

**RADIATION PROTECTION PROGRAM INTERNAL ASSESSMENT SUMMARY FOR THE CY 2008 -
CY 2010 TRIENNIUM
FERMILAB RADIATION PROTECTION GROUP
DECEMBER 2010**

EXECUTIVE SUMMARY

During the CY2008-CY2010 triennium, the internal audits of all elements of the Radiation Protection Program (RPP) implemented at Fermilab were conducted as required by 10 CFR 835.102. Here a brief synopsis is given with the detailed sections of this report to follow.

During this triennium, the corrective actions to the findings and recommendations of the peer review of the Fermilab Radiation Protection Program led by personnel from Argonne National Laboratory in April 2007 continued to be addressed. All of the recommendations and findings associated with that review continued to be considered closed but ongoing developments of both the Fermilab scientific and environment, safety, and health program merit review of the observations made at that time as the peer review was very helpful in suggesting several significant long term program improvements. A detailed synopsis is given in Section 1.

A major focus of the internal assessment activities conducted during this period were focused on those needed to accommodate and implement the amendments to 10 CFR Part 835 promulgated in the June 2007 (*Federal Register* Vol. 72, No. 110, June 8, 2007 pp. 31904-31941). In conducting these activities a number of recommendations were self-identified that are currently in the process of being further investigated or closed out. As a result, the Fermilab RPP was revised twice and submitted to DOE. The first submission of December 19, 2007 served as an implementation plan for the revised 10 CFR 835 requirements while the second submission of July 26, 2010 documented their completion within the time scale mandated by the 2007 *Federal Register* Notice. No exemptions were requested in either RPP submittal. A detailed synopsis is given in Section 2.

The self-assessment components of two external reviews chartered by the Department of Energy Office of Science constituted major elements of the assessment this triennium. These were a nuclear facility hazard categorization review and a management assessment of accelerator safety. The completion of actions associated with both the preparations for these reviews and followup activities subsequent to them were of great benefit to the Fermilab radiation protection program. Detailed synopses are given in Sections 3 and 4, respectively.

Internal assessments of the radiation dosimetry program inclusive of but not limited to Department of Energy Laboratory Accreditation Program (DOELAP) requirements and of the Sealed Source and Materials Control and Accountability (MC&A) and Nuclear Materials Management System (NMMS) programs also verified adequate program implementation. Detailed synopses are given in Sections 5 and 6, respectively.

The Laboratory's main umbrella committee on environment, safety and health matters is the Fermilab ES&H Committee (FESHCom) (called the Laboratory Safety Committee before CY2010). The Radiation Safety Subcommittee of this body continues to serve as a valuable

forum for both technical experts and citizen members in promoting improvements to the Laboratory's program in radiation protection and thus comprises part of this internal assessment program. The monthly meetings of the Radiation Safety Subcommittee constitute an important part of program implementation, provide a forum for ongoing identification and resolution of problem areas, and give a connection to the overall Fermilab ES&H program. Also, two additional FESHCom subcommittees were chartered during CY2010 to assist with important aspects of accelerator radiation safety. A detailed synopsis is given in Section 7.

During this period, the first assessments of radiation protection related-activities were conducted by the newly established Fermilab Office of Quality and Best Practices (OQBP). A detailed synopsis is given in Section 8.

The assessment process was completed in the format of a tabletop assessment based on a line-by-line systematic appraisal of the implementation of 10 CFR 835 at Fermilab. This assessment involved all Division/Section/Center personnel designated as Radiation Safety Officers (RSOs). A detailed synopsis is given in Section 9.

Radiological training constitutes an important part of the radiation protection program. All Fermilab employees are required to have an individual training needs assessment (ITNA) that covers all required training, including radiological training. Summary information on training completion is provided weekly to all Division/Section/Center Heads and verifies substantial compliance with the training requirements.

Overall, the implementation of radiation protection requirements continues to be effective as judged by the radiation exposures received, reported annually on time and as required to the DOE REMS system, and the lack of significant noncompliances, or potential noncompliances with radiation protection requirements or radiation-related environmental protection requirements.

DETAILED SYNOPSES

1. Ongoing Actions on the April 2007 Peer Review of Fermilab's Radiation Protection Program

This Peer Review was led by personnel from Argonne National Laboratory April 24-27, 2007, near the end of the last triennium (CY2007-CY2010). Several of the results of this review are well-connected with activities reaching into the CY2008-CY2010 triennium as ongoing efforts at program improvement are made. That assessment categorized its specific results according to the following definitions that merit repetition here:

Finding - is a violation of requirement of a published standard. Published standards are Fermilab's Radiation Protection Program Plan (RPP), the Fermilab ES&H Manual (FESHM), the Fermilab Radiological Control Manual (FRCM), and the Fermilab Work Smart Standard (WSS) set and applicable DOE and Executive Orders.

Recommendation - is the identification of a condition that affords an opportunity for improvement but does not constitute a specific violation as would a Finding.

Noteworthy Practice - is a work process that is shrouded in safe work practices, improves productivity and exceeds the spirit and intent of the applicable regulations and standards. Noteworthy practices may include best management practices.

Observations - pertain to conditions observed by the review team that, following subsequent review and analysis support a Finding, Recommendation, or Noteworthy Practice. Observations can also be used to capture the “working notes” of the assessment team.

Although the results of the April 2007 peer review were closed prior to December 31, 2007, this assessment was not shelved and forgotten. Several of the observations are clearly linked to ongoing efforts with current status of them reviewed and discussed here.

Professional Staff Level-Observation No. 1

Shielding for new facilities is designed by those working on the project, but the design reviews must be done by the ES&H Section. The design reviews should be done by experts independent of those that do the original designs. Effectively, this means the task falls upon one or two individuals. The ES&H organization does not seem to be adequately staffed to perform and/or provide independent review of shielding designs for new facilities being planned or designed at Fermilab.

Since the end of the last triennium the research and operational program of the Laboratory have become much better defined as specific new projects have emerged. Several actions have been taken that address this observation.

Two new subcommittees of FESHCom, the Fermilab Environment, Safety, and Health Committee, were formed in May 2010, the Safety Assessment Document Review and Shielding Assessment Review Subcommittees. As of this writing these new subcommittees have begun their work. These subcommittees include personnel with extensive expertise in accelerator safety and accelerator radiation shielding outside of the ES&H Section, thus broadening the resource base for the required reviews.

Also, two new scientists holding doctoral degrees in nuclear/particle physics were added to the staff of the ES&H Section during CY2010. The presence of these two individuals is already affecting this perceived weakness in the program. Staffing has also been improved by the addition of three individuals with appropriate degrees related to health physics to the staffs of the Accelerator (2) and Particle Physics Divisions (1). These staffing improvements also are viewed as strengthening the succession planning posture of this program in view of several retirements of key staff members anticipated during the next few years.

Review and Revise the RPP-Observation No. 2

Although the RPP underwent a minor revision when FRA assumed management of Fermilab, there has not been a substantive revision of the RPP since 2000. The RPP should be reviewed to determine whether an update is necessary as per 10 CFR 835.101(g). If such an update is necessary, then the RPP should be revised. This could possibly be linked to an ongoing Notice of Proposed Rulemaking on 10 CFR 835.

10 CFR 835 was amended effective July 9, 2007. Two revisions to the RPP were made during this triennium and are discussed in more detail in Section 2.

Training for Radiological Control Technicians-Recommendation No. 4

The RCT training course shown to the committee amounted to only 4 hours of training every two years. This hardly seems adequate to ensure coverage of the full array of knowledge needed by an RCT. However, other records seem to show that the RCTs receive considerable training in addition to this, but that the laboratory is not taking credit for all that they receive. Documented continuing education for biennial recertification of RCTs is too brief and should be expanded to ensure coverage of all important elements. Retraining should be conducted on a 24-month basis as is the standard for other DOE radiological safety training. RCT skills-based performance, e.g. performing a radiological survey, should be evaluated and documented by use of a criterion referenced checklist.

During this triennium a new training program for RCTs motivated in part by this Recommendation has been implemented. As of this writing, 21 modules are envisioned and 18 are, as of December 2010, in place. These modules constitute both the initial and continuing training for RCTs at Fermilab. The program is being embraced by its participants and their supervisors with enthusiasm as being helpful to the day-to-day duties of the RCTs. Since its inception, one new RCT has been added to the list of RCTs bringing the total number of qualified RCTs to 10. Two additional individuals are making good progress toward achieving completion of the upgraded RCT training program.

