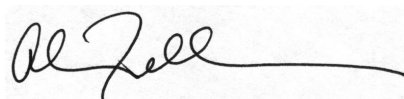


Technical Report

**Core
Laboratories/ProTechnics/SpectraTek**

**Radiation Safety Program Audits
Summary Report**

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July 31, 2024

LIMITATIONS

NV5 Dade Moeller (Dade Moeller) has prepared this evaluation based on a review of the Core Laboratories/ProTechnics/SpectraTek radiation safety programs at their Nuclear Regulatory Commission (NRC) and Agreement State licensed facilities throughout the United States. The reviews were conducted over the course of 2023, with the final audits finishing up during Q1 2024. Our work is based on information available at the time of publication. Information provided in this report by Dade Moeller is intended exclusively for the use of Core Laboratories/ProTechnics/SpectraTek. The findings and conclusions discussed in this report are based on the information provided, and our current understanding and interpretation of regulatory agency regulations, guidance and policies. The professional services have been performed in accordance with practices generally accepted by other health physicists practicing in this field. No other warranty, either expressed or implied, is made.

EXECUTIVE SUMMARY

The Core Laboratories/ProTechnics/SpectraTek facilities possess and use several radioactive sources under radioactive materials licenses issued by the NRC and Agreement State agencies. Radiation safety program responsibility rests with Jeremy Diaz, corporate radiation safety officer (RSO), licensee RSOs, district managers, and well-logging supervisors. Five of the audits were conducted in-person; the remaining were conducted virtually. The audit team consisted of four Dade Moeller senior health physicists, three of whom are certified by the American Board of Health Physics. The audits followed the guidance provided by NRC in NUREG-1556 Volume 14 Revision 1, Program-Specific Guidance About Well Logging, Tracer, and Field Flood Study Licenses, Appendix E ‘Suggested Well Logging and Subsurface Tracer Studies Audit Checklist. Each audit involved a comprehensive evaluation of the radiation safety program content and implementation.

In reviewing all radiation safety program elements, auditors looked for deficiencies related to either a license condition or regulation. In addition to identifying deficiencies, audit reports included numerous recommendations for program improvement. The deficiencies and recommendations offered in the audit reports are consolidated in this report.

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1.0 AUDIT HISTORY

Deficiencies:

- Field audits had not been routinely performed at some districts and while this was identified during internal audits, no corrective actions had been implemented.
- Annual audits of the radiation protection program were not performed at all locations in all years.

Recommendations:

- Establish a schedule for an annual audit at each facility to review the radiation protection program content and implementation.
- Ensure that RSOs maintain copies of all annual program reviews.

2.0 ORGANIZATION AND SCOPE OF PROGRAM

Deficiencies: None

Recommendations:

- Consider updating the (training) Outline and Syllabus For Well Logging Operations, which was reviewed as part of the 2015 license renewal application. Suggested changes include:
 - Delete 7(a)(i)(4) 1 REM = 1 day loss of life; this is not a scientifically defensible statement
 - Delete Objective 5, “To familiarize students with the genetic effects of radiation and the effect of radiation on life span.” As with the prior recommendation, this is not something ProTechnics would ever want to defend. The fact is that there have been no studies demonstrating a radiation-induced impact on the incidence of genetic abnormalities in humans. Furthermore, many studies suggest increased life span in animal studies in cohorts receiving low to moderate magnitude radiation doses.
- Consider the changes to the O&E Procedures manual. Suggested changes include:
 - Section III Radiation Safety Program, consider adding a section defining the ALARA philosophy of radiation protection with a statement of commitment towards implementing effective ALARA strategies at all radioactive materials storage locations and temporary in-field project sites.
 - Section III 13.0 add “outside surface of shipping containers containing Class 7 material must be labelled and marked as per DOT HAZMAT requirements.

