INVESTIGATION CONCLUSION
ANOMALOUS SOIL SAMPLES
AT HUNTERS POINT NAVAL SHIPYARD
REVISION 1

April 2014

HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

TETRA TECH EC, INC.
1230 Columbia Street, Suite 750
San Diego, California 92101-8536

- **Hypothesis: Can Sample Results in Question Be Replicated?**
    - Samples collected during the investigation fail to yield results that match the uniform results for K-40, Ra-226, and progeny produced in the anomalous set of systematic results for each survey unit in question. Collection of soil samples at various depths within a survey unit does not result in replicating anomalously low K-40, Ra-226, and progeny results, with few exceptions. The exceptions noted are at depths significantly below the surface.
- **Hypothesis: Does Visual Inspection and Comparison Show Soil Homogeneity?**
    - Visual inspection of the survey units in question shows a wide variety of soil types, such that a consistent concentration of naturally occurring radioactive materials within an individual survey unit is unlikely.
    - Visual inspection of the anomalous soil samples as compared to other soil samples collected in the area shows a homogeneity in the anomalous soil samples that is not produced in any other soil sample collected within the area.
- **Hypothesis: Did Inappropriate Sampling Techniques Result in Discrepancies?**
    - All individuals interviewed claimed all appropriate soil sampling techniques were employed. Personnel interview information is contained in Attachment 9.
- **Hypothesis: Did Management Commitment to Schedule Create a Motive to Complete Work by Unethical Means?**
    - Field RCTs, lab technicians, and laborers from the sampling crew, when directly asked during individual interviews if they felt pressure to meet a schedule, all stated that they felt no pressure to complete work. The one exception was Steve Rolfe's comments that the work in the 707 Area had not been completed within the period of performance, and that there was an extended period of time that billable work had not been completed in Parcel E.
    - As the RCTs are subcontracted workers typically migrating to different projects at the completion of contract work, it is counterintuitive for them to complete work in an unethical manner. When the work is completed, the RCTs associated with the contract are released from work, and must seek employment on another contract. Thus, it appears to be beneficial to the RCTs for a work period to be extended as long as possible, such as through more remediation work resulting from systematic soil samples with concentrations of radionuclides of concern exceeding the radiological release criteria. Personnel interview information is contained in Attachment 9.

CONCLUSIONS

With the above hypotheses ruled out, there is one feasible explanation for samples exhibiting consistently low concentrations of K-40, Ra-226, and progeny, with visual characteristics that are similar, if not identical, but not representative of the heterogeneous soil types within the survey units in question. That explanation is that the persons listed as the sample collectors on the chain-of-custody forms, either by themselves or in conjunction with others, collected soil samples in areas outside the designated survey units. Note that Mr. Anthony Smith and Mr.

Joseph Cunningham were listed on the chain-of-custody forms but were not available for interviews because they had left the HPNS project before the investigation began.

The homogeneity of the soil sample results and visual characteristics indicate that the soil samples may have been collected from one homogeneous soil type, possibly from a small area. The soil referred to as the "road base" in the Survey Unit 22/23 areas of the Site 707 may be a source of the material, as its radionuclide signature is similar to that of the soil from the "anomalous" samples, and the grayish color is similar. Sample results collected from drill cuttings from another contractor and stored in Buildings 253/211 show similar "low K-40" results as discussed previously. This may have also served as the source of the "low K-40" soil. Additionally, in the case of sample collection at the North Pier, soil samples were collected from four survey units at the North Pier and one other survey unit all in one day according to the chain-of-custody forms. This quantity of sample collection performed in one day is unrealistic based on interviews with members of the sampling team. The sample collection rate of one to two survey units per day appears to be corroborated by the sample collection rate performed for this investigation.

The motivation for collecting soil samples in areas outside the assigned survey units is unclear. The radioanalytical and physical evidence contradicts the oral testimony provided by members listed on the sampling section of the chain-of-custody forms. Note that multiple survey units in the Site 707 area were remediated primarily as a result of Cs-137 concentrations exceeding the release criterion. The five survey units within the North Pier that showed anomalous results provided a basis for an FSS report to radiologically release the North Pier.

It is counterintuitive for RCTs and HPNS supervisors to want to complete the release of an area rapidly, as this may shorten the length of employment. On the other hand, if the RCT and/or supervisors believed that rapidly finishing survey units would result in future work awards from the Navy at HPNS, or if they wanted to collect samples from an area that did not require significant manual effort, such as the uses of picks and chipper hammers, some motivation to sample in an area outside a survey unit may exist. It is not believed that the anomalous soil samples were a result of sabotage, as the soil sample results all yielded radionuclide of concern concentrations well below any respective release criterion.