Accessibility of Radiological Areas and Radioactive Material-Finding No. 2

This finding is prompted by a situation encountered during a tour of the accelerator building. It encompasses several concerns, but the most directly applicable portion of the regulation is 835.901, Radiation Safety Training, hence we include it here. An accelerator footprint area door, posted as a Radioactive Materials Area, was unlocked and could allow unrestricted access to passers-by (We noted that a group of high school students was touring the building at the same time we were.) An open bag labeled Contaminated Material was just outside the door and was accessible. The committee member who spotted this chose not to inspect the bag to see if it actually contained contaminated material, but we must assume that it could have. We cannot know, on the basis of a brief tour, whether this situation was unique. Since the charge to the committee is to perform a programmatic review, not a walk-through audit, we express our finding in broad terms. Fermilab should investigate the extent to which radiological areas and/or radioactive materials are accessible to persons who are not adequately trained to deal with them and correct this situation where it exists. 10 CFR 835.901(a)

This remains a vulnerability well-known to senior Laboratory management that is largely a legacy of design of the facility. It is also not possible to always keep all the doors locked due to temporary conditions that arise in the course of facility operation. A very high percentage, approaching 100 %, of the Laboratory population including employees, users, and subcontractors have current GERT training, the minimum level of training by policy required to enter such areas. The hazards in question pose only very small radiological risks that are well-understood. Specifically, as verified by the Accelerator Division Radiation Safety Officer the accessible areas in Accelerator Footprint Area do not contain any radiation areas, contamination areas, or airborne radioactivity areas (as defined by 10 CFR 835) so that the radiological hazards are limited to low level radioactive materials. This Finding remains closed, but the issue should be kept in mind. See further discussion below in the section summarizing the Table Top Assessment.

Quality Assurance-Recommendation No. 6

The applicability of DOE QA Order 414.1C, and of the QA requirements of 10 CFR 830 Subpart A to non-accelerator facilities like the rad calibration shop and the waste facility, should be reviewed.

These questions raised by this Recommendation have been further addressed by the results of the Nuclear Facility Hazard Categorization Review and Accelerator Safety Order Implementation Assessment discussed in Sections 3 and 4, respectively. Fermilab has now established the OQBP to maintain its quality assurance program on an ongoing basis. Initial assessments by OQBP related to the radiation protection program are discussed in Section 8.

Noteworthy Practices

The Peer Review report also identified 17 Noteworthy Practices. A review of the current (December 2010) status of these indicates that all Noteworthy Practices are being continued. For reference these are listed here:

NP 1: Definition of a Radioactive Material Area

Fermilab has defined a Radioactive Material Area (RMA) so as to include all areas with radioactive material, rather than applying the less restrictive criteria of 10 CFR 835 Appendix E.

NP 2: Definition of Radioactive Material

Radioactive material is not defined in 10 CFR 835, however Fermilab has developed a practical and measurable definition that is implemented effectively throughout the laboratory.

NP 3: Laboratory Organization

The Laboratory has recently undergone a reorganization in conjunction with a new contract award to the Fermi Research Alliance. In the new management structure, the Senior Radiation Safety Officer (SRSO) reports directly to the Lab Director. This structure provides the SRSO with the authority to define the Radiation Protection Plan and implement radiation safety policy uniformly throughout the lab. Furthermore, it places an emphasis on radiological safety at the highest level of Laboratory management.

NP 4: Fermilab Radiological Control Manual (FRCM)

The FRCM is a mature document that appears to be complete and well-understood by the radiation protection staff.

NP 5: ALARA Program

The ALARA program is strong and has been effectively implemented to manage worker radiation dose.

NP 6: Participation in DOELAP

As a DOELAP assessor, the dosimetry program manager adds strength to the program.

NP 7: Area Monitoring Program

The area monitoring program is well developed and comprehensive, and covers both active and passive rad levels and air monitoring, with central collection and tracking of data.

NP 8: Posting for Beam-off Conditions

FNAL has a well developed policy for posting interlocked accelerator areas for the beam-OFF (not the beam-ON) conditions that would be encountered by workers, and this policy has been approved by DOE in the RPP.

NP 9: Records for Radioactive Sources

Not only is the source inventory carefully tracked, but lists of authorized users and monitors for each source are maintained. Records of sealed sources are maintained by the RSO group. Documents requested by the Review Team were readily accessible.

NP 10: Dosimetry Reports

The web-based application for issuance of dosimeter badges is a best practice to ensure the completeness of dosimetry records and reports.

NP 11: Radiation Worker Training Required for Dosimeter

All those issued a dosimeter badge are required to have Radiological Worker (RW) training; and anyone authorized controlled access to accelerator areas is checked to ensure RW training is up to date.

NP 12: Training for Visiting Scientists

For visiting scientists, the access controls assured that required RW training is completed prior to performing radiological work.

NP 13: Review of DOE Directives

The ES&H organization reviews every directive from the Fermi Site Office (FSO) that comes to the Lab, to ensure radiation safety aspects are addressed early and throughout the planning and design stages.

NP 14: Frisking on Exit from Radiological Areas

All radiation workers are taught in RW training to self frisk upon exit from radiological areas, and to survey removed articles for radioactivity and for contamination.

NP 15: Tracking of sealed sources

All sealed sources are in the system, not just those above Appendix E levels.

NP 16: Special Form Certificates

Special form certificates were available for all high activity sources.

NP 17: Emergency Facilities and Training

The BODA facility and the training of Fire Department staff in emergency rad response are best practices.

2. Radiation Protection Program Revisions

The rather significant changes in the DOE-prescribed system of radiation safety as well as more minor matters of practice set forth in the June 8, 2008 Federal Register Notice (FR, Vol. 72, No. 110, Docket No. EH-RM-02-835, pp. 31904-31941) required an extensive review of the DOE-approved formal Fermilab Radiation Program (RPP) and its chief, but not sole, implementation vehicle, the Fermilab Radiological Control Manual (FRCM).

Given the scope of the changes it was decided in 2007 to make the required transition as a two-step process given the benefit of the unusually long implementation period of three years. First, the RPP and its associated internally used Document Reference version, were rewritten as a implementation plan that acknowledged new or modified requirements could be implemented with relative ease and set forth plans for making the changes necessary to achieve compliance with those new or modified requirements that would take considerable time and effort. The result was submitted by the Laboratory to the Department of Energy Fermi Site Office (FSO) on December 19, 2007. The FRCM modifications went through the standard Fermilab-wide review. This generated a number of comments and identified problems that needed further resolution. At this time modifications were made to the FRCM that implemented those items amenable to rapid implementation at that time. In the course of their review FSO offered a number of helpful comments that were acknowledged in a revised RPP submitted to FSO for approval on June 11, 2008. Approval was granted by FSO on June 19, 2008. At this time work was underway to address the more complicated implementation items.

The final stage of RPP implementation was a new version of the RPP that addresses how compliance was achieved. This new RPP was submitted to FSO on July 26, 2010 and was approved by FSO on August 10, 2010. As before, the FRCM was revised, with Lab-wide review and comment, to incorporate the changes made to the program. It was found that the most significant and high-impact changes were those associated with prompt radiation fields, notably those with neutron radiation.

3. Nuclear Facility Hazard Categorization Review

In FY2008, DOE-SC, with the assistance of its site offices including DOE-FSO launched a hazard review of all of its facilities to be conducted during FY2008 to assure that facilities such as Fermilab are evaluating their radioactive materials produced or used in the context of 10 CFR 830, Nuclear Safety management, Subpart B, and DOE-STD-1027-92, "Hazard Categorization Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analyses Reports, "Change Notice 1, September 1997. This was done with clear statements from

DOE-FSO that both 10 CFR 830 and DOE Order 420.2 B, "Safety of Accelerator Facilities", clearly state that accelerator facilities are not considered to be nuclear facilities. Documents related to this review are found in the ES&H Docdb System (ESH Docdb): No. 772, at: <https://esh-docdb.fnal.gov:440/cgi-bin/ShowDocument?docid=772>.

The review consisted of two parts. Phase 1 was a self-assessment performed against DOE-SC established lines of inquiry. That report was submitted to DOE-FSO in final form on March 19, 2009. This submittal included a wealth of information about locations of radioactive materials and, notably, sealed sources on the Fermilab site. This self-assessment phase promoted a number of modifications to the sealed source program, especially concerning its documentation, that have achieved considerable improvements that, along with others associated with increased DOE stringency in this area motivated by radioactive material control considerations beyond those germane to 10 CFR 835 requirements, have strengthened an already well-managed program to still higher standards of excellence.

