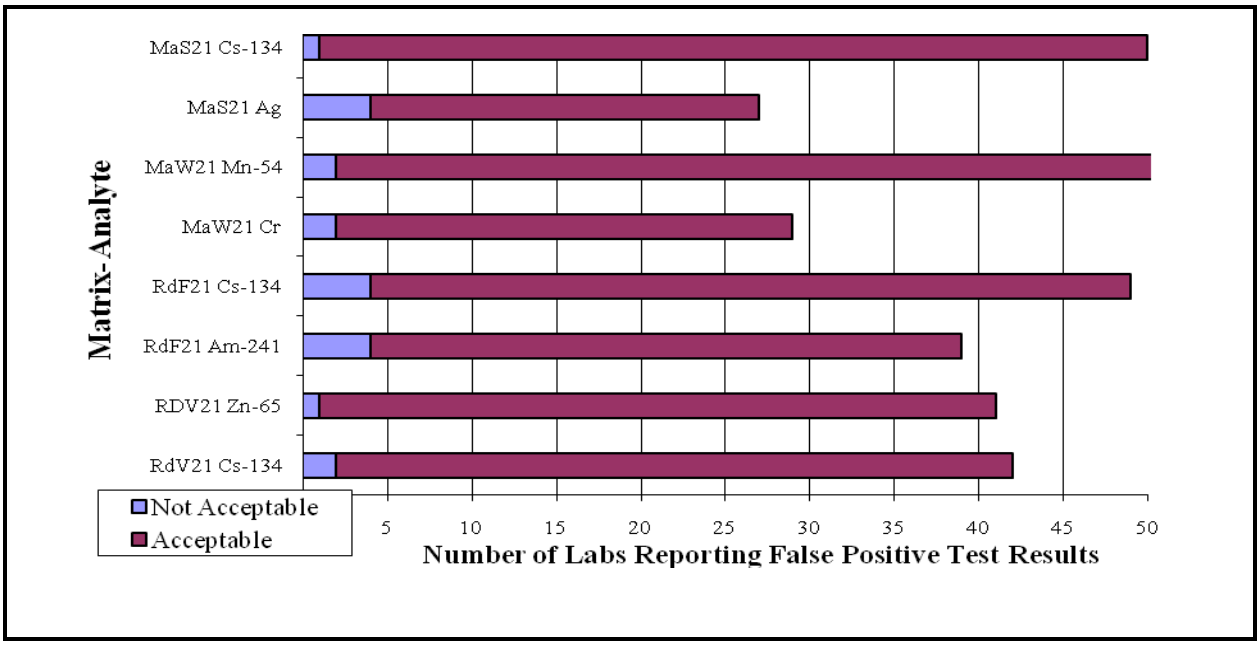

Figure 3.2 – Summary of False-positive Tests in MAPEP Series 21 (July 2009)

Laboratories Not Reporting Results for Special Tests

MAPEP has observed that laboratories have difficulties reporting or not reporting analytes near detection levels. Various mechanisms have been employed by some participant laboratories to avoid reporting unacceptable results including: simply not reporting a result for the analyte although they have reported that same analyte in previous studies; reporting results as exactly zero +/- zero (0 +/- 0); inflating the

uncertainty on a false positive test ensuring a statistically positive result is not reported; and deflating the total uncertainty on a sensitivity test ensuring that the unknown activity is detected.

These laboratories have received "Report Warning (RW)" flags in previous MAPEP Series as indicated in Figure 3.3. However, a new policy will be initiated with Series 23 evaluations where these instances will be considered "Not Acceptable" when MAPEP identifies that the laboratory is failing to properly report results. Laboratories are now clearly being directed to report the actual result and uncertainty for all radiological measurements they routinely perform for DOE. Failure to report results is not acceptable. MAPEP instructions state "Failure to report results for requested analyses will result in a "Not Acceptable" performance evaluation if the analysis is within the scope of your routine function or contractual obligations." This may result in an increased number of "Not Acceptable" designations in the future.

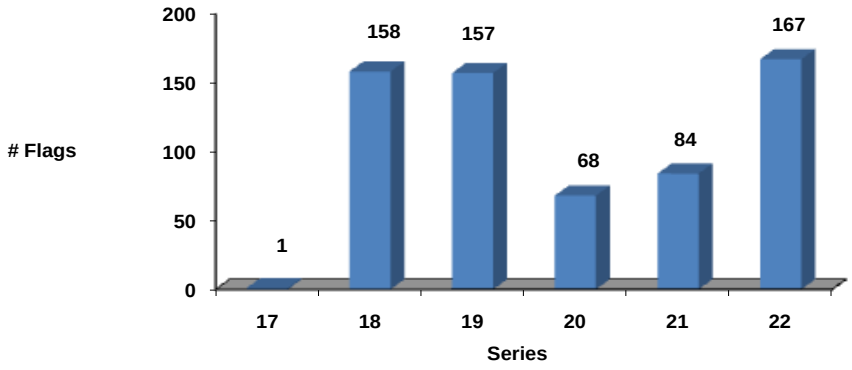

Figure 3.3 – Number of Report Warning Flags for MAPEP Series

3.2.3 MAPEP Web-Based Reporting and Query System Developments

The MAPEP has been continually improving the data reporting and data review portion of the Web Site at http://mapep.inl.gov. Options are available within the MAPEP web site to query the MAPEP historical database for review of specific laboratory data or an analyte's historical performance by all laboratories. These query options are powerful tools for DOE and other authorized personnel awarding new laboratory contracts, reviewing performance by existing contracted laboratories, and monitoring laboratory performance on an ongoing basis. DOECAP auditors routinely utilize the web site in reviewing performance of the audited laboratories related to the performance evaluation samples.