- Section IV page 9 Emergency Procedures – update the Emergency Notification table with current contact information (Attachment IV-1).
 - Section VII Bioassay, 3.2 – Tritium Bioassay; 3.2.2 states that if > 28 pCi/L over a calendar quarter is measured in the urine, file a report with the appropriate regulatory agency within 30 days. This should be deleted as there is no quarterly intake or dose limit that would require reporting to the regulator.
 - Section VIII 6.4.2 related to DIS waste disposal states that the radiation level is to be measured “on contact with the waste.” Consider changing this to measuring the radiation level “at the surface of the waste container,” as that is typically how DIS waste is monitored. If all readings along the surface of the container are indistinguishable from background, the waste is suitable for disposal without regard to radioactivity.
 - Section IX 4.1 Receiving and Monitoring Radioactive Material establishes that a package receipt survey is to be conducted if the package appears to be damaged. Add “and for all labeled radioactive materials packages.”
 - Section X Transportation of Radioactive Material - Add to 2.0 a sentence that states that all persons involved in preparing packages containing radioactive materials for shipment will be compliant with the U.S. Department of Transportation (DOT) HAZMAT training requirements.
 - Throughout the document, replace “TLD,” “OSL,” and “film” with “radiation dosimeter badge.”
- The RSO should review the training materials on an annual basis.

3.0 FACILITIES

Deficiencies: None

Recommendations: None

4.0 EQUIPMENT AND INSTRUMENTATION

Deficiencies: None

Recommendations: The audit of the SpectraTek calibration lab in Albuquerque identified some issues related to the implementation of calibration procedures leading to errors in the determination of instrument detection efficiency.

- Cease using the 5 nCi check source to determine detection efficiency. Efficiency may be determined only by placing a NIST traceable disk source into a calibration jig, providing identical counting geometry for each measurement. This is not a requirement for an exposure calibration, but could be continued as part of the calibration procedure if so

desired. Should efficiency determination continue to be a part of the calibration procedure, include as part of 4.3.2 “Only NIST-traceable standards can be used to determine detection efficiency.” 4.3.4 should start with “Place the calibration source and the detector in an appropriate calibration jig to ensure reproducible geometry.”

- Modify the exposure calibration procedure (Section VII, 4.0 O&E Procedures manual) as follows. Between steps 4.2.7 and 4.2.8, insert “Record the actual pre-adjustment readings in the column showing the measured values. As long as all observed:actual ratios fall within 0.95 – 1.05, the meter can be considered operating within acceptable conditions and can be put back into service.”
- Record all calibration data, including sources used, actual counts observed, and actual readings observed.

5.0 MATERIAL USE, CONTROL, AND TRANSFER

Deficiencies:

- For the most part, licensed sources are secure and inaccessible to unauthorized persons. However, there were three instances noted where radioactive material was left unsecured and/or unattended at one facility:
 1. A source was left on a workbench and there were no personnel present in the lab. The lab doors were open to the rest of the facility.
 2. A bag of check sources was noted in a box in the records storage office.
 3. The locker used to store sealed sources when not in use was discovered to be unlocked. The locker is located in the facility receiving room. The outside door to this room is not typically locked during normal working hours.
- The procedure for receiving radioactive material does not include collection of wipe samples on the exterior of the package, as required.
- Receipt surveys were not consistently performed upon receipt of radioactive material packages.
- Copies of the shipping papers that accompany packages containing radioactive material were not consistently retained.

Recommendations:

- Train personnel receiving packages of radioactive material on the procedure and confirm through observation that contamination and exposure rate measurements are being implemented properly and documented.
- Some records show the Transport Index (TI) as a whole number. The TI is defined as a dimensionless number (rounded to the next tenth) placed on the package radiation label

measured in mSv/hr times 100 or the level in mrem/hr at 1 m (3.3 ft). Therefore, enter the TI with one digit to the right and one digit to the left of the decimal.

6.0 INVENTORIES

Deficiencies:

- For the most part, inventory of radioactive materials are quantified and documented as required. However, there was one instance at one facility where a quarterly inventory had not been completed.