To maximize the Navy's confidence in the overall quality of data provided in the future, and to minimize the likelihood of accidental and/or purposeful inappropriate soil sampling to the maximum extent possible in the future, TtEC developed corrective actions to strengthen the quality of all aspects of the soil sample collection and quality control review process. For example, one corrective action focused on retraining the field teams in proper sample collection procedures including proper use and documentation of chain-of-custody forms. As another example, to send a message to all workers that any apparent deviation from sampling protocol will not be tolerated, TtEC proactively removed the three remaining RCTs who had signed the majority of the chains of custody for the identified unacceptable soil samples from any TtEC projects, and severely disciplined the two health physics supervisors responsible for supervising the RTCs. As a third example, to provide increased soil sample collection quality across the entire process, TtEC significantly increased the number of quality control surveillances by the Project QC Manager or another authorized independent party during the final systematic soil sample collection process. In addition to close personal scrutiny by health physics professionals, TtEC also uses Microsoft Excel conditional formatting in soil sample result spreadsheets to

screen and identify soil sample results for closer review and evaluation. A detailed listing of each of the corrective actions implemented by TtEC is included in the "Corrective Actions" section.

Since implementing these corrective actions, TtEC has performed numerous quality control surveillances to confirm the corrective actions were correctly implemented. These inspections have validated that the corrective actions were implemented in accordance with TtEC's plan. More importantly, since implementing these corrective actions, a recurrence of anomalous sample results similar to the results identified in this investigation report has not occurred

ROOT CAUSE

A TtEC Quality Event RCA summary form is provided as Attachment 16. This form is used to conduct the causal analysis of events that resulted in a deficient condition. Each item identified as a cause has a corrective action that is associated with it.

PROCESSES THAT MAY HAVE CONTRIBUTED TO THE CONDITION

Using the Systematic Cause Analysis Technique (SCAT), the following potential processes that may have contributed to mishandling of soil samples and falsified data are listed. The corrective actions in the following section provide a means to prevent the same events from occurring in the future.

- **IMPROPER FOCUS ON PRODUCTION** – The HPNS project management team may have conveyed a message to workers that completion of work by a scheduled date was of undue importance.

- **INADEQUATE FIELD SUPERVISION** – The HPNS project management team may not have shown adequate supervision over health physics supervisors. Health physics supervisors may not have provided adequate supervision over radiation control technicians and laborers.

- **INADEQUATE QUALITY CONTROL SURVEILLANCES** – HPNS QC personnel may not have conducted a sufficient number or adequately detailed surveillances during soil sample collection.

- **INADEQUATE REVIEW OF DATA** – The Radiation Safety Officer may not have sufficiently reviewed radioanalytical data collected during the soil sampling process.

- **INADEQUATE CONCERN FOR OTHERS** – HPNS individual workers may not have questioned actions by co-workers that appeared to be nonstandard.

CORRECTIVE ACTIONS

The following is an update on corrective actions from the initial investigation report dated November 29, 2012. The corrective actions are shown in italics, followed by a listing of the status of the corrective action, as well as a reference to evidence of completion.

1. *Take disciplinary action for individuals identified as the sample collector on the chain-of-custody forms for sample sets containing anomalous data reflecting uniformly low K-40, Ra-226, and progeny concentrations. Disciplinary action will also be taken with the*

management team, quality control team, and radiological supervision responsible for overseeing and inspecting the work.

Disciplinary action has been taken in that the three RCTs still working at the site and whose signatures appeared as sample collector on the chain-of-custody forms for anomalous samples in the survey units as identified in Tables 2 and 3 of the report were removed from TtEC projects. Additionally, the two TtEC health physics supervisors who were responsible for the soil sample collection work in the survey units with the anomalous samples were given one month leave without pay, and letters of caution. One of the two Health Physics Supervisors is no longer employed by TtEC. All other project management personnel who were involved in the sampling process or could have identified the sampling malfeasances, including the project management team, quality control team, and radiation safety team, were issued letters of caution.

This action item is closed.

2. *Retrain all personnel involved in sampling on proper sampling as detailed in SOP HPO-Tt-009, or corporate equivalent procedure, focusing on sample collection depth, representativeness of soil sample, and use and decontamination of equipment.*

   All individuals directly involved in soil sample collection at HPNS were provided refresher training on December 5, 2012, by the site Radiation Safety Officer Representative (RSOR) on proper soil sample collection per SOP HPO-Tt-009, as well as proper filling out of chain-of-custody forms. Training sign-in sheets are provided in Attachment 17. Refresher training is held annually.

   This action item is closed.

3. *Train all individuals at HPNS involved with soil sampling on importance of ethical behavior, and company and personal ramifications of falsified data. Note that this training has already been initiated with TtEC employees and subcontractors associated with sample collection.*

   All individuals involved in soil sample collection, as well as virtually every TtEC employee and subcontractor on the HPNS site, were provided training on ethical behavior by the HPNS RSOR on November 28, 2012; January 29, 2013; February 12, 2013; and January 30, 2014. A copy of the training presentation and copies of sign in sheets are provided in Attachment 18.