The MAPEP historical database contains performance data for the last ten years for laboratories participating in MAPEP. Other federal agencies, international and standard organizations have requested historical queries to be performed on the MAPEP database. A well defined query of the MAPEP database can provide not only laboratory performance information, but information related to method and instrumentation performance since MAPEP has always requested this information with a reported result.

The Query Tool within the MAPEP website assists the program user with setting a specialized query using various fields to search on. Some of the main query fields that can be specifically identified for a query are the MAPEP Series; Study; Matrix Code; Analyte Name; Lab Name; Preparation Method; Detection Method; Lab Results; Reference Value; Bias; and Result Flag.

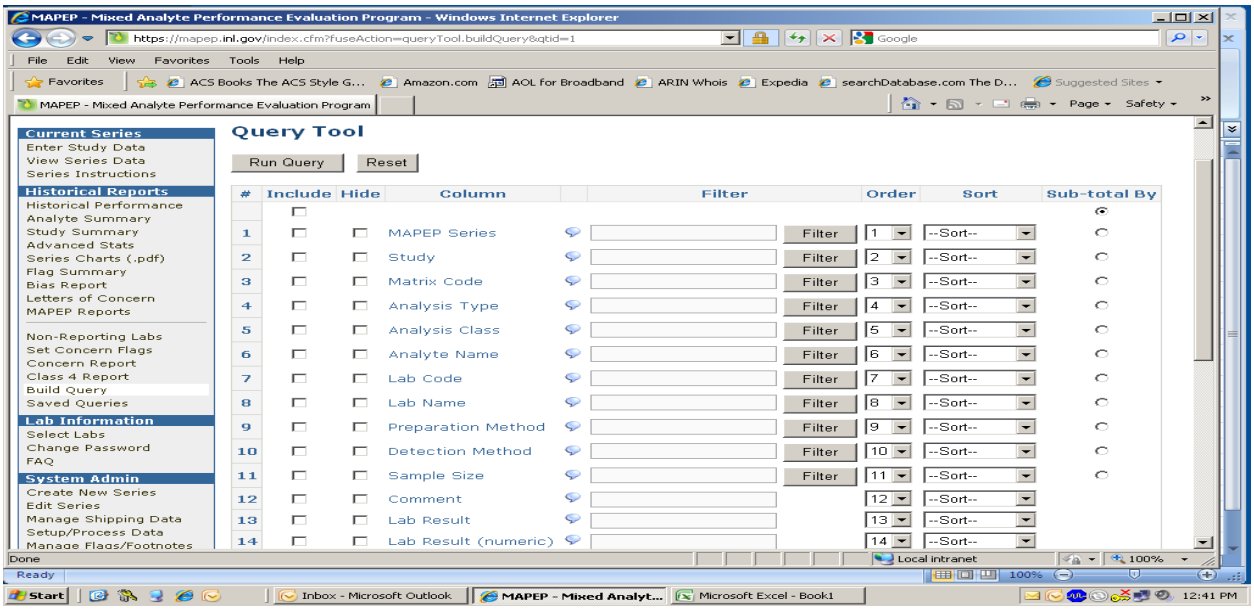

Figure 3.4 – MAPEP Web-Based Query Tool

3.2.4 Management and Program Highlights

Increase Laboratory Participation

A goal for 2010 was to expand MAPEP's laboratory participation. MAPEP initially was open to all labs, but since 2004, labs were required to demonstrate direct or indirect support of the DOE mission. During RESL's recent reorganization its mission was revised to include protecting the health, safety, and environment of the general public. Effective April 2010 MAPEP resumed open participation to all laboratories providing these services. Demonstrating specific DOE mission support is still desirable, but no longer necessary for MAPEP participation.

MAPEP Remedial Samples Policy

The DOECAP issues Priority I Findings whenever a laboratory fails the same analyte in two or more consecutive PT test sessions. Priority I Findings have encouraged immediate corrective actions by laboratories in order to sustain their credibility to perform specific analyte determinations for DOE and other customers. Performance is demonstrated by passing a similar PT test and confirming the problem has been resolved. RESL has issued a policy that addresses how laboratories can request remedial

MAPEP samples between designated test sessions. In 2010 DOECAP identified four Priority I Findings related to failing the same analyte in two consecutive PT test sessions. The findings resulted in one MAPEP Remedial Sample request.

