ZONE III
EPA REGION 9

RCRA ENFORCEMENT, PERMITTING, AND ASSISTANCE CONTRACT

FINAL
ROCKETDYNE TECHNICAL SUPPORT AND FIELD OVERSIGHT DOCUMENT REVIEW FOR BUILDINGS T-012, T-023, T-028, T-029, AND T-363

DECEMBER 20, 2002

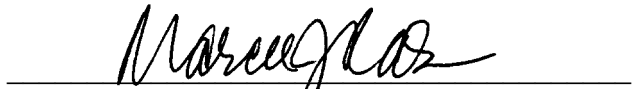
Prepared for:

U.S. Environmental Protection Agency
Office of Compliance
Washington, DC 20460

Prepared by:

Tetra Tech EM Inc.
135 Main Street, Suite 1800
San Francisco, California 94105

EPA Contract No. 68-W-02-021
Work Assignment No. R09107



Marcie Rash
Project Manager

CONTENTS

ABBREVIATIONS AND ACRONYMS

ALARA	As low as reasonably achievable
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm^2	Square centimeter
Co	Cobalt
COC	Contaminants of concern
Cs	Cesium
DHS	Department of Health Services
DOE	Department of Energy
dpm	Disintegrations per minute
EPA	U.S. Environmental Protection Agency
ESSAP	Environmental Survey and Site Assessment Program
ETEC	Energy Technology and Engineering Center
kW	Kilowatt
m^2	Square meter
Mn	Manganese
MARSSIM	Multi-Agency Radiation Site Survey Investigation Manual
µR/hr	MicroRem per hour
MDC	Minimum detectable concentration
Mev	Mega-electron volts
NaI	Sodium iodide
NRC	Nuclear Regulatory Commission
NuReg	NRC regulation
ORISE	Oak Ridge Institute for Science and Education
pCi/g	Picocuries per gram
Ra	Radium
RCRA	Resource Conservation and Recovery Act
REPA	RCRA Enforcement, Permitting, and Assistance
Rocketdyne	Boeing-Rocketdyne
SSFL	Santa Susana Field Laboratory
Tetra Tech	Tetra Tech EM Inc.
ZnS	Zinc sulfide

EXECUTIVE SUