Office of Environment, Health, Safety and Security
Operating Experience Summary

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Lessons Learned from Outsourcing Dosimetry Services at the Savannah River Site

Introduction

Maintaining the equipment, technical expertise, and staffing levels for in-house dosimetry programs is an increasing challenge for many Department of Energy (DOE) sites. Outsourcing dosimetry services has become a common alternative.

This Operating Experience Summary (OES) shares Savannah River Nuclear Solutions (SRNS) Lessons Learned during their successful transition from an in-house dosimetry system to outsourcing of dosimetry processing and can provide valuable insights for other sites that are considering the change.

Background

The Savannah River Site had an in-house dosimetry system, beginning with film badges, since 1953. A commercial Panasonic Thermoluminescent Dosimeter (TLD) system was implemented in 1982. In 1995, a Panasonic albedo neutron dosimeter was added. While this system ran well for many years, SRNS realized in 2016 that the current TLD system was aging and had little support from the vendor. This started the process of finding a replacement system.

Discussion

A cost/benefit analysis was performed to determine if dosimetry processing would be a ***make*** (keep an in-house system) or ***buy*** (outsource to a vendor) proposition. The cost/benefit showed that a ***buy*** would have the lowest cost and a vendor was then selected.

<u>Lesson Learned</u>: It is a good idea to have the preliminary information on this analysis and the specifics of the cost/benefit documented and archived. The decision to outsource could be questioned later in the process, if issues arise.

The vendor selected provided Optically Stimulated Luminescent (OSL) dosimeters for whole body and skin/eye monitoring, and a CR-39 track etch dosimeter for neutron monitoring. Initial testing of the vendor's dosimeters using side-by-side testing was performed. The side-by-side testing included the TLDs used by the site, electronic personnel dosimeters (EPDs) for both gamma and neutron, portable neutron instruments, and a Rotating Neutron Spectrometer (ROSPEC). The results of the side-by-side testing were favorable.

<u>Lesson Learned</u>: When performing dosimeter testing, ensure you challenge the Lower Limits of Detection (LLD) and Minimum Reportable Doses (MRD) of the dosimetry. SRNS performed testing with zero dose (false positive test) and exposures well above the LLD/MRD to test dose tracking software functions. More attention at the LLD/MRD levels would have been beneficial when unexpected low level neutron dose results for the initial issue of CR-39 dosimeters were received.

A new vendor-supplied dosimetry system requires revision to many of the existing program implementing procedures as well as to the Technical Basis Manual (TBM). It was decided to author separate procedures wherever possible and develop a separate TBM.

<u>Lesson Learned:</u> As it is necessary to still operate the current dosimetry system while bringing the vendor dosimetry system online, the decision to author new procedures and a

separate TBM limits the impact on the current system documents. Once the change is made, the old system documents can be deactivated.

The software used to implement the SRNS external dosimetry program is a combination of Commercial-off-the-Shelf (COTS) and modifications made by onsite Information Technology (IT) personnel. This IT team had already rewritten one of the COTS dosimetry software modules and they took on the task of revising the software to accept dosimetry and results from a vendor. This team consisted of a Group Lead who supported the current External Dosimetry software since its inception in 2005, and several good, early career, motivated programmers who were up to the challenge.

<u>Lesson Learned:</u> Good, early career, motivated programmers can easily find other, better paying opportunities elsewhere; replacing like-for-like is very difficult. A contingency plan is needed for when key personnel on a team leave. Start that plan at the beginning stages of the task.

Software development for this type of task is an iterative process that can be delayed by staffing changes and hampered by new programming personnel coming to grips with the concepts and terminology used by Health Physics. A DOE Laboratory Accreditation Program (DOELAP) assessment was scheduled for the outsourcing of dosimetry. When DOELAP arrived, they were able to review the documented procedures, program, equipment calibration, Quality Assurance (QA) program, etc. However, the team was not able to observe all the necessary processes required for accreditation due to an incomplete software system for generation of Dose Reports.

<u>Lessons Learned:</u> Using a project manager that is outside of the main groups involved helps in keeping groups on schedule and tracking successful completion of interim milestones.

It is also important to get senior management involved early to resolve issues that can cause the failure of an assessment.

After the failure of the first DOELAP assessment, senior management was fully involved in looking at the corrective action plan that was developed and asked the team what was needed to get the project back on track. They endorsed a plan to reassign the previous IT Group Lead who was experienced in dosimetry software to this project. In addition, routine update meetings attended by the group managers were formalized. Routine updates were also made to senior management and decision milestones were established to monitor progress. This resulted in completing a successful DOELAP assessment for the use of vendor-supplied dosimetry.