Photo 3.4 – Analyzing MAPEP PT Sample for Alpha Emitting Radionuclides

Proficiency Testing Provider Accreditation

RESL received re-accreditation for both ISO 17025:2005 *General Requirements for the Competency of Testing and Calibration Laboratories* and ISO 17043:2009 *General Requirements for Proficiency Testing* by the American Association for Laboratory Accreditation in February 2010. Currently RESL is preparing an application for accreditation as a Certified Reference Materials Producer according to ISO Guide 34 *General Requirements for the Competence of Reference Material Producers.*

Traceability of RESL to the National Institute of Standards & Technology

RESL currently is designated by HSS as the DOE reference laboratory for environmental analyses. RESL maintains direct radiological traceability to the NIST through a unique Interagency Agreement. The NIST/RESL Radiological Traceability Program (RTP) provides for an annual exchange between NIST and RESL of test materials containing a number of radionuclides in various sample matrices (soil, water, air filter, vegetation, synthetic urine, and synthetic fecal). It is designed to provide a mechanism for evaluating the ability of RESL scientists both to prepare test materials of known radionuclide activities, and to correctly analyze test materials of unknown activities. PT standards are prepared by NIST, sent to RESL and analyzed by RESL for subsequent evaluation by NIST. RESL sends prepared PT standards to NIST for verification of the known reference values. This assures that the preparation and measurement processes at RESL are traceable to NIST. RESL has successfully completed analytical performance for the preparation and analyses of the 2010 RTP samples. A new Interagency Agreement was developed between DOE and NIST for the next four years assuring continued direct traceability to NIST.

MAPEP Interactions

As a part of the ASP, the MAPEP prepared and presented program updates and PT topics at the ASP 2010 Workshop. The MAPEP Team continues working with the ASP and the DOECAP by participating in the bi-monthly conference calls and interacting with the DOECAP community throughout the year. The MAPEP Team also hosts an annual workshop for participants and stakeholders at the Radiobioassay and Radiochemistry Measurements Conference.

Photo 3.5 – Preparing MAPEP PT for International Laboratories

Program Promotion/Technical Assistance

The MAPEP continues to provide and explore opportunities to promote the Program and demonstrate its relevance to present and future needs of the DOE Complex. Opportunities to offer technical assistance to national and international organizations have been and are continuing to be identified. Participation in conferences, workshops, and meetings promotes the importance of laboratory PT analyses, and presentations, reviews, and updates on MAPEP extend PT understanding. Additionally, MAPEP continues to provide technical assistance to participating laboratories fostering improved performance levels and assisting in meeting Departmental expectations for quality data.

Relocation of RESL Laboratories

Through the efforts and direction of the DOE Office of Nuclear Engineering, DOE Idaho Operations Office, and RESL management, the laboratory will be relocating its laboratories and offices to the Idaho National Laboratory Research Center in Idaho Falls, ID. This new state-of-the-art facility will constitute a major upgrade and provide improved operational space to continue MAPEP activities. RESL management and staff is coordinating with DOE Program Managers at Headquarters and the Idaho Operations Office to minimize the impacts of the move on RESL's programs. RESL ancipates being in their new home by the end of summer 2011.

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Appendix A

FY10 Analytical Services Program Annual Workshop

The Analytical Services Program annual workshop (ASP 2010) was held September 20-24, 2010 as a primary means to share information, provide training and obtain feedback from Program and audited facility personnel. The workshop atmosphere allowed a free and open exchange between ASP components; senior DOE management; DOE site participants; analytical laboratory representatives; treatment, storage and disposal facility personnel; and other governmental agencies (i.e., the Department of Defense, the Environmental Protection Agency, etc.). The meeting was attended by over 140 individuals and provided significant input from all participants for overall Program improvements.

The keynote speaker at the meeting was William Taylor (Assistant Manager Environmental Safety and Quality, Office of River Protection, Hanford). Session presentations were made by DOECAP, MAPEP, and SPADAT representatives and participants regarding individual site Program status, DOE site challenges and environmental actions, successful environmental projects, and audited facility improvements and progress. The Workshop continued to focus on training sessions related to the consolidated audit program materials, Official Use Only policies, point-of-contact responsibilities, training guidance, effective auditing, report writing, and process document updates. In addition, the Workshop was extended by one day to accommodate independent VSP and TNI training opportunities to attendees.

Working sessions included continuing resolution of Quality Systems for Analytical Services technical issues, laboratory and TSDF checklist comments, the FY11 DOECAP audit schedule, and feedback on DOECAP operations and implementation. Consistent with previous meetings, the program included presentations from audited laboratory and TSDF senior management, project managers using VSP tools, EPA representatives, and participants from the US Navy Laboratory Quality & Accreditation Office.

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Appendix B

FY10 DOECAP AUDITED LABORATORIES	
ACO – B&W Y-12 Analytical Chemistry Organization, Oak Ridge TN	ALSU - ALS Laboratory Group, Salt Lake City, UT
ALSC - ALS Laboratory Group, Fort Collins, CO	ARSA – American Radiation Services Analytical, LLC, Albuquerque, NM (closure audit)
ARS - American Radiation Services, Inc., Port Allen, LA	BCL - BC Laboratories, Inc., Bakersfield, CA
CAL - Caltest Analytical Laboratory, Napa, CA	CAI - CEBAM Analytical, Inc., Bothell, WA
CLA – Centauri Laboratories, Montgomery, AL	DFL - Davis and Floyd, Inc., Greenwood, SC
ESO - Eberline Services, Inc., Oak Ridge, TN	ESR - Eberline Services, Inc., Richmond, CA
GEL - GEL Laboratories, LLC, Charleston, SC	LLI - Lionville Laboratory, Inc., Lionville, PA
MBT – Microbac Laboratories, Johnson City, TN	MCL - Materials and Chemistry Laboratory, Oak Ridge, TN
ORISE – Oak Ridge Institute for Science and Education, Oak Ridge, TN	PAL - USEC Paducah Analytical Laboratory, Paducah, KY
PORTS - USEC Portsmouth Analytical Laboratory, Piketon, OH	RMAL – Radioactive Material Analysis Laboratory, Oak Ridge, TN
RACL – Radioisotope and Analytical Chemistry Laboratory, BWXT, Lynchburg, VA	SES – Shealy Environmental Services, Inc., Cayce, SC
SRI - Southwest Research Institute, San Antonio, TX	TAA – Test America, Inc., Arvada, CO
TAR – Test America, Inc., Richland, WA	TAS – Test America, Inc. - St. Louis, Earth City, MO
TAK – Test America, Inc., Knoxville, TN	

FY10 DOECAP AUDITED TSDFs	
ARG – Clean Harbors Aragonite, Aragonite, UT	DPT - Clean Harbors Environmental Services, Deer Park, TX
DSSI - Diversified Scientific Services, Inc., Kingston, TN	ELD – Clean Harbors El Dorado, El Dorado, AR
EST - Energy Solutions, LLC, Oak Ridge, TN	ESU – Energy Solutions of Utah, Clive, Utah
IMP – IMPACT Services, Inc. Oak Ridge, TN	MEC - Materials and Energy Corporation, Oak Ridge, TN
PFF- Perma-Fix of Florida, Gainesville, FL	PFN – Perma-Fix Northwest, Richland, WA
WCS - Waste Control Specialists, LLC, Andrews, TX	

Appendix C

MAPEP Series 23 Laboratories, 2010

Lab Name (Domestic Laboratories)	City	State
Alabama Department of Environmental Management	Montgomery	AL
USAFSAM/OEHHL	Brooks City-Base	TX
Argonne National Laboratory/Analytical Chemistry Lab.	Argonne	IL
Argonne National Laboratory	Argonne	IL
ALS Laboratory Group, Environmental Division	Fort Collins	CO
Idaho National Laboratory	Idaho Falls	ID
Analytical Support – Radiochemical Processing Laboratory	Idaho Falls	ID
American Radiation Services Inc.	Port Allen	LA
CH2M Hill Applied Science Laboratory	Corvallis	OR
B&W Y-12, Analytical Chemistry Organization Laboratory	Oak Ridge	TN
BC Laboratories, Inc	Bakersfield	CA
Northeast Laboratory Services, Inc.	Waterville	ME
Caltest Analytical Laboratory	Napa	CA
California Department of Public Health	Richmond	CA
Colorado Dept of Public Health and Environment	Denver	CO
Lawrence Livermore National Laboratory - EMRL	Livermore	CA
222-S Laboratory	Richland	WA
Carlsbad Environmental Monitoring and Research Center	Carlsbad	NM
CHPRC Central Count Room	Idaho Falls	ID
TestAmerica Denver	Arvada	CO
Davis & Floyd, Inc.	Greenwood	SC
Department of Environmental Health & Safety	Raleigh	NC
DLE Associates	Hercules	CA
S&S Onsite Analytical	Findlay	OH
B&W Pantex - D&RMG	Amarillo	TX
EMAX Laboratories, Inc	Torrance	CA

Lab Name (Domestic Laboratories)	City	State
U. S. EPA Office of Radiation and Indoor Air	Las Vegas	NV
Lawrence Livermore National Laboratory ERAD	Livermore	CA
Washington State Public Health Laboratories	Shoreline	WA
Environmental Radiation Laboratory	Atlanta	GA
Region 5 EQC Tritium Lab	Aiken	SC
ETTP	Oak Ridge	TN
EnergySolutions, LLC	Clive	UT
Florida Dept of Health Environmental Laboratory	Orlando	FL
Florida Dept of Health Mobile Radiological Lab	Orlando	FL
Fernald Project	Harrison	OH
Fermi National Accelerator Laboratory (FermiLab)	Batavia	IL
Lawrence Livermore Laboratory	Livermore	CA
GEL Laboratories, LLC	Charleston	SC
Georgia Power Company Environmental Laboratory	Smyrna	GA
GPL Laboratories, LLLP	Frederick	MD
Hazards Control Analytical Lab	Livermore	CA
Hall Environmental Analysis Laboratory	Albuquerque	NM
SC Dept Health & Environmental Control Radiological Lab	Columbia	SC
Washington Closure Hanford	Richland	WA
Oak Ridge National Laboratory-Internal Dosimetry Group	Oak Ridge	TN
ISU - Department of Physics/Health Physics/EAL	Pocatello	ID
Jefferson Laboratory	Newport News	VA
Kansas Dept of Health & Environment	Topeka	KS
Kennedy Space Center, HP Laboratory	Kennedy Space Center	FL
Los Alamos National Laboratory	Los Alamos	NM
Lawrence Berkeley National Laboratory	Berkeley	CA
Lawrence Livermore National Laboratory	Livermore	CA
ICP Analytical Services Laboratories	Idaho Falls	ID
Idaho National Lab ATR Complex Radioanalytical Lab	Scoville	ID
USEC, Inc.	Piketon	OH