Following this self-assessment phase, Phase 2 consisted of an on-site review conducted in September 2009 by DOE-SC, DOE-CH, and DOE-FSO personnel. This review analyzed the Phase 1 submittal and included field inspections. The review report was finalized in December 9, 2009. The full document is posted in the above document file (ESH Docdb No. 772). The Executive Summary followed by descriptions of the Level 3 Observation and the two Noteworthy Practices are reproduced on the next page. The Level 3 Observation was addressed and closed in a letter from Bruce L. Chrisman, Chief Operating Officer, to DOE-FSO dated February 1, 2010, included here. The selected corrective action is connected with the corrective actions to Management Assessment of Accelerator Safety Order Implementation.

**Report for Office of Science (SC) – Headquarters (HQ) Review of
Fermilab National Accelerator Laboratory (Fermilab) Nuclear Facility Hazard Categorization**

Executive Summary:

DOE-HQ Office of Science conducted an off-site review of implementation of DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, "Change Notice 1, September 1997 (see Reference 1) at the Fermilab National Accelerator Laboratory (Fermilab) during September 2009. The Senior Nuclear Safety Advisor was requested by the SC Deputy Director for Field Operations to verify implementation of DOE-STD-1027 for SC facilities as part of an extent of condition review.

Ten criteria from DOE-STD-1027 and 10CFR830, Subpart B (see Reference 2) were used. Based on an overall review of the findings and observations, the review team concluded that the elements of DOE-STD-1027 have been implemented at Fermilab. Fermilab has a series of inventory databases for determining if radiological inventories exceed the radiological thresholds of DOE-STD-1027, although the site has only accelerator operations. While some discrepancies were identified with this database, these items did not result in impacts to hazard categorization. Fermilab inventory listings were consistent with the location and labeling found in the facilities. Fermilab completed a self assessment that appropriately identified several accelerator items (railhead yard, beam dumps, lithium lenses and some targets) that had not been identified and analyzed in their Safety Assessment documentation. Fermilab has 27 special form items, and appropriately excluded these items since they are used for accelerator operations. While current inventories demonstrate that there is no potential for criticality, Fermilab should consider modifying their database to evaluate the potential for criticality in the event of future mission changes.

The ground rules of DOE-STD-1027 were appropriately followed (e.g., Type B containers, segmentation, commercially available products) by Fermilab and no additional Hazard Category 1, 2 or 3 nuclear facilities were identified. Each of the ten criteria was met.

The review identified no findings (no Level 1 (L1) findings, no Level 2 (L2) findings), one observation and two Noteworthy practices (NWP) in accordance with the SCMS procedure, *Quality Assurance and Oversight* (see Reference 12). All of the ten review criteria were met.

Level 3 Findings and Observations:

FIND-OBS-01: It is recommended that Fermilab identify the potential for criticality limits in their database so if the mission would evolve, Fermilab could ensure fissile inventories remain below the potential for criticality thresholds. This is an observation.

Noteworthy Practices:

NWP-01: Fermilab's databases used to track radiological inventories demonstrated that item locations and identification were both current and accurate.

NWP-02: Fermilab self-identified that some radiological materials associated with accelerator operations were not accounted for in their databases or evaluated in the Safety Assessment documentation and need to be included in the SADs.



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February 1, 2010

Mr. Mark E. Bollinger
Acting Manager
Fermi Site Office
U.S. Department of Energy
P.O. Box 2000
Batavia, Illinois 60510-0500

Dear Mr. Bollinger:

**SUBJECT: DEPARTMENT OF ENERGY (DOE) OFFICE OF SCIENCE (SC)
HAZARD REVIEW OF FERMI NATIONAL ACCELERATOR
LABORATORY (FERMILAB)**

REFERENCE: Letter, same subject, M. Bollinger to B. Chrisman, January 7, 2010

Fermilab has carefully reviewed the results of the DOE-SC Hazard Review transmitted by the referenced letter. As you are aware this review was conducted in several phases over a period of more than a year culminating in the final assessment conducted in September 2009. At each phase of this process, a significant number of incremental improvements to our program for managing our sealed radioactive sources as well as our Materials Control and Accountability (MC&A) program were suggested by reviewers. These reviewers included members of the Department of Energy Fermi Site Office (DOE-FSO) staff. These improvements were discussed in detail during the September assessment and viewed favorably in the December 9, 2009 report.

Fermilab also continues to be actively implementing the corrective actions developed as a result of the March 2009 Management Assessment of Accelerator Safety Order [DOE O420.2B] Implementation at Fermilab. This corrective action plan was submitted to your office on July 28, 2009 and all proposed corrective actions remain on schedule. The sealed radioactive source, MC&A, and accelerator safety order implementation programs are being continually reviewed to assure that the requirements of DOE O420.2B are being fully met. As the Fermilab mission continues to advance with time, these programs will provide a strong basis for assuring that appropriate accelerator

safety requirements are being met.

The referenced review report includes a concern regarding any future, potential use of special nuclear material (SNM) at Fermilab with respect to the associated nuclear criticality limits. Fermilab presently has no SNM on site and no plans for acquiring any SNM as part of its current mission. Should the Fermilab programmatic mission be altered to include the use of SNM, the Fermilab MC&A program would require an appropriate reevaluation of applicable requirements. We believe that implementation of the Fermilab program fully addresses the concern about future use of SNM identified in the assessment report.

If you have any questions regarding this correspondence, please contact Dr. J. Donald Cossairt at extension 3465.

Sincerely,



Bruce L. Chrisman
Chief Operating Officer

cc: J. D. Cossairt
N. Grossman
Y.-K. Kim
P. Oddone

ES&H File: Hazard Review of Fermilab

4. Management Assessment of Accelerator Safety Order, DOE Order 420.2B, Implementation at Fermilab

In March 2009, the DOE Office of Science conducted a Management Assessment of Accelerator Safety Order, DOE Order 420.2B, Implementation at Fermilab. The assessment team was led by a representative of DOE-SC and comprised of members of several DOE-SC site offices. This external assessment was originally planned to be the first of a series covering all the DOE-SC laboratories with accelerators, though no additional assessments have been held as of December 2010. Perhaps because this assessment was originally envisioned to be part of a series, it was preceded by an extensive round of discussions among the DOE-SC accelerator community including both contractor and DOE representatives. This led to an informal, but intense self assessment of Fermilab by members of the Fermilab staff that transcended organizational boundaries despite the fact that all accelerators at that time were built and operated by the Accelerator Division.

DOE Order 420.2B clearly addresses a wide-range of environment, safety, and health topics much broader than those specifically “radiological” in nature and hence well beyond those strictly regulated by 10 CFR 835 or for that matter DOE Order 5400.5. It clearly relates to the overall implementation of Integrated Management Systems at accelerators. However, at any large accelerator, the safety of accelerator operation is of paramount importance in preventing unacceptably high doses that would exceed 10 CFR 835 limits and radiological incidents that would exceed those of DOE Order 5400.5. Furthermore, the effective management of accelerator safety includes the provisions for maintaining radiation exposures As Low As Reasonably Achievable (ALARA).

The informal self-assessment activities preceding the DOE-SC assessment were successful in the preparation for the assessment and also identified some weaknesses in program implementation that were confirmed by the assessment proper. The full detail of the assessment, its final report issued to the Fermilab on May 19, 2009, and followup activities is found in ESH Docdb No. 14 at: <https://esh-docdb.fnal.gov:440/cgi-bin/ShowDocument?docid=14>. The assessment identified the following key results:

- The assessment team validated the accelerator inventory at Fermilab. The team was able to confirm that Fermilab has 1 accelerator and 11 safety assessment documents (SADs), but tracking the accelerator safety envelope (ASE) approvals through the various correspondence and associated SADs was confusing.
- The assessment resulted in numerous opportunities for improvement in the accelerator safety documentation. Fermilab’s safety analysis methodology can be improved to show why the proper bounding conditions are selected. Those controls can then be flowed into the DOE-approved ASE.
- The safety management systems supporting accelerator safety are sufficiently implemented; however, Fermilab’s consistency in meeting its internal document control requirements needs improvement.
- Fermilab has done a good job in tracking training for operations and support personnel. Personnel are sufficiently trained, and the laboratory effectively tracks training to ensure access control and safe operations. Fermilab’s operations and maintenance procedures are well documented, maintained, and enforced.
- The assessment team determined that, with a few deviations, FSO and Fermilab meet the intent of the DOE Order on accelerator safety. The team identified some opportunities for improvement. The accelerator activities that the team observed demonstrated a good safety culture.

As of this writing (December 2010), completion of corrective actions submitted in response to this assessment is on schedule. The principle outcomes will be:

- A greatly improved Safety Assessment Document (SAD) system at Fermilab, replacing a fragmented set of individual documents with one that is coherent and up-to-date
- Better safety analyses that support the SAD
- A better clarified Accelerator Safety Envelope (ASE) that documents bounding conditions many of which have significant importance on radiation protection

- Documentation coverage of support facilities throughout the remainder of Fermilab, a single-program laboratory
- Better coordination and uniformity of accelerator safety implementation transcending Division/Section/Center boundaries

These actions are anticipated to be highly beneficial to the Fermilab program of radiological protection.