Recommendations:

- Inventories are required by the regulations, license, and the company procedures. RSOs should ensure to complete that inventories are performed prior to the due date.

7.0 INSPECTION AND MAINTENANCE

Deficiencies: None

Recommendations: None

8.0 AREA RADIATION SURVEYS AND CONTAMINATION CONTROLS

Deficiencies:

- An appropriate survey program is in place, but examples were found where surveys of radiation levels and contamination levels were not consistently performed.
- The date of survey, name of the individual performing the survey, and an exact location of the survey is not shown on all survey records.
- Survey records indicate that several surveys were conducted with meters that had not been calibrated within six months prior to the date of the survey. Note: Mr. Garcia stated that the meters used for the surveys were in calibration when used but that the calibration status was not documented properly. That being the case, once the information is updated on the survey forms, ProTechnics will no longer be out of compliance with this requirement.
- In some cases, vehicle contamination surveys are performed but not recorded.
- Licensees are required to establish compliance with public dose limits either by (1) demonstrating via measurement or calculation that the TEDE to the individual likely to receive the highest dose is within the limits, or (2) demonstrating compliance with the regulatory limits and by proving (via demonstration) that no individual in an unrestricted area would receive more than 2 mrem in any one hour.

The documentation available at some facilities did not satisfy either of the above approaches.

Recommendations:

- RSOs need to ensure that all required surveys are completed. An overreliance on pre-filled templates is negatively impacting the quality of the records. The lack of manager review of survey records prior to submittal is allowing anomalous results to be submitted as records.
- All survey forms should identify the person conducting the survey.
- Leak tests are required to be collected at intervals not to exceed six months. While ProTechnics is currently in compliance with this requirement, that was not the case between November 17, 2022 (when samples were due to be collected) and December 13, 2022 (when they were collected). Ensure that future samples are collected prior to the not to exceed six months due date.
- Document the exterior surveys of the facility. These surveys are already conducted periodically. Documentation will allow the facility to take credit for completing them and will help establish compliance with dose limits for the general public.
- Consider creating a records quality process that may include sign and date of the survey by the person performing the survey, single line out with date and initials of any changes to the original survey, and prohibiting the use of white out or correction tape on records.
- This recommendation is specifically for the Broussard, LA facility. While ProTechnics does not have any known air emissions, there is potential airborne redistribution of radioactivity resulting from operators performing tasks inside the shop area (*e.g.*, sweeping floors and kicking up dust) and/or air turbulence inside the facility. Some differences in measured exposure rates in unrestricted portions of the facility over the two-day audit period were observed. The radiological dose, if any, from inhaling any such suspended solids would be low, but the lack of documentation to prove so represents an undefined risk. Therefore, collection of air samples to measure airborne radioactivity should be considered. **NOTE: Following receipt of the audit report, Dade Moeller returned to the site and deployed several air samplers, finding that there is no inhalation hazard resulting from airborne dispersion of radioactive material within the facility. The differences noted initially in exposure rates are attributed to background fluctuation and/or building material's changing contribution to the background exposure rates observed.**
- The detection efficiency used for all surveys should be the value provided by Ludlum on the most recent calibration certificate prepared for the scalar. The Albuquerque RSO is encouraged to continue to use the check source in his possession for quality control purposes. Counting that source prior to counting samples will verify that the instrument is working properly by producing a relatively stable count rate, much like using a check

source with a hand-held survey instrument provides confidence of instrument operability prior to use.

- The current practice is to show the original source activity on leak test certificates. SpectraTek should consider replacing the original activity with the decayed activity as of the date of the leak test sample collection.
- Wipe sample results are shown as < MDA with units of dpm/cm². The minimum detectable activity (MDA) should be provided on the form and the units should be changed to dpm/100 cm², since each sample is collected by wiping an area of approximately 100 cm².
- The Leak Test Sample Results spread sheets generated for samples collected in December 2021 and December 2022 do not show the facility associated with each of the sources sampled (the one report includes sources collected from multiple ProTechnics facilities). Ensure that future records of leak test sample results identify the location of the sealed sources. [Note-This recommendation is directed to the persons involved in counting the samples at the Houston facility.]
- The Leak Test Sample Results spread sheet generated for samples collected in May 2022 show 0.0000 µCi for all sample results. This is a statistically incorrect number; going forward, ensure that the analytical results from counting each sample are provided, which are typically less than the MDA associated with the measurement. [Note-This recommendation is directed to the persons involved in counting the samples at the Houston facility.]