Lab Name (Domestic Laboratories)	City	State
United States Enrichment Corporation	Paducah	KY
Radioactive Material Analysis Laboratory	Oak Ridge	TN
MDPH-Radiation Control Program	Jamaica Plain	MA
PIKA International	McClellan	CA
National Air and Radiation Environmental Laboratory	Montgomery	AL
B&W Services-Radioisotope & Analytical Chemistry Lab	Lynchburg	VA
New Jersey Dept. of Health & Senior Services, PHEL, ECLS	Trenton	NJ
Assaigai Analytical Laboratories, Inc.	Albuquerque	NM
Nuclear Technology Services, Inc.	Roswell	GA
Life Science Laboratories, Inc.	East Syracuse	NY
Ohio Department of Health Laboratory	Reynoldsburg	OH
ORISE/IEAV	Oak Ridge	TN
Outreach Technologies, Inc.	Broken Arrow	OK
NASA Plum Brook Reactor Facility Lab	Sandusky	OH
Environmental Science Lab PNNL/ESL	Richland	WA
TestAmerica St. Louis	Earth City	MO
TestAmerica Knoxville	Knoxville	TN
TestAmerica Richland	Richland	WA
WRPS RadCon Program Count Room	Richland	WA
RSA Laboratories, Inc.	Hebron	CT
Savannah River National Laboratory/SRNS	Aiken	SC
GPL Laboratories Alabama, LLC	Montgomery	AL
SRS Environmental Monitoring Laboratory	Aiken	SC
SLAC DOE National Accelerator Laboratory	Menlo Park	CA
Scientific Laboratory Division	Albuquerque	NM
Southwest Research Institute	San Antonio	TX
Sandia National Lab, Radiation Protection Sample Diagnostics	Albuquerque	NM
Texas Department of State Health Services Laboratory	Austin	TX
Teledyne Brown Engineering - Environmental Services	Knoxville	TN

Lab Name (Domestic Laboratories)	City	State
Environmental, Inc., Midwest Lab	Northbrook	IL
Eberline Services Oak Ridge Laboratory	Oak Ridge	TN
Eberline Analytical Corp. Richmond CA Lab	Richmond	CA
FUSRAP	Berkeley	MO
UniTech-235	Barnwell	SC
UNLV Radioanalytical Services Laboratory	Las Vegas	NV
UniTech Services Group	Springfield	MA
Lionville Laboratory	Exton	PA
Waste Sampling and Characterization Facility	Richland	WA
Pace Analytical Services, Pittsburgh	Greensburg	PA
WI, DPH, Radiation Protection Section	Madison	WI
WIPP Laboratories	Carlsbad	NM
Wisconsin State Laboratory of Hygiene	Madison	WI
WVDP Environmental Laboratory	West Valley	NY
West Valley Process Chemistry	West Valley	NY
WVDP Radiation Protection Lab	West Valley	NY
Durateck, Inc. - Bear Creek Lab	Oak Ridge	TN
Pacific Northwest National Laboratory	Richland	WA
AREVA NP Environmental Laboratory	Westboro	MA
US Army Yuma Proving Ground / Material Analysis Lab	Yuma	AZ

Lab Name (International Laboratories)	City	Country
Atlantic Environmental Radiation Unit	Dartmouth	B2Y4A2 Canada
Analisis Por Activacion	Santiago	Chile
Laboratorio de Vigilancia Ambiental Radiactiva	Quito	Ecuador
Low Background Radioactivity Laboratory	Taiyuan	China 30006
Comision Nacional de Energia Atomica	San Lorenzo	Paraguay
Centre for Radiation, Chemical and Environmental Hazards	Didcot	UK
Chemistry Support Services	Dounreay	UK
Departamento Ingenieria Nuclear	Bilbao	Spain
The Supreme Council for the Enviroment and Natural Resources	Doha	Qatar
Radiation Protection Bureau ERHD NMS	Ottawa	Canada
Ministry of Health, Radiation Protection Department Lab	Sharq	Kuwait
Environmental Studies Centre (ESC)	Doha	Qatar
Foods and Water Laboratories Center	Muscat	Oman
Hydrometeorological Institute of Slovenia	Ljubljana 1000	Slovenia
HPA, CRCE Scotland	Glasgow	UK
International Atomic Energy Agency	Seibersdorf	Austria
Instituto Boliviano de Ciencia y Tec. Nuclear	La Paz	Bolivia
Laboratory of Analitycal Ecotoxicology, SevertzovIinstitute	Moscow 117011	Russia
Radiation Hygiene Laboratory, Inst. of Public Health	Bucharest	Romania
MNSR/NAA Lab, ACG	Islamabad	Pakistan
Instituto Peruano de Energia Nuclear	Lima - 41	Peru
Inst. Of Public Health Timisoara		Romania
Istanbul University, Department of Biology, Radioecology Laboratory	Vezneciler	Turkey
Radiation Measurements Laboratory	Amman	Jordan
Royal Scientific Society, Environmental Instrumental Analysis Laboratory	AL-Jubaiha	Jordon