5. Dosimetry Program Assessment Activities

The radiation dosimetry program obviously provides a crucial component of the radiation protection program as it provides the official long-term records of radiation doses received by personnel. The DOELAP accreditation process, while a 10 CFR 835 requirement, has been embraced by Fermilab as the vehicle for providing the necessary quality assurance of dosimetry results. During this triennium, there were three assessments related to this program that will be summarized here.

Internal Assessment of the External Dosimetry Program – April 2008

This assessment was conducted by Fermilab staff members and reviewed pertinent documentation including dosimetry management procedures, training records, dosimetry data, a sampling of exposure investigations, results of previous assessments, blind audit data, and RP Note # 124, "Technical Basis Document for External Dosimetry at Fermilab" as well as dosimetry vender (Landauer, Inc.) QC and blind audit data. The conclusions were that the program is functioning well. Dosimetry is provided to those requiring it, the dose results obtained are valid, and the results are being provided to the dosimetry badged personnel. The aggressive blind spike programs continue to serve the program well and help assure quality results. Six minor recommendations were made and corrective actions closed by October 28, 2009. The assessment is documented in frESHTRK as Review ID No. 29468 at: http://www-esh.fnal.gov/pls/default/eshtrk_common.audit_details?rid=29468.

DOELAP Assessment – July 21-22, 2008

A DOELAP onsite assessment was conducted of the Fermi National Accelerator Laboratory (Fermilab) dosimetry program to assure routine practices comply with criteria contained in DOE/EH-0026, "Department of Energy Laboratory Accreditation Program (DOELAP) Handbook." All the Fermilab staff involved in the assessment process were viewed as competent, conscientious and cooperative. The assessment team reviewed progress towards resolving the findings identified in the previous DOELAP assessment and evaluated the current compliance of the program with DOELAP requirements. Nine findings were identified, including zero Deficiencies, four Concerns and five Observations. All of these items could be classified as of minor significance to program function. The corrective actions to the Concerns were closed by December 31, 2009 and the five Observations were addressed by October 29, 2009 in accordance with the corrective action plan approved by DOE. The renewed DOELAP accreditation was awarded with no gap in accreditation. The assessment is document in frESHTRK as Review ID No. 29708 at:

http://www-esh.fnal.gov/pls/default/eshtrk_common.audit_details?rid=29708.

DOELAP Assessment – February 23-24, 2010

A DOELAP onsite assessment was conducted of the Fermi National Accelerator Laboratory dosimetry program to assure routine practices comply with criteria contained in DOE/EH-0026, "Department of Energy Laboratory Accreditation Program (DOELAP) Handbook." All the Fermilab staff members involved in the assessment process continued to be viewed as competent, conscientious and cooperative. The assessment team reviewed progress towards resolving the findings identified in the previous DOELAP assessment and evaluated the current compliance of the program with DOELAP requirements. Seven findings were identified, including zero Deficiencies, three Concerns and four Observations. One of the observations was a Noteworthy Practice recognizing the fact that Fermilab planned to institute formal, routine assessments of the Dosimetry vendor. All items could be considered minor in nature. Two of the Concerns and one Observation were closed as of June 10, 2010 and all remaining actions are on schedule with the corrective action plan approved by DOE. The renewed DOELAP accreditation was awarded with no gap in accreditation. The assessment is document in frESHTRK as Review ID No. 31801 at:

http://www-esh.fnal.gov/pls/default/eshtrk_common.audit_details?rid=31801.

6. Sealed Source and Materials Control and Accountability (MC&A) and Nuclear Material Management System (NMMS) Programs

During this triennium the sealed source program, an activity motivated directly by 10 CFR 835 requirements, as well its companion in implementation the Fermilab's MC&A program, continued to be implemented in accordance with the requirements. Several modifications, especially to the sealed source program were made in view of the Hazard Assessment also discussed in this report. All routine reporting requirements for both programs were met. In addition, some special assessments were completed. Short reports on those assessments follow. These assessments are found in ESH Docdb No. 129 at: <https://esh-docdb.fnal.gov:440/cgi-bin/ShowDocument?docid=129>.

January 2008 Fermilab Nuclear Materials Control and Accountability Program Tabletop Self-Assessment

This assessment was conducted and the recommendations and documentation of responses taken is provided below:

Fermilab Nuclear Materials Control and Accountability Program
Tabletop Self-Assessment Conducted January of 2008

RESPONSE TO RECOMMENDATIONS

A tabletop assessment of the Nuclear Materials Control and Accountability (NMC&A) Program was conducted on January 17, 2008 by members of the ES&H Section Radiation Physics Group. J. Donald Cossairt, Associate Head for Radiation Protection, and the Radiation Physics Team members; Susan McGimpsey, Vernon Cupps, and Kamran Vaziri, conducted the tabletop self-assessment.

All recommendations from past audits of this program have been addressed and closed. No findings resulted from this self-assessment. Two observations and six recommendations have been identified as a result of this tabletop self-assessment.

Recommendations

1. Nuclear materials program documents with dated signatures should be converted into PDF files and placed on Eshserver1.

Response to Recommendation 1

Nuclear materials program documents with signatures were converted to PDF files and placed on \\ESHSERVER1\ESH_SECTION\PUBLIC_RPG\NUCLEAR MATERIALS PROGRAM\NUCLEAR MATERIALS ASSESSMENTS on 1/30/08.

2. A document that defines the most commonly used nuclear materials terminology, acronyms, and nomenclature should be created and placed on Eshserver1.

Response to Recommendation 2

A list of nuclear materials control & accountability program acronyms was created and placed on \\ESHSERVER1\ESH_SECTION\PUBLIC_RPG\NUCLEAR MATERIALS PROGRAM\NUCLEAR MATERIALS ASSESSMENTS.

3. The Nuclear Materials Representative should contact Fermilab's Procurement Department to ensure that deuterium is included on the list of forbidden materials.

Response to Recommendation 3

In response to this recommendation, the Nuclear Materials Representative contacted Fermilab's Procurement Department and verified that deuterium is indeed on the restricted list of hazardous/radioactive materials.

4. The Nuclear Materials Representative should ensure that the current revision of the referenced hazard assessment in the Nuclear Materials Program Implementation Plan appropriately reflects depleted uranium and other nuclear materials hazards.

Response to Recommendation 4

The Nuclear Materials Representative reviewed the applicable portion of the 2005 Hazard Assessment Document and found all nuclear materials-related information to be factually accurate.

5. Dosimetry badge spiking, using neutron sources, is now being performed on a routine basis. These irradiations are performed at the Radiation Physics Calibration Facility, usually overnight, while the building is unoccupied. The Nuclear Materials Control and Accountability Program document should be revised to include this activity and address the security measures that are in place.

Response to Recommendation 5

Information regarding overnight use of sealed neutron sources for dosimetry badge spiking at the Radiation Physics Calibration Facility will be included in the next revision of Fermilab's Nuclear Materials Control & Accountability Program document.

6. The Nuclear Materials Representative should verify that the quantity of tritium contained in a bottle at the Radiation Physics Calibration Facility (RPCF) is below reporting threshold levels.

Response to Recommendation 6

The Nuclear Materials Representative confirmed that the quantity of tritium contained in a device located at RPCF is well below nuclear materials reporting thresholds.

Best Management Practices Self-Assessment for CY 2008 for Fermilab's Sealed Source Program and Fermilab's Nuclear Materials Program

The following self-assessment on this subject was documented in January 21, 2009:

Best Management Practices for CY 2008 for Fermilab's Sealed Source Program and Fermilab's Nuclear Materials Program

Kathy Graden
January 21, 2009

Sealed Source Program Improvements

1. Special form certificates for sealed sources that require special form certification were verified and updated. A spreadsheet titled Fermilab Sealed Source & Special Form Certificate Cross

Reference was created to summarize necessary information regarding all sealed sources requiring special form certificates. Fermilab Sealed Source & Special Form Certificate Cross Reference is reviewed semiannually to ensure that all special form certificates continue to be up-to-date.