   This action item is closed.

4. *Determine, with Navy input, whether survey units identified for possible resampling in Table 3 and/or other survey units need to be resampled.*

   TtEC, under its own initiative, resampled all survey units listed in Table 3 with the exception of the Parcel C Trench Survey Units 234, 238, and 242. Any survey units exhibiting activity concentration exceeding the release criterion for a respective radionuclide of concern were remediated and resampled until all release criteria had been met. All suspect data, including anomalous soil sample data and gamma static survey results, were rejected.

   FSS reports are in the process of being drafted for survey units associated with the North Pier and the Former 707 Triangle Area. Each FSS report will contain a reference to data being rejected due to identification during the quality assurance review process.

The four Parcel C trench units listed in Table 3 had already been backfilled, and draft SUPR reports submitted to the regulatory agencies for concurrence. TtEC submitted recommendations concerning Trench Units 234, 238, 242, and 302 in the October 2013 investigation report. A summary of TtEC's final recommendations for these four trench units has been updated and is included as Attachment 19.

Ancillary soil samples were collected on January 14, 2013 outside of the footprint of the trench backfill for Trench Unit 234. The results were compared to the original soil systematic sample results and were found to be similar, which indicates the original low K-40 results were representative of subsurface conditions.

Trench Units 238 and 242, located outbound of the former shoreline in Parcel C, reported low K-40 concentrations. Statistical analysis of original and ancillary data for Trench Units 238 and 242 indicated the samples may be representative of the trench conditions, but the data were not conclusive. Fill encountered in the trench excavations was compared to fill materials described in the Site Conceptual Model for Parcel C (Attachment 1). Both trench units contained greenish gray soils as shown in excavation photographs, and are in proximity to other locations with documented Franciscan-derived fill material. Franciscan-derived fill is well documented as having very low levels of K-40 and other isotopes. Based on this association, the low K-40 concentrations reported for these trenches were found to be correlative to typical concentrations observed at Parcel C in the presence of Franciscan-derived fill material.

Trench Unit 302 has been re-excavated, and soil samples re-collected and analyzed. All soil samples were less than the HPNS site radiological release criteria. A revised SUPR for Trench Unit 302 was submitted to the Navy for review in January 2014.

This action item is closed.

5. *Continue to resample, and remediate as necessary, survey units identified in Table 2. Once the survey units have verified sample analytical data supporting a recommendation of radiological free release, final status survey reports will be prepared and submitted to the Navy for review and approval.*

   TtEC resampled all survey units listed in Table 2. Any survey units exhibiting activity concentrations exceeding the release criterion for a respective radionuclide of concern were remediated and resampled until all release criteria were met. All suspect data, including anomalous soil sample data and gamma static survey results, were rejected. FSS reports are in the process of being drafted. Each FSS report will contain a reference to data being rejected due to identification during the quality assurance review process.

   This action item is closed.

6. *Implement a protocol such that an independent QC person, or health physicist, will verify through a quality control surveillance that a minimum of 10 percent of final systematic samples for each survey unit have been collected in accordance with the appropriate work documents (SOPs, Task-specific Plans, etc.).*

   A member of the HPNS quality control team has conducted a surveillance of a minimum of 10 percent of final systematic sample collection. Issues identified during the surveillances have been documented and are corrected. Documentation of QC surveillances is contained in Attachment 20.

   This action item is closed.

7. *Develop and implement a protocol for reviewing sample sets to identify radionuclide concentration trends for radionuclides quantified in gamma spectroscopy reports that are inconsistent with previous sampling within a survey unit and/or surrounding survey units. Note that this will include K-40 and other radionuclides that are not radionuclides of concern.*

   As soil sample results are imported into the database, the results are screened by the use of Microsoft excel filters to highlight any results with K-40 at concentrations less than 5 pCi/g. Note that low K-40 soil exists at HPNS as shown by soil sample results in Attachment 2, and in the site conceptual model as shown in Attachment 1. For any results that meet this criterion, the corporate Radiation Safety Officer is notified by e-mail to make a further evaluation. The number of low K-40 results, the location of the samples collected, and previous data for the survey unit (if applicable) are used to determine whether the data are suspect. Using this process provides another level of quality assurance to ensure that soil sample collection is representative of soil sample from the respective survey units.

   This action item is closed.

FINAL CONCLUSION

Collectively, completion of the above action items has resulted in high-quality FSS results. These corrective actions ensured that all samples were collected and handled in full compliance with the Sampling and Analysis Plan. TtEC has not had a recurrence of the type of anomalous soil sample results that led to this investigation, indicating that the corrective actions have addressed the problem.

This page intentionally left blank.

ED_002781A_00003489-00008