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Appendix D

International Conference, Doha, Qatar

HSS Analytical Service Program
International Collaborations Through the Use of Quality Assurance Proficiency Testing

International non-proliferation of nuclear material and the expansion of new nuclear initiatives in the Middle East have fostered a call for an increase in quality assurance baseline monitoring and analyses of potential radiological contaminants entering the environment. Negotiations between the United States Government and foreign Nations for arms control and securing nuclear material through on-the-ground verification, coupled with new nuclear desalination projects, power plants, and concerns that certain plants may be upgrading nuclear material into fissile products has increased international concerns, especially in the Middle East where "nuclear", in the heart bed of an oil and gas Region, was not perceived as a concern a decade ago.

The Department of Energy's HSS Office of Corporate Safety Analyses, through its management oversight of a quality assurance Mixed Analyte Performance Evaluation Program (MAPEP) proficiency testing (PT), has developed foreign partnerships by assuring that international analytical laboratories can produce defensible environmental data to determine the nature and extent of potential environmental contaminates. Included in the PT program are foreign laboratories tied to Cooperative Air Monitoring in Western Europe, the Nuclear Test Ban Treaty, and the Radiation Measurements Cross Calibration Project involving ten Middle East nations.

Twice a year, Idaho's Radiological and Environmental Sciences Laboratory (RESL) distributes performance test samples (soil, water, air filter, and vegetation) spiked with known amounts of radioisotopes, stable inorganics and organic constituents to each participating laboratory. Laboratories then analyze the test samples and are evaluated based upon their test results. Laboratory performance on these PT samples is reported by RESL as "Acceptable" (A), "Acceptable with Warning" (W), and "Not Acceptable" (N) according to criteria described in the MAPEP Handbook, found on-line at **http://www.inl.gov/resl/mapep**. In the course of one year, over 1400 samples (700 samples per testing "series") are distributed to participating laboratories with over 13,000 analyses performed by the laboratories. Approximately 130 analytical environmental laboratories currently participate in the MAPEP testing. Twenty-five are foreign-based including ten in Middle Eastern countrie**s.** The MAPEP provides an important environmental quality control such as tracking the concentration levels and extent of contamination, and data trending service for the Department, its field sites, and foreign collaborative partners.

A recent example of the HSS foreign collaborative effort involved participation in the Fifth Radiation Measurements Cross Calibration Conference (RMCC) held in Doha, Qatar in mid-May 2010. The Sandia National Laboratories Cooperative Monitoring Center (CMC), sponsored by the International Nuclear Safeguards and Engagement Program (NA-242) and in collaboration with the International Atomic Energy Agency (IAEA), initiated the RMCC project to develop internationally recognized standards for

radiation measurements and radiochemical techniques; expand the network of qualified radiological measurement laboratories; and improve scientist-to-scientist communication in the Middle East. Representatives from France, IAEA, and ten Middle Eastern countries were involved in the workshop. Outcomes from the workshop included a strong support for the Department's corporate MAPEP, along with certain requested programmatic upgrades. Several Middle East nations requested that Ra-226 be added as a new proficiency testing measurement regarding pipeline well field contamination, increasing the reporting period from 60-days to 75-days, and a request for assistance regarding false positive analytical testing results. In response to these requests, the MAPEP is now testing for Ra-226, increased the foreign laboratory reporting period to 75-days to accommodate foreign Custom checks, and provided technical assistance to rectify false positive analytical results.

For further information about the HSS MAPEP, as part of its broader Analytical Services Program, please refer to the following website: **http://www.hss.doe.gov/CSA/Analysis/ASP/mapep.html**

Fostering international cooperation between the United States Government and International Collaborations through Quality Assurance Proficiency Testing of Analytical Environmental Laboratories

Appendix E

SPECIAL RADIOLOGICAL PROFICIENCY TESTS USED IN MAPEP

Note: the inorganic and organic sections of MAPEP also perform false positive/negative testing, but since reporting a total uncertainty is not currently required, the testing procedure varies from the radiological tests.