2. An inventory list of Fermilab accountable sealed sources based on the most recent 2007 version of 10 CFR Part 835 Appendix E values was created and maintained throughout the year.
3. The Hazard Control Technology Team inventoried and documented each sealed source designated for disposal by source inventory number. All sealed sources prior to 2008 were logged for disposal based on configuration and other variables, but not necessarily by source inventory number. There are approximately 1500 sources designated for disposal. A new spreadsheet was created for each sealed source to be disposed. This list is different than the master list of source inventory numbers that have been used in the past. The master list of source inventory numbers was changed to include only previously used source inventory numbers. This improvement to Fermilab's sealed source program provides a method to distinguish sources designated for disposal from previously used source inventory numbers.
4. A DOE data call request for Fermilab's listing of accountable sources per DOE N 234.1 was created and submitted to the DOE Fermi Site Office. There are a total of 334 accountable sources based on the requirements of this request.
5. A sealed source and nuclear material cross-reference to DOE STD 1027 Category 2 Category 3 radionuclides was developed during the last quarter of 2008. This spreadsheet provides total quantities of radionuclides for each facility that contains large numbers of sealed sources. The spreadsheet also identifies special form certificate numbers and expiration dates for special form certificates.
6. The sealed source inventory form was revised to include a section to document that sealed source labeling and area posting is verified during monthly source rounds.

Nuclear Materials Program Improvements

1. Fermilab's Site Security Plan, Chapter 2, Nuclear Materials Control and Accountability, was revised.
2. A tabletop self-assessment of Fermilab's nuclear materials program was conducted in January of 2008. No findings resulted from this tabletop self-assessment. All recommendations from the previous internal assessment were addressed and all recommendations for this tabletop assessment have been implemented.
3. The Nuclear Materials Control & Accountability Program Task Analysis and Training Needs Assessment document was revised.
4. The Fermilab Training Approval Program (TAP) Self-Evaluation Matrix for Fermilab's nuclear materials program was revised.
5. The Safeguards Management Software (SAMS) Data Entry Procedure was updated.
6. The internal procedure for completing the Nuclear Material Inventory Assessment (NMIA) report was revised.

March 9-12, 2009 Safeguards and Security Survey of Fermi National Accelerator Laboratory

DOE-CH conducted this assessment. A number of topics unrelated to the radiation protection program were included in the agenda. Cover letters and relevant excerpts of this assessment that assigned an overall rating of "SATISFACTORY", the highest rating possible, are reproduced below.



Department of Energy

Fermi Site Office
Post Office Box 2000
Batavia, Illinois 60510

MAY 21 2009

Dr. Bruce L. Chrisman
Chief Operating Officer
Fermilab
P.O. Box 500
Batavia, IL 60510


Dear Dr. Chrisman:

**SUBJECT: SAFEGUARDS AND SECURITY SURVEY OF FERMI NATIONAL
ACCELERATOR LABORATORY (FERMILAB), MARCH 9-12, 2009**

Reference: Memorandum, T Gradle to J. Livengood, dated 5/8/09, Subject: Same As Above

The enclosed memorandum formally transmits a copy of the final report of the Safeguards and Security Survey conducted of Fermilab by the Office of Science-Chicago Office, Safeguards and Security Services (SSS) during the subject period. An overall rating of **SATISFACTORY** is assigned.

If the Laboratory has any questions concerning this correspondence, please contact Ed Bucki at extension 4891 or Tom Gradle, SSS, at (630) 252-2052. Thank you.

Sincerely,

Dr. Joanna M. Livengood
Site Manager

Enclosure:
As Stated

cc: P. Oddone, w/o encl.
Y.-K. Kim, w/o encl.
D. Carlson, w/encl.
N. Grossman, w/encl.
M. Leininger, w/encl.
W. Flaherty, w/encl.
V. White, w/encl.
D. Cossairt, w/encl.
S. Bradley, TPS, w/encl.



Department of Energy

Office of Science
Chicago Office
9800 South Cass Avenue
Argonne, Illinois 60439

MAY 08 2009

Dr. Joanna M. Livengood, Manager
Fermi Site Office

**SUBJECT: TRANSMITTAL – SURVEY OF THE FERMI NATIONAL ACCELERATOR
LABORATORY**

Enclosed please find a copy of the referenced Safeguards and Security Survey report. The subject survey was conducted by the Office of Science-Chicago Office, Safeguards and Security Services for your office during the period March 9-12, 2009.

Two findings were given for program improvement. An overall rating of Satisfactory is assigned. This information has been entered into the Safeguards and Security Information Management System. Based on the results of the survey and discussion with your staff, the survey frequency will remain at 24 months.

Should you have any questions or require additional information regarding the attached report, please contact me at (630) 252-2052.

Thomas A. Gradle, Director
Safeguards and Security Services

Enclosure:
As stated



U.S. DEPARTMENT OF
ENERGY

Office of Science

SAFEGUARDS AND SECURITY SURVEY

of the

FERMI NATIONAL ACCELERATOR LABORATORY

Batavia, Illinois

Survey Number 09MAR09-CH-0733-SSPS

Performed by
*U.S. Department Of Energy
Office of Science - Chicago Office
Safeguards and Security Services*

March, 2009

Security Plans required during this survey period. A review of the Specific Security Plans was conducted and no deficiencies were noted.

A review was also conducted to verify Visa and Passport information is gathered and that Subject Matter Expert reviews were conducted. This review resulted with no deficiencies.

5.5 Approvals and Reporting

Fermilab's Unclassified Foreign Visits and Assignments Program is the responsibility of the Laboratory Director. The Laboratory Director has delegated authority to the Assistant Director and in the absence of the Assistant Director, the Chief Operating Officer has the authority to approve/deny requests for visits and assignments. The authority has been designated in writing as required per DOE Order 142.3.

When required, all visit and assignment requests and specific security plans are reviewed and approved by the Subject Matter Experts. Interviews were conducted with all Subject Matter Experts. The Subject Matter Experts were knowledgeable in regards to the Foreign Visit and Assignments program.

6.0 NUCLEAR MATERIALS CONTROL AND ACCOUNTABILITY (MC&A) PROGRAM - SATISFACTORY

This portion of the survey included a review and evaluation of the Fermilab Nuclear Material Control and Accountability (MC&A) program effectiveness and compliance with DOE directives. This review encompassed the following topical areas: Program Administration, Materials Accounting, Material Control, and Inventory Verification.

There were no findings in the MC&A topical area. Fermilab's nuclear material inventory is static, with no nuclear material transactions reported during the period covered by this survey. The MC&A program continues to provide reasonable assurance that nuclear materials have been accounted for and that identified protection needs have been met. The Nuclear Material Control and Accountability Program is therefore rated **Satisfactory**.

6.1 Program Administration

The objective of the MC&A program is to provide a basis for planning, implementing and evaluating an information and control system with associated checks and balances sufficient to detect and assist in the prevention of the unauthorized use and removal of nuclear materials from the facility or its authorized location. The Program Administration portion of this survey is rated **Satisfactory**.

Organization

Operation of Fermilab's MC&A Program is the responsibility of the Environment, Safety, and Health (ES&H) Section. Staff members of the Radiation Physics Team have been designated as the facility Nuclear Materials Representative (NMR) and Alternate NMR. A third Radiation Physics Team member has been assigned as the facility nuclear materials custodian. The NMR

had training in Nuclear Materials Management and Safeguards System (NMMSS) reporting, and Basic Nuclear Materials Accounting. The Alternate NMR has also has NMMSS training and

basic MC&A training. The ES&H Section completed a task analysis and training needs assessment on June 24, 2008. This document addresses each staff position with assigned MC&A program responsibilities. Training records for ES&H section personnel with MC&A responsibilities address both formal training courses and task oriented on the job training.

MC&A Plan

The Fermilab MC&A Program is described in Chapter 2 of the Site Security Plan which was last approved in February, 2009. The laboratory also has a Nuclear Materials Control and Accountability Implementation Plan and MC&A Program plan which were last approved in January 2007. These plans were reviewed and found to be current and address all required program elements.

Incident Investigation and Reporting

Incidents involving nuclear materials may require reporting under DOE Manual 470.4-1 Change 1, Section N "Incidents of Security Concern" (08/26/2005) and DOE Manual 231.1-2 "Occurrence Reporting and Processing of Operations Information" (8/19/2003). Reporting under DOE Manual 470.4-1 is required for incidents involving: actual or suspected loss, theft or diversion of special nuclear material or radioactive materials that could pose a health threat or endanger security; SNM found in an exceptionally dangerous/hazardous unapproved storage environment, or unapproved mode of transportation/transfer; inventory differences in excess of alarm limits; shipper/receiver differences that are statistically significant or involve item discrepancies; or loss detection indicators. Reporting under DOE Manual 231.1-2 is required for incidents involving loss of control of radioactive materials, technical safety requirement violations, nuclear criticality safety, operational emergencies, personnel injury, or spread of radioactive contamination.