9.0 TRAINING AND INSTRUCTION TO WORKERS

Deficiencies:

- Annual safety reviews are not consistently being performed on each tracing supervisor.

Recommendations:

- Revise the O&E manual and training program to state that a minimum of two reviews per year will be performed with a goal of quarterly reviews. This will increase operational flexibility without impacting regulatory and procedural compliance.
- Explore the use of mock-ups and walkthroughs as an alternate method for the safety reviews. This may warrant regulatory approval prior to implementation.
- Some changes to the Outline and Syllabus For Well Logging Operations are offered in Section 2.0 above.
- Some slides from the initial and refresher radiation safety modules should be considered. Refresher Course Module (Radiation Safety #1):

- Slide 27 – shows a fixed contamination limit in units of mR/h; this should be changed to units of dpm/100 cm². Typically, the limit for fixed contamination is set equal to five times the limit for removable contamination.
- Slide 38 – In the definition of Transport Index (TI), add “in units of mR/h, with one digit to the left and one digit to the right of the decimal.”

Initial Course Module (Radiation Safety For Well Logging And Subsurface Tracer Operations):

- Slide 87 – same as slide 27 in refresher course.
- Slide 93 – Provides background doses to average person in the continental U.S. based on NCRP 49, which has since been updated (twice). Replace with data from NCRP 184. The total annual dose has gone from 360 mrem to 540 mrem. The natural background component remains at 310 mrem but the man-made component is now 230 mrem, with the increase due to increased use of radiation in medicine.
- Slide 108 – The slide addresses cancer risk estimates and references the BEIR V Report which was published in 1990. This should be updated to the BEIR VII Report (2005) which projects a risk of 1 per 1,000 per rem. Also consider adding a statement such as “This type of quantitative risk analysis is highly controversial due to the large body of evidence failing to identify any increased risk of cancer at doses less than 10 – 20 rem.”
- Slide 112 – The slide addresses genetic risk and quantifies the risk of a genetic abnormality as being equal to 1/3 of a chance in 10,000 for every rem of chronic exposure per year. Consider deleting this statement. The fact is that there has never been a study in humans that has demonstrated an increased incidence of genetic abnormalities in offspring of irradiated persons (this includes the study of 66,000 persons born to Hiroshima and Nagasaki survivors). Including the slide as it currently reads is misleading at best.
- Slide 125 – same as slide 38 in refresher course.

10.0 RADIATION PROTECTION

Deficiencies:

- A written ALARA program is not appropriately included in company documents.

Recommendations:

- Formalize the ALARA actions in the TOM into an ALARA section.
- Establish an external exposure threshold which will trigger a RSO review of the individual's exposure and a discussion of ways to minimize exposure going forward.

- Develop a process whereby personnel on extended assignments can turn in badges on time. This will minimize the potential for exposures that could approach limits, especially near the end of the year.
- Dosimetry data should be handled similar to medical records. The RSO should provide employee doses to each individual, but should not be sharing all of the dosimetry data with the entire staff.

11.0 RADIOACTIVE WASTE MANAGEMENT

Deficiencies (both pertain to the Midland, Texas facility):

- The radioactive waste building was not posted as with “Caution, Radioactive Material.”
- Surveys of the radioactive waste storage building were not being performed.