Vendor-supplied dosimetry was issued January 1, 2020. Running both the TLD and OSL/CR39 dosimetry systems simultaneously went well and the in-house TLD system was retired after all outstanding TLDs were processed. The first dosimetry results for the 1st quarter of 2020 (SRNS uses dosimeters quarterly) were received in April 2020. Only three workers received a measurable neutron dose while the previous quarter had about fifty workers, which is typical. It was quickly discovered that the application of the Facility Neutron Correction Factor (FNCF), which was being applied by the SRNS software, needed to be applied by the vendor for their QA process to work properly. The FNCF corrects the CR-39 dosimeter response to the actual neutron exposure from a specific neutron energy spectrum.

<u>Lesson Learned:</u> Applying protocols from one process (TLD) to another process (CR-39) can have unintended consequences. SRNS wanted to be able to apply the FNCF in their software to easily allow different FNCFs for facilities as had been done in the past. This decision; however, negatively impacted the vendor's QA process. Do not assume a vendor fully understands the impact of the customer requests they agree to.

The vendor reanalyzed the neutron doses with the FNCF applied and reported about 4,000 CR-39 dosimeters as positive with the majority in the 10-30 mrem range. The cause of having a very large number of neutron exposures above the MRD was not readily apparent. SRNS used the updated data along with corresponding Radiation Work Permit usage and EPD results to develop a specific, conservative, MRD for this dataset. This resulted in reducing the number of

reportable neutron doses to about 400. The investigation of the issue continued.

The 2nd quarter of 2020 neutron dose results were received in July and indicated 22 workers above the MRD, aligning closely to expectations. The vendor remained committed to the 1st quarter results and the investigation continued.

In a September 2021 meeting with the vendor, an SRNS staff member questioned whether the reprocessed results from the 1st quarter of 2020 had been properly put through the QA process. It turned out that the vendor, when reanalyzing the 1st quarter 2020 doses, had reported raw data without applying QA corrections.

Lesson Learned: The vendor has a well-defined QA process for CR-39 dosimeters that works smoothly in the normal read cycle. SRNS' request to re-analyze a large number of neutron results deviated from the normal vendor process and the proper QA of the results was missed.

In November 2021, SRNS received a CR-39 result of zero mrem where the worker's EPD recorded about 300 mrem during the exposure period. A re-analysis of the dosimeter resulted in the same zero result. The SRNS Dosimetry Manager visited the vendor and requested a recount of selected CR-39 dosimeters under their observation. The SRNS Dosimetry Manager worked with the vendor to identify that neutron track sizes were not being counted accurately. Small tracks on the CR-39 were not always counted as a neutron but rather as an anomaly. Some of the vendor technicians were not accustomed to seeing tracks from lower energy neutrons. There was also a vendor rule in place for a specific customer that if no gamma was present from the OSL dosimeter, the results would be evaluated by the Technical Lead. This rule caused some confusion when reading SRNS dosimetry as to whether it applied or not.

Lessons Learned: Institutional protocols for specific customers can result in vendor uncertainty when assessing another customer's data. Spend the needed time at the vendor's facility to observe your dosimeters being processed.

SRNS has extensive experience with the process for determining neutron dose from TLDs. This experience can contribute to making incorrect assumptions when using a different neutron dosimeter system.

In addition, outsourcing dosimetry services removed the ability of SRNS to perform their own testing, re-analysis, and troubleshooting when issues arise. This paradigm shift takes some time to work through with onsite customers.

Conclusion

SRNS has had no serious issues with the use of the OSL or extremity dosimetry supplied by the vendor, and the site workers adjusted quickly to use of the new dosimetry.

SRNS also purchased readers to perform intermediate reads of the OSL dosimeters, and this hardware has proven to be successful, and is easy to use and maintain.

The site facilities had to adjust to not receiving dosimetry results within a few hours of delivering to the External Dosimetry Group. This has been a big change for the operating nuclear facilities at the site. However, the emergency read process with the vendor has worked well with extremity and whole body dose results being normally reported within 24 hours of receipt at the vendor, and CR-39 results reported within 48 hours of receipt.

It is also worth noting that the April 2020 initial issue with the reported neutron doses came at a time when travel restrictions were being put in place at the Federal, State, and company levels due to the COVID-19 pandemic. This precluded face-to-face meetings with the vendor. It is SNRS' position that the issue would have likely been resolved sooner if travel between SRNS and the vendor had been possible.

Overall, the change from an in-house to a vendor supplied dosimetry system has gone well. The concerns/issues that drove SRNS to retire the in-house TLD system were resolved with the use of vendor-supplied dosimetry.

The DOE EHSS Office of ES&H Reporting and Analysis publishes and shares OES articles to promote organizational learning among DOE facilities and program offices.

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