Fermilab maintains procedures for reporting of incidents under the appropriate incident reporting method which are documented in Section N of the MC&A Program Plan. There were no incidents in the past 24 months that involved the loss of control of nuclear materials.

Assessment Programs

The Assessment Programs subtopic encompasses the internal assessment and program oversight functions of the facility's MC&A Program. Each facility must periodically assess the overall performance of the MC&A program. This assessment should include a review practices and procedures to assure that material controls are effective.

The most recent self-assessment of the Fermilab MC&A Program was completed on January 24, 2008. The self assessment was performed by the Associate Head of the Radiation Protection Program and three members of the Radiation Physics Team. The self assessment included a review of program documentation, training records, program procedures, accounting system reports and logs, and computerized records and spreadsheets. The self assessment resulted in a rating of A+ with no findings, two observations, and six recommendations. The first

observation was a notation by the self-assessment team that there will be a major programmatic impact after 2010 when the DZero calorimeter is dismantled and decommissioned. This instrument contains 237,792 kilograms of depleted Uranium in the form of metal and Uranium/Niobium metal alloy plates. The potential date of the decommissioning may be postponed if the Tevatron is run an additional year due to startup difficulties at the Large Hadron Calorimeter (LHC). The second observation noted that the SAMs data entry procedure was not assigned a procedure number. The recommendations addressed issues with program documents and procedures, assurance that Deuterium is included on the Laboratory's list of restricted hazardous/radioactive materials, assurance that nuclear materials are appropriately addressed in the Laboratory's Hazard Assessment documentation, changes to the dosimetry procedures that require overnight irradiation of dosimetry badges at the Radiation Physics Calibration Facility (RPCF), and assurance that quantities of tritium maintained at the RPCF are below reportable quantities. The NMR addressed all of the self assessment recommendations.

6.2 Material Accountability

Materials accounting involves the completeness, accuracy and timeliness of the accountability record system. The materials accounting portion of this survey consisted of an interview with Alternate NMR and a review of internal and external accounting records, reports and procedures. Material accountability at Fermilab is rated **Satisfactory**.

Accounting System Procedures

Fermilab has written procedures for maintaining the nuclear materials accounting system. The procedures were reviewed and found to be consistent with DOE nuclear materials accounting and reporting requirements.

Account Structure

Fermilab is arranged as a single Material Balance Area. The Nuclear Materials Representative maintains files of nuclear material transactions in chronological order that due to the limited number of transactions may be easily segregated by material type.

Records and Reports

The Fermilab records and reporting system provides information on all nuclear material transactions. Material Balance Reports (MBRs) are prepared quarterly and are submitted to DOE-CH for three material types [Depleted Uranium, Americium 241, and Deuterium]. All MBRs are prepared manually and submitted on a timely basis. All reports were checked for accuracy and proper reporting to the NMMSS Data base. The Composition of Ending Inventory (COEI) Reports are prepared and submitted to DOE-CH quarterly. These reports summarize the nuclear material inventory by project number and composition code. All COEI reports were reviewed and no discrepancies were noted. The accounting system includes logs for receipts and shipments, on site transfers, and adjustments to inventories.

System Assurance

Accounting system records are stored in locked filing cabinets in the ES&H Section offices in Wilson Hall. Access to the filing cabinets is limited to the NMR and Alternate NMR. The computerized nuclear material inventory is maintained in an Oracle database on the ES&H Section file server. The database may be accessed through a web interface that is password protected. The interface consists of Java applets running on the Oracle application server. The accounting system includes a series of excel spreadsheets that are linked to the Oracle database and are used to produce reports. The user can specify the date for a given report and refresh the data for that time period. The ES&H Section file server is backed up to tape on a daily basis.

Physical Inventories

Fermilab performs an annual physical inventory of nuclear materials and reports the results of this inventory to the DOE Fermi Site Office. Physical inventories were completed on March 7, 2007, March 11 – 13, 2008, and February 26, 2009. Additionally, the sealed sources are leak tested and inventoried by ES&H Section personnel on a monthly basis.

Measurements

The Fermilab nuclear material inventory consists of sealed sources, depleted uranium metal, and deuterium gas. Physical inventories are based primarily on item identification. The ES&H Section radiation instruments used to survey inventory items and perform contamination surveys of the sealed sources. Deuterium gas may be measured by PVT calculations using measured pressures and temperatures combined with known cylinder and tank volumes.

Material Transfers

The ES&H Section is responsible for all receipts and shipments of nuclear material at Fermilab. Receipts of nuclear material are verified prior to issuance or storage. The Nuclear Materials Representative completes the Nuclear Material Transaction Report (Form 741) and reconciles the receipt data to the shipper's data. There were no transfers of nuclear materials during the period covered by this survey.

Material Control Indicators

The Fermilab MC&A system provides procedures for reporting and investigating inventory differences and missing material. There were no Inventory Differences, Shipper/Receiver Differences, Normal Operational Losses, Accidental Losses, or reportable decay of nuclear materials during the period covered by this survey.

6.3 Material Control

The material control function encompasses the process of identifying persons needing access to nuclear materials, authorization of access to nuclear material, documentation, and maintaining a system of checks and balances. Fermilab's system for the control of nuclear materials and the control of access to the MC&A system and system data was found to be **Satisfactory**.

Material Access

Fermilab is approved as a Category IV facility. The current inventory consists of only source and other nuclear materials (Depleted Uranium, Americium 241, Deuterium, and less than reportable quantities of Cf-252). Access to nuclear materials is limited to authorized persons and is documented in an on-site transfer log.

Data Access

Accounting system records are stored in locked filing cabinets in the ES&H Section offices in Wilson Hall. Access to the filing cabinets is limited to the NMR and the Alternate NMR. The computerized nuclear material inventory is maintained in an Oracle database on the ES&H Section file server. The database may be accessed through a web interface that is password protected. The interface consists of Java applets running on the Oracle application server. The accounting system includes a series of Excel spreadsheets that are linked to the Oracle database and are used to produce reports. The user can specify the date for a given report and refresh the data for that time period. The database and accounting system data is backed up to tape on a daily basis.

Material Surveillance

Fermilab's material surveillance requirements are documented in Section L of the MC&A Program Plan. Nuclear materials are required to be stored in a locked room or storage area when not in use or attended. Each nuclear material storage location was capable of being locked.

Material Containment

Material Containment encompasses the physical barriers, plans, and procedures in place to restrict nuclear materials to authorized locations. Fermilab is configured as a single Material Balance Area (MBA) with defined workplaces for the use and storage of nuclear materials. All areas where nuclear materials are used or stored are kept locked when not attended.

Material Transfers

All shipments and receipts of nuclear material are controlled by the ES&H Section. When materials arrive on site, Fermilab Shipping/Receiving notifies the ES&H Section. The section receives materials and it is verified and transferred to the appropriate Laboratory Division or section where they the materials will be used. The ES&H Section performs transfer checks and

provides transaction documentation for all nuclear materials received at and shipped from the Fermilab site.

Tamper Indicating Devices (TIDs)

Fermilab maintains a supply of paper seals which are used in the control of shipments of radioactive materials. There have been no shipments of nuclear materials in the period covered by this survey and none are anticipated in the foreseeable future.

Inventory Verification

Fermilab is configured as a single Material Balance Area. The nuclear material inventory consists of sealed sources used for calibration, depleted uranium metal, and deuterium gas.

Radiation Physics Calibration Facility (RPCF – Site 38) – The RPCF is a concrete shielded facility with a room containing a concrete coffin for the storage of neutron sources. The facility also contains an exposure room and a projector room in the concrete enclosure. The RPCF is kept locked and alarmed when not attended. Nuclear materials in this area include four Americium 241/Beryllium neutron sources, one small Americium 241 source. There are also two Californium 252 neutron sources that have decayed to the point where they are less than a reportable quantity. The sources may be signed out by authorized members of the ES&H Section staff for use in calibration. A logbook is maintained to record the use of the sources. The sources are leak checked and inventoried on a monthly basis.

Site 40 – The Site 40 building serves as the office and work areas for ES&H Section staff. The nuclear materials stored at Site 40 consist of 2 kilograms of depleted uranium metal in the form of thin targets and small metal bars. These materials are kept in a locked source cabinet in a locked workroom adjacent to the building high bay area.

Railhead Area – Deuterium Storage – Fermilab maintains an inventory of 81.4 kilograms of deuterium gas contained in 4 large storage tanks and 123 cylinders housed in a locked fenced area outside of the Lundy Barn in the Railhead area. The deuterium gas is inventoried on an annual basis.

