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LLNL-TR-666289

Lessons Learned & Observations on the 2014 Integrated Field Exercise

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January 16, 2015

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This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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Below is a series of observations made during the course of the exercise. Overall, the exercise went very well and achieved many of the objectives. These observations and opinions are intended to identify areas and opportunities for improvement of the inspection system and represent fine-tuning.

Search logic
It was unclear to those outside the inspection team (even the control team) how search logic was implemented. Maybe that was intentional. The criteria for lowering or raising interest in some areas could use further consideration. Possible examples where the search logic was unclear include the police training facility, long-used farming locations, and chicken farms.

Lessons learned:

- Process for weighing individual observations or measurements in mission planning decisions could be strengthened.

Training:
Specific to the RN techniques, the exercise demonstrated that there is insufficient field experience in their implementation at all levels of the inspection team. Application of the various techniques didn't appear to be attempting to maximize coverage or optimize sensitivity at a particular location. More work on the individual techniques would yield more skill on when and how to apply them. The techniques of backpack, in situ and sampling can be used individually or as complementary techniques. The strategy for the order to apply the techniques to maximize coverage and sensitivity could be improved.

> Carborne Survey: The IT had very few of these instruments, it wasn't apparent that there was sufficient number of instruments to deploy one with each field mission, potentially representing both a health and safety issue as well as potential for missing transient sources. For some parts of the play, the ISP required that the instruments be shut off. The significant restart time (minutes) resulted in even larger areas of the inspection area going unmeasured.
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> Backpack survey: The IT used this device in two modes, as an additional instrument for carborne survey and for walking survey in specific polygons. For carborne use, the backpacks are much less sensitive than the actual carborne system. It is not clear why the IT made the decision to use the backpacks as carborne systems other than they had few carborne systems available. The lower efficiency of the backpacks meant reduced sensitivity compared to the actual carborne systems.

In walking survey mode, the IT attempted to link observation of a radiation anomaly (defined as triggers later in this document) to subsequent sampling decisions. The anomaly assessments were based upon dose rate observations compared to the BOO. The use of this instrument in dose rate mode likely reduced the frequency with which the IT had radiation-anomaly-based reasons to take samples. This is because these types of instruments are generally slow to respond. Comparison to background at the BOO assumed that the entire IA had similar composition. It turned out parts of the IA had lower background than the BOO, potentially further reducing the radiation anomaly-based triggers in the field.

In Situ Gamma Spec: The application of this technique was very dependent on the actual inspection team members. There were a number of poor choices of both when and how to apply the technique. Examples include against steep hillsides, between vehicles, and others often resulting in reduced solid angles for the measurement. Additional training on the technique is warranted. Understanding how the technique compares to physical sampling in terms of sensitivity would help guide implementation of the in situ technique. And, setting up measurements at the beginning of operations at a specific polygon, would maximize its utility.

Sampling: Sampling opportunities were missed and in some cases odd location choices were made. For example, early in the exercise, washes and low spots (concentration by evaporation) were ignored in favor of smooth rocks located outside the wash that appeared to have been washed clean by rain the preceding day(s). More training is needed on what represents a good sampling opportunity, the visual queues that should lead to a decision to sample, and the choice of method actually employed.

Collection of samples could stand improvement. There were some instances in which a surface scrape was collected and a duplicate collected as a second scrape of the same area. That didn't really represent a duplicate. In some tape-based collections, material was removed from the tape prior to packaging. The sampling methods could use more structure and better means to assess their performance.

Contamination Control: Contamination control is a learned skill that takes a lot of practice. Some IT members neglected to use gloves, and equipment was sometimes dropped on the ground without the use of tarps or other barriers. The contamination controls in place at the BOO could use further refinement. Generally, swipe and gross alpha/beta counters are better at detecting low-level contamination than the portal-like monitor that was used at the BOO.

Lessons learned:

- Equipment needs to be appropriate to the intended mission and application. Need better understanding of the appropriateness of techniques, their relative sensitivities and uses.
- More flexibility is needed with application of the various techniques in the field while actually deployed. Decisions to deploy with only a subset of capabilities limited the ability of the field teams to adjust to observables, impacting their overall effectiveness on any given mission. Perhaps a mission package should be assembled for RN that is deployed with each field team.
- Sampling decisions could be better informed by visual observations and measurements in the field.
- Sampling techniques need to be more quantitative and performance quantifiable.
- Contamination control needs to be better engrained. Some techniques, such as use of barriers in the field and scanning equipment returned to the BOO need to be improved.
- More detailed training on the application of individual RN techniques would make stronger both their application individually and as a set of techniques.