MAPEP performs several special proficiency tests that include false positive/negative testing and sensitivity evaluations. They are all related to each other, so it is typically helpful to provide an overview that includes all of them. Most radiochemists are familiar with using the confidence interval provided by the total uncertainty estimate of the measurement to identify a "positive" reported result, such as 2.59 +/- 0.19 Bq/L of Pu-238. The reported result exceeds the absolute value of the total uncertainty estimate at two standard deviations (sigma), which is expected to happen by chance alone with less than 5% probability. As the specific activity of the sample nears the detection limit, the total uncertainty of the measurement will increase. The counting uncertainty does not disappear, even though instruments must sometimes be coaxed to report the total uncertainty at or near the detection limit. Instruments are sometimes setup so that only an MDA will be reported at the detection limit (contrary to the criteria of many Analytical Standards and Guides (see ANSI N42.23 and ISO Guide to the Expression of Uncertainty in Measurement)). As the specific activity decreases, the associated counting uncertainty of the measurement increases until the measurement becomes statistically zero (e.g., 2 +/- 3 Bq/L).

The reported result and total uncertainty indicate the sensitivity of the measurement, for the exact circumstances and sample dependent variables of that measurement. The result and total uncertainty contain the most relevant information pertaining to that measurement, not the a priori estimate of sensitivity as defined by the traditional MDA. A result and its uncertainty, even when statistically zero, convey important sensitivity information that is lost when a "Not Detected" and/or MDA is substituted for the actual measurement result. Just as a result of (0.0259 +/- 0.0019) Bq/L of Pu-238 is certainly more sensitive than a result of (2.59 +/- 0.19) Bq/L, a statistical "zero" of (0.002 +/- 0.003) Bq/L Pu-238 is more sensitive than a "zero" of (2 +/- 3) Bq/L. When MAPEP performs a false positive test or sensitivity evaluation, the actual result and total uncertainty obtained by the participant's measurement must be reported because the reported uncertainty is crucial for the test. If the result and uncertainty are not reported, we cannot perform the test. That is why we indicate in the instructions that the failure to report results for a requested analyte may result in a "Not Acceptable" performance evaluation:

"Radiological analyses should report results for only the analytes listed on the sample description. Other analytes may be detectable but will not be evaluated. This includes any chemical or spectral interference deliberately added to the sample. Conversely, some of the radiological analytes listed on the sample

description may not be detected. Report the actual results obtained for all analyses performed, including negative numbers, even if the radionuclide was not detected (i.e., do not report results as "Less Than" or "Not Detected"). Do not report a "0.0" result or uncertainty. The result and total propagated uncertainty are required for sensitivity determinations and false positive testing. Failure to report results for requested analyses may result in a "Not Acceptable" performance evaluation if the analysis is within the scope of your routine function or contractual obligations." ... (Page 3, Instructions for MAPEP Test Sessions).

False positive results are a very important quality concern for DOE since they typically initiate needless investigations, require additional sampling and analysis, and may be used to formulate erroneous decisions, thereby increasing DOE's liability risk and taxpayer costs. The MAPEP program uses false positive testing to identify laboratory results that indicate the presence of a particular radionuclide in a MAPEP sample when, in fact, the actual activity of the radionuclide is far below the detection limit of the measurement. Acceptable ("A") performance is indicated when the range encompassing the result, plus or minus the total uncertainty at three standard deviations, includes zero (e.g., 0.5 +/- 0.2; range of -0.1 to 1.1). In this example there is sufficient probability that the "true" value is zero since zero is included within the range of the reported uncertainty at three standard deviations. Not Acceptable ("N") performance, and hence a false positive result, is indicated when the range encompassing the result, plus or minus the total uncertainty at three standard deviations, does not include zero (e.g., 2.5 +/- 0.2; range of 1.9 to 3.1). Statistically, the probability that a result can exceed the absolute value of its total uncertainty at three standard deviations by chance alone is less than 1%. MAPEP uses a three standard deviation criterion for the false positive test so that we can be confident about issuing a false positive performance evaluation. A result that is greater than three times the total uncertainty of the measurement represents a statistically positive detection with over 99% confidence. Some labs may use two standard deviations as the criterion for a positive result, but MAPEP is deliberately being conservative in the application of this test by flagging false positive results only at the higher confidence level and not at the typical two standard deviation (about 95% confidence) level.

Sensitivity evaluations are also performed and tie together with the false positive tests. MAPEP typically ensures that the specific activity for a targeted radionuclide is well above the detection limit. This minimizes the counting uncertainty associated with the sample analysis. When the counting uncertainty is relatively small, the standard MAPEP acceptance window is sufficiently large to accommodate an acceptable deviation from the MAPEP reference value and a reasonable measurement uncertainty. As the specific activity nears the detection limit, the counting uncertainty begins to dominate the error propagation, and the MAPEP acceptance criteria must make allowance for this relatively large measurement uncertainty. If the measurement uncertainty is not considered, participants will be unfairly penalized for determinations that fall outside the standard acceptance window but are still within the statistics of the measurement. Specifically, the normal MAPEP acceptance criteria are based upon conditions where enough specific activity is present in the sample to provide less than 10% (and typically less than 5%) counting uncertainties with reasonable sample size, count time, and backgrounds. If enough activity is present, the propagated combined total uncertainty involved with a participant's reported result and the MAPEP known reference value becomes insignificant compared to the MAPEP