D0 Assembly Building – D0 (pronounced D Zero) is one of the two large detectors that collect data from particle collisions in the Tevatron. A major component of the D0 detector modules consists of 237,792 kilograms of depleted Uranium in the form of metal and Uranium/Niobium metal alloy plates. The detector is enclosed in a cryostat, which is filled with liquid argon when the detector is in use. At the time of this survey, the detector was inside of its enclosure (aligned with the Tevatron beam tube) with a shield wall made of large concrete blocks in place. A D0 test cryostat containing 21,016 kilograms of depleted uranium is kept in a locked fenced area adjacent to the D0 assembly building.

KTeV Experimental Hall – The experimental apparatus from the Kaons at the Tevatron (KTeV) experiment includes 1,863 kilograms of depleted uranium encased in 16 steel plates mounted in the beam line. The KTeV building is kept locked when unattended and access is limited to authorized Particle Physics Division and ES&H Section staff.

Me Muon Area – Three items of depleted uranium are stored in a building designated as the ME-7 Worm, which is kept locked when unattended. These items include 529 kilograms as a prototype CCEM module, 98 kilograms in the form of 28 8" x 8" plates stored in a steel canister, and a target wheel containing 0.038 kilograms of depleted uranium metal that had been used in the E709 experiment. The target wheel is stored in a locked metal cabinet.

Meson Area MC-7 – Two cylinders of deuterium gas are stored in a cylinder rack in a fenced area adjacent to the MC-7 enclosure. The fenced area is kept locked.

7. FESHCom Activities

At Fermilab, the Fermilab ES&H Committee [FESHCom, before mid-CY10 formerly called the Laboratory Safety Committee (LSC)] serves as the umbrella body for a set of subcommittees that cover all aspects of environment, safety, and health. The Radiation Safety Subcommittee, a body that also serves as the Fermilab ALARA committee is one of these FESHCom subcommittees. The Radiation Safety Subcommittee meets monthly and a report to the full FESHCom is presented and documented 3 times annually. The meetings, as well as the reports to FESHCom are documented and posted as ESH Docdb No. 91 at: <https://esh-docdb.fnal.gov:440/cgi-bin/ListBy?topicid=91> and on the ES&H Section web pages at: <http://esh.fnal.gov/xms/Resources/FESHCom>. The meetings are devoted to discussion of compliance and program implementation issues, reviews of ALARA program activities, and Integrated Safety Management and Environmental Management Systems topics. This subcommittee has a major role in the ongoing development of the Fermilab Radiological Control Manual (FRCM), a document that is a part of the overall Fermilab ES&H Manual (FESHM).

During this triennium, the Radiation Safety Subcommittee was heavily involved in the efforts to revise the Fermilab RPP to implement the 2007 amendments of 10 CFR 835 beyond those directly addressed by the FRCM. Likewise, this committee supported the efforts to rewrite the entire FRCM twice as part of the implementation process (see Section 2). Another major effort of the subcommittee during this triennium was to revise both General Employee Radiological Training (GERT) and Radiological Worker (RW) training to bring them up-to-date and to improve their accuracy and effectiveness. Specific new information about background radiation levels developed by the National Council on Radiation Protection and Measurements (NCRP Report No. 160, March 2009) was adopted into the training.

During CY 2010, the charters of all the subcommittees were revised. That of the Radiation Safety Subcommittee refocused the efforts of this subcommittee. A report of each subcommittee's activities each fiscal year is now required. The report of the Radiation Safety Subcommittee for FY10 was prepared and is posted on ESH Docdb No. 850 at: <https://esh-docdb.fnal.gov:440/cgi-bin/ShowDocument?docid=850>. Additionally, two new subcommittees were chartered that related to radiation safety issues. These are the Shielding Assessment Review Committee and the Safety Assessment Document Review Subcommittee. The addition of the new subcommittees strengthen the already effective integration of the radiation protection program into the overall environment, safety and health program of Fermilab. See also Section 4.

8. Assessments by the Fermilab Office of Quality and Best Practices (OQBP)

“As Is” Assessment, First Quarter CY2010

During this triennium, the newly established Fermilab Office of Quality and Best Practices (OQBP) began its work. On February 5, 2009, Fermilab Director Pier Oddone commissioned a comprehensive “As Is” review of Quality Assurance to be completed by April 30, 2009. This assessment was done under the auspices of OQBP. This assessment resulted in four findings related to ES&H Section Radiation Protection Group activities connected with the Fermilab Radiation Protection Program. While detailed documentation is retained in the database of the OQBP, brief synopses and summary of corrective actions are provided here associated with the OQBP finding identification number.

- A. *ES-03/19/2009-1: The Calibration Records in the Instrument Lab do not have a Supervisor signature as stated in the FRCM requirements.*

Description: The calibrations are documented using electronically generated forms. Past practice has been for the supervisor to informally spot check the results to be sure that proper calibrations are being performed by the technicians having primary responsibility for doing the work according to written procedures that are signed by the supervisor.

Corrective Action Plan: The calibration worksheets have been revised to include identification of facility, specific location, supervisor signature upon approval, and date of approval in accordance with the requirements of FRCM Chapter 7. This corrective action was closed on June 25, 2009.

- B. *ES-03/19/2009-2: The logbooks for documenting the calibration and documenting the results of surveys for the Mobile Environmental Radiation Lab (MERL) have entries made in pencil, entries crossed out with no initials and dates, do not have a Supervisor signature, and in general do not meet FRCM records keeping requirements.*

Description: The MERL has been in use for over 35 years. The logbooks observed with these deficiencies in the assessment include archival logbooks created in an era when document control procedures such as those set forth in FRCM Article 713 were not so clearly defined. These logbooks remain useful for reference purposes.

Corrective Action Plan: The logbooks in current use do follow the FRCM Article 713 practices, therefore this finding is invalid with respect to current practice. A memo from supervision will be inserted into the logbook to make these expectations clear. This corrective action was closed on May 1, 2009.

- C. *ES-03/19/2009-3: The “Mobile Environmental Radiation Monitoring Laboratory” (MERL procedure?) document is not approved or controlled, and does not meet FESHM 1051, Control of ES&H Documents.*

Description: The present document was developed over a period of years as a set of informal procedural notes as the use of the MERL developed over time. This is a natural result of the nature of MERL usages as, in part, a development of experimental techniques to measure the unique radiation fields near a high energy particle accelerator.

Corrective Action Plan: These operational notes will be rewritten as a procedure in conformance with FRCM Chapter 7 and FESHM Chapter 1051 requirements. From time-to-time, this procedure may require amendment as new/revised experimental measurement techniques are developed. The techniques may be developed using standard laboratory documentation methods first, then incorporated into procedures. This corrective action was closed on August 5, 2009.

- D. *ES-03/31/2009-1: The monthly “Instruments Due For Calibration” report and “Instruments Due for Calibration in AD” report for 2/27/09 indicate that 50-60% of the instruments are “Past due” for calibration. A process or control for addressing the issue of “Instruments Overdue For Calibration” is not documented.*

Description: Instruments are issued by the RPCF [Radiation Physics Calibration Facility] team to other organizations. The present database does not track separately those instruments in actual use and those that might be in storage pending return for calibration or repair. Thus one cannot distinguish between instruments that are in actual use for which their calibration has expired and those that await return for calibration for which their calibration has expired. All Fermilab ES&H training emphasizes verification of instruments having current calibrations.

Corrective Action Plan: The database will be modified to correctly label instruments awaiting calibration, repair or modification within the ES&H Section RPCF. A program of increased vigilance in assuring that the line organizations to which instruments have been issued correctly remove instruments from service, identify them, and assure that they are not being used without current calibrations will be instituted. The corrective action was closed on August 12, 2009.

Noncompliance Tracking System (NTS) Submittal: This problem was also identified as a potential non-compliance with 10 CFR 835.401(b)(1), “Subpart E Monitoring of Individuals and Areas” and 10 CFR 835.703(d) “Subpart H Record”. Accordingly, this resulted in the submittal NTS-FSO-FNAL-FERMILAB-2009-0002 to NTS made on April 22, 2009. The corrective action was closed in NTS on August 12, 2009. This was the only NTS submittal related to 10 CFR 835 made by or about Fermilab during this triennium.

OQBP Assessment OQBP - 10-IA-QA-002: Combined OQBP and ES&H Assessment of the Nuclear Materials Management At Fermilab

DOE requires completion of a biennial management assessment of nuclear materials management (NMM). Prior management assessments have been conducted by personnel within the ES&H Section including individuals beyond the Radiation Protection Group. During early CY2010 a joint assessment was conducted by the Office of Quality and Best Practices (OQBP) and by the ES&H Section in order to combine assessment activities, minimize the impact on the

assessed organization, and to provide a fresh perspective focused on both technical and QA controls.