Triggering:
Criteria for using one technique (like backpack) to trigger other IT activities (like sampling) were demanded by the ISP. Early in the inspection, the IT/ISP settled on using a background deviation criteria of 5x DOSE rate as compared to that measured at the BOO. However, DOSE rate is a poor criterion for anomaly detection for several reasons. These include: insensitivity and slow response of instruments; and real backgrounds vary significantly within individual polygons depending on, for example, the local geology. Later, the IT/ISP agreed to allow other forms of triggers such as visual observation queues.

Lessons learned:
- Need resolution on whether or not a trigger is even necessary. If so, a trigger should be better defined than a deviation from a background measured "far" away.
- Other queues, such as visual observation of washes, etc., should have been more effectively used as queues.
- Backgrounds should also be established locally near and within a polygon rather than only in comparison to that observed only at the BOO. Every inspection polygon area will be different, hence reliance on the BOO background is tenuous. The observed background rate at the BOO was actually higher than in many parts of the inspection area.

Artificialities of the exercise:
Point sources can't replicate the actual distribution and movement of radionuclides that would occur in the real environment. While the exercise "physics" was generally correct at the initial start of the scenario, the "radiochemistry" (potential movement and migration) resulting from precipitation (for example) was not

played. As the scenario played out, real precipitation occurred in the inspection area and should have influenced (changed) the contamination area. Use of actual radiation point sources doesn't allow for these more realistic aspects. Some techniques, such as sampling, were adjusted "to give a hit", but that could have led to some inconsistencies with the other techniques (maybe noticed, maybe not). For example, the in situ method should also have been adjusted "to give a hit" but that couldn't be replicated without requiring the creation of inject spectra. Capability to create spectral inject data was not available.

Lesson learned:

- If sources are to be used in the scenario to represent distributed radioactivity, take care of unintended consequences of their use. The CT needs to be prepared to replicate all of the physical phenomena that might be encountered.

Optimization of IT/ISP interactions:

Days were too long. The scheduling of the D+2 meeting and D+1 meeting might have been better had they been reversed in order during the day. Having the D+1 meeting late in the day led to, in reality, only the late evening being available to the CT to make adjustments. This is because the D+2 meeting didn't necessarily reflect what was ultimately agreed at the D+1 meeting. Had the D+1 meeting occurred early in the day, it would have allowed for a full day to verify any last-minute needed preparations. A specific example is regarding the radioactive sources. The D+1 plan changed just enough compared to the D+2 that it would have been nice to field the sources in a couple of instances. However, word was received too late for that to occur.

Lesson learned:

- Need to better consider logistical requirements of executing an inspection.

Control team needed equipment – good thing they had some:

Having some dedicated detection equipment proved very useful to the Control Team. Assumptions were being made on how/whether inspection team (IT) equipment would actually perform as anticipated by the CT (assuming correct use by the IT). Having equipment to verify/validate whether sources were observable from various angles was very valuable as it impacted decisions on when/whether the sources needed to be put into the field. The CT, however, was not able to assess whether the sources would have been observed in some circumstances because we didn't have the time or comparable equipment.

Lesson learned:

- Consider making equipment available to the CT in future exercises to (before hand) verify/validate expected performance of systems.

OSC couldn't provide IT-requested services:

The IT wanted significantly more support from the OSC than was provided. These included requests for daily weather forecasts, mission-planning simulations using local ATM, etc. Neither the OSC nor the inspection team had capabilities for local ATM, local weather prediction, etc.

Lesson learned:

- Decisions are needed on the extent to which the IT can rely upon the OSC, specifically on what support the OSC is to provide and whether the OSC can "reach back" to others.
- Based upon the above, either the IT or the OSC need capabilities for local weather prediction, ATM for mission planning, etc.
- Consider increasing staff depth that the OSC, if they are to have a significant operational role during a real inspection.