acceptance window. Whenever we perform a false positive test or sensitivity evaluation, however, the participant's reported uncertainty becomes an important component of the acceptance criteria since the counting uncertainty associated with the targeted radionuclide is no longer insignificant. A participant cannot perform better than the statistics of the measurement will allow, and therefore applying the typical MAPEP acceptance criteria would be unfair. In a false positive test the targeted radionuclide is typically not present in the sample, or is only present at specific activities far below the detection limit. In a sensitivity evaluation the radionuclide is present at or near the detection limit, and the difference between the reported result and the MAPEP reference value is compared to the propagated combined total uncertainties. Again, the results are evaluated at three standard deviations. If the observed difference is greater than three times the combined total uncertainty, the sensitivity evaluation is "Not Acceptable". The probability that such a difference can occur by chance alone is less than 1%.

For example, if MAPEP is performing a sensitivity evaluation for Pu-238 in soil, a small, but potentially detectable amount of Pu-238 is added to the soil (e.g., 0.48 +/- 0.11 Bq/kg). The first test is whether the reporting laboratory detected the Pu-238. This test is similar to the false positive test, only this time a "positive" detection is very possible, i.e., the range encompassing the result plus or minus the reported total uncertainty at three standard deviations may not include zero (result/total uncertainty >3). If the laboratory did not report a positive result, this is noted in the text field of the MAPEP performance report, and represents a potential false negative, dependent upon the laboratory's detection limit for the radionuclide. At this point MAPEP's evaluation is still "Acceptable", since we do not know the appropriate detection limits for each participant (we do not dictate the sample size or count time), but personnel responsible for direct oversight should be looking closely at the performance evaluation to see if a "Not Detected" is in reality a "False Negative". For some results, the sensitivity of the measurement may indicate that the targeted radionuclide should have been detected and then MAPEP will issue a "False Negative" (see below). If a "positive" result is reported, it is evaluated against the known MAPEP reference value, only this time the total uncertainties are also incorporated. If the (reported result - reference value) / $[(\text{reported total uncertainty})^2 + (\text{total reference value uncertainty})^2]^{1/2} > 3$ then the evaluation is "Not Acceptable". For example, assume a participant reported 7.47 +/- 1.26 Bq/kg in the Pu-238 sensitivity evaluation. The evaluation is then (7.47 - 0.48 Bq/kg) / $[(1.26)^2 + (0.11)^2]^{1/2}$. This is $6.99 / (1.59 + 0.01)^{1/2} = 6.99 / 1.26 = 5.55 = 5.6$ standard deviations, which is > 3 standard deviations and is therefore "Not Acceptable". The probability that such a difference can occur by chance alone, even after incorporating the combined total uncertainties from the reported result and the MAPEP reference value, is less than 1%.

It is also possible to fail a sensitivity evaluation by reporting a false negative based on the sensitivity of the measurement. In this scenario the sensitivity of the reported measurement indicates that the known specific activity of the targeted radionuclide in the sample should have been detected, but was not. In the above example, suppose a Pu-238 result of 0.003 +/- 0.002 Bq/kg was reported. This is statistically a zero result, but the reference value minus three times its uncertainty is greater than the reported result plus three times its uncertainty (0.48 - 3*0.11) > (0.003 + 3*0.002), so the two numbers do not overlap at even the extreme bounds of their total uncertainties at three standard deviations. This indicates that the

sensitivity of the measurement should have detected a specific activity of Pu-238 at 0.048 +/- 0.11 Bq/kg. Therefore the MAPEP evaluation indicates that a false negative was reported. In addition to identifying false positive and false negative results, the false positive and sensitivity evaluation tests are designed to help participants ensure they are not under estimating or over inflating their total uncertainties.

I know this is a lot of information, but it essentially explains why and how MAPEP conducts these special tests. The bottom line is that for a MAPEP false positive test, if you want to indicate "Not Detected", ensure that the (reported result / total uncertainty) <= 3. If the (reported result / total uncertainty) > 3, a false positive result is being reported, as defined by the very conservative MAPEP criteria. If a MAPEP sensitivity evaluation is being performed, a positive result may be the "correct" result. It will be evaluated against the MAPEP reference value using both the reported total uncertainty of your result and the total uncertainty of the MAPEP reference value (see above). Ensure that a very small (unreasonably small) uncertainty is not reported, or the sensitivity of the measurement may show that the specific activity present should have been detected and therefore a false negative is being reported (see above). Of course, it may be difficult to tell whether a false positive test or sensitivity evaluation is being performed. If the total uncertainty is over inflated to try and pass a false positive test, it will result in a "Not Detected" if the test is actually a sensitivity evaluation, and vice versa for a false positive test. An accurate estimate of the total uncertainty of the measurement is the best way to ensure that both tests can be passed. And that is, after all, the reason for conducting these special proficiency tests.