The assessment scope was defined and agreed upon by all participants. Interviews were conducted independently by the ES&H Section and OQBP. Work observation and reviews of documentation were done independently by the two teams. The technical assessment of Nuclear Material Management was conducted by the ES&H Section based on DOE M470.4-6 *Nuclear Material Control and Accountability Manual*. The independent assessment was conducted by OQBP using Fermilab's Integrated Quality Assurance (IQA) criteria based on DOE O 414.1C *Quality Assurance*. Each report was approved by the assessment teams for accuracy prior to submittal.

The OQBP assessment resulted in a finding for lack of training with respect to the Fermilab Records Management Program within NMM activities and two observations regarding missing revisions and lack of printed name under the authorized signature on the On-Site Nuclear Material Transfer forms. The OQBP Finding identifier was ES-20100325-01, issued on May 4, 2010 and was closed on August 9, 2010. The ES&H assessment issued the following two corrective actions, the incorporation of *DOE M470.4-6 A.I.6* into self-assessments, and investigation of the use of significant figures in reporting tools. Although the Fermilab Records Management Program finding was identified in connection with the NMM program, it was not viewed as a significant one for the NMM program but rather one of larger implications for overall ES&H Section activities. Corrective actions to address these larger implications are now complete.

9. Tabletop Assessment of the Radiation Protection Program

On July 8, 2010, the ES&H Section convened a tabletop assessment of the Radiation Protection Program (RPP). The reviewers consisted of Division/Section/Center Radiation Safety Officers as well as selected members of the ES&H Section Radiation Physics team. The Fermilab RPP was distributed in advance of the meeting and reviewed section-by-section. As the discussion proceeded, comments on compliance were recorded and followup actions/inquiries were identified. None of these are identified as being significant deficiencies but all will be pursued further in the 2011-2013 triennium. The following is the minutes of the meeting with actions requiring further followup highlighted and amendatory comments added stating the situation in December 2010.

10 CFR Part 835 Triennial Tabletop Self-Assessment Notes

July 9, 2010

K. Graden

Followup Actions indicated in red.

Status of Followup Actions as of December 2010 in blue.

Attendees:

D. Cossairt	S. McGimpsey
N. Duff	D. Reitzner
M. Gerardi	R. Ruthe
K. Graden	K. Vaziri

Overview

Fermilab ES&H Section led a tabletop triennial self-assessment for compliance with the requirements of 10 CFR Part 835, Occupational Radiation Protection on July 8, 2010. Radiological control personnel/Radiation Safety Officers from Accelerator Division, Particle Physics Division, Technical Division, Facility Engineering Services Section, and Business Services Section were represented. Specific assessments of individual divisions/sections/centers (D/S/C) were not conducted during this triennial self-assessment. Instead, the above D/S/C worked collaboratively to determine compliance with the Fermilab Radiation Protection Program (RPP) and 10 CFR Part 835.

The focus of this triennial self-assessment was to assess the overall compliance posture of the Laboratory by conducting a section by section review of the April, 2010 revision of the Fermilab RPP. D. Cossairt led the discussion and requested that written comments resulting from this triennial assessment be sent to him in the next week or so.

Section By Section Review and Comments

Subpart A Scope

- 835.1(b) Look up foreign government jurisdiction in FRCM. This is addressed in FRCM Article 111.10.
- 835.1(c) Ensure that Fermilab obtains occupational exposure records for people working at foreign sites. Efforts are made to obtain such occupational exposure records to the extent practicable.
- 835.2 The review did not include a detailed review of the Definitions Section of the Fermilab RPP.
- 835.3 & 835.4 Reviewed and no comments.

Subpart B Management and Administrative Requirements

- 835.101, 835.102, 835.103, and 835.104 Reviewed and no comments.

Subpart C Standards for Internal and External Exposure

- 835.202 Limits are contained in the FRCM.
- 835.203 Review weighting factors table in RPP to determine whether ICRP Report # 60 or ICRP Report # 103 values are used. The tissue weighting factors were taken directly from 10CFR835, and originated from a detailed list found in ICRP Report # 74. The radiation weighting factors are those found in ICRP Report # 103, consistent with statements made in the RPP.
- 835.204 & 835.205 Reviewed and no comments.
- 835.206 NOTEWORTHY PRACTICE: The Fermilab Medical Office communicates effectively with D/S/C regarding pregnant worker policies.
- 835.207 OPPORTUNITY FOR IMPROVEMENT: Radiation Protection policies for minors and the public are not being effectively implemented. For example, TARGET students who are minors show up at their work location their first day without D/S/C receiving communication from WDRS.
- Supervisors need to be informed of TARGET students and others who are minors before they show up on their first day of work.
 - WDRS should check with the appropriate D/S/C before students are placed in a particular job.
 - Possible corrective action would be to implement a policy to require ES&H Department approval of TARGET students and other minors.
- Talk to WDRS staff about the above opportunity for improvement item. This remains an action item in coordination with related efforts in other ES&H disciplines.
- 835.208 Add Radiation Safety for Visitors Handout (R.P. Form # 31) to RPP documentation reference. This was done and is in the current approved RPP.
- 835.209 Reviewed and no comments.

Side Comment regarding DOE Order 458.1: Doses to persons near site boundary and non-occupational persons living on-site are addressed in this new Order that is in the approval process.

Subpart D Reserved

Subpart E Monitoring Individuals and Areas

835.401 & 835.402 Reviewed and no comments.

835.403 Look up RP Note regarding welding and machining radioactive material to see if this is applicable and if it should be included in RPP documentation reference. Several RP Notes address this and related matters and are included in the RPP Document Reference.

835.404 Reserved

835.405 Reviewed and no comments.

Subpart F Entry Control

835.501 & 835.502 Reviewed and no comments.

Subpart G Posting and Labeling

835.601 Reviewed and no comments.

835.602 OPPORTUNITY FOR IMPROVEMENT: Access/Entry to Controlled Area may be weak and a concern. Example is that a homeless person was found in the transfer gallery. The solution is to make these areas entry-controlled. The problem is that it is very expensive to implement. Senior Fermilab management is aware of this issue.

835.603 Posting discussion. Fermilab posts for beam-off conditions. The Fermilab policy in the RPP states this. However, the DOE could enforce posting for beam-on conditions in the future.

The Office of Science and FSO are aware of this issue and are working to create a DOE-SC interpretation.

835.604, 835.605, and 835.606 Reviewed and no comments.

Subpart H Records

835.701 Reviewed and no comments.

835.702 Double check point about historical doses and make sure the statement from the Federal Register on this point is included in the RPP and the FRCM. The notation about historical doses in the Federal Register Notice is explicit in the RPP and also stated in FRCM Article 721.

835.703 OPPORTUNITY FOR IMPROVEMENT: Some paper dose records are very old and the paper is degrading. Consideration should be given to scanning and saving these dose records electronically.

835.704 Reviewed and no comments.

Subpart I Reports to Individuals

835.801 Look into the change in total effective dose equivalent to total dose equivalent and other dose terminology as it affects the annual report (NRC/DOE Form # 5) sent to individuals. In harmony with the DOELAP program, equivalent dose was decided to be the term that best incorporated the revised system of radiation protection into the dosimetry reports. The changes have now been implemented.

Subpart J Radiation Safety Training

835.901 Reviewed and no comments.

835.902 & 835.903 Reserved

Subpart K Design and Control

835.1001 Reviewed and no comments.

835.1002 Optimization could be a weak area because an ALARA Committee is not instituted for each experiment. However, ALARA elements are covered as part of the Hazard Assessment. ALARA topics are an agenda item at every Radiation Safety Subcommittee meeting.

OPPORTUNITY FOR IMPROVEMENT: Some individuals who work in Booster towers may receive more than 100 mrem per year and these people are not trained. Accelerator Division ES&H Department is re-evaluating the Booster Shielding Assessment. One solution to this problem would be to move individuals to a new location.

[Radiation levels in the Booster Towers continue to be monitored and reviewed.](#)

835.1003 Reviewed and no comments.

Subpart L Radioactive Contamination Control

835.1101 [Add wipe surveys to RPP documentation reference. This was done.](#)

835.1102 [Add Material Move Request Form to RPP documentation reference. This was done.](#)

Subpart M Sealed Radioactive Source Control

835.1201 & 835.1202 Reviewed and no comments.

Subpart N Emergency Exposure Situations

835.1301, 835.1302, 835.1303 (Reserved), & 835.1304 Reviewed and no comments.

Appendix A [Review RPP footnotes in this section and consider changing to a smaller font. This was done.](#)

Appendix E Reviewed and no comments.