Recommendations (pertaining to the Albuquerque SpectraTek facility):

- Containers with DIS waste have a record attached to the container indicating the container content (radionuclide and estimated activity). Rather than discard these upon emptying the container, add the disposal date for the container contents and maintain the records in a DIS folder.
- DIS procedures across industries typically include:
 - Upon closing the container and placing in storage, determine the date in the future following 10 half-lives of the longest half-life radionuclide in the waste.
 - After a minimum of 10 half-lives, move the container to an area exhibiting background radiation levels.
 - Scan the entire outer surface of the container. [Note, this is done without removing any of the waste from the container.]
 - If the scan results are indistinguishable from background, remove the wastes, destroy or remove any radioactive materials labels, and discard the waste materials without regards to radioactivity.

SpectraTek can consider simplifying the current procedure with that shown above.

- Try and locate the missing radioactive waste manifests from the 2016 disposal shipments. Contact Thomas Gray and Associates and inquire if they can provide copies if unable to find them.

12.0 RECORDKEEPING FOR DECOMMISSIONING

Deficiencies: None

Recommendations: None

13.0 TRANSPORTATION [10 CFR 71.5(A) AND 49 CFR 170-180]

Deficiencies:

- Transportation of Class 7 (radioactive) materials in company-owned vehicles to and from job sites are noncompliant with 10 CFR 71.5 which establishes that even if DOT regulations are not applicable to a shipment containing licensed radioactive materials, the licensee still needs to follow the paperwork, marking, and labeling requirements established by DOT in Title 49 of the CFR. Despite 49 CFR 171.1(d)2 establishing that transportation of HAZMATs in private vehicles is exempt from the requirements, the NRC regulation cited above takes precedence.

Recommendations:

- Consider updating the DOT training content.
- Issues related to documenting the TI for outgoing packages are addressed in Section 5.0 above.

14.0 OPERATING AND EMERGENCY PROCEDURES

Deficiencies: None

Recommendations: None

**15.0 SECURITY PROGRAM FOR CATEGORY 1 AND CATEGORY 2
RADIOACTIVE MATERIALS [10 CFR PART 37]**

Not applicable – No Category 1 or 2 sources are authorized on the license.

16.0 AUDITOR'S INDEPENDENT MEASUREMENTS (IF MADE)

Deficiencies: None

Recommendations: None

17.0 NOTIFICATIONS AND REPORTS

There have not been any reportable events from any of the licensed facilities.

18.0 POSTING AND LABELING

Deficiencies:

- At the Midland, Texas facility, the radioactive waste storage building was not posted.

- At the Broussard, Louisiana facility, improper signs were observed within the storage area, on the outside of the fence of the storage area, and at the boundary of the restricted area. The use of “High Radiation Area” signs should only be posted in instances where the measured radiation is 100 millirem (mrem) per hour or more at a distance of 30 centimeters from a source or the surface of a container housing the source. In addition, some signs utilized unauthorized colors.

Recommendations:

- Familiarity and consultation with the applicable regulations will ensure the proper signage is in place for any given time.
- At the Albuquerque, New Mexico facility, remove the ‘Keep Door Closed At All Times’ sign from the door to the warehouse if, in fact, it is acceptable for the door to be open. Otherwise, ensure that it is kept shut as the sign instructs. Place a Caution Radioactive Materials label on the blue cabinet in the Hot Lab.

19.0 FIELD STATIONS AND TEMPORARY JOB SITES

Not Applicable.

20.0 ABANDONMENT OF SOURCES

Deficiencies: None

Recommendations: None

21.0 NRC OR STATE CORRESPONDENCE

Deficiencies: None

Recommendations: None

22.0 INTERNAL AUDITS OR INSPECTIONS

See Section 1.0 above.

23.0 DEFICIENCIES IDENTIFIED IN AUDIT; CORRECTIVE ACTIONS

Several program deficiencies and suggestions for program improvement are provided based on the audits of 12 facilities operating under either NRC or Agreement State licenses. Each site RSO was provided with a copy of the audit report related to their facility; in addition, audit reports were provided to the corporate RSO and EH&S staff as directed.

Approved by: Pete Hernandez

Date: July 31, 2024

Print Name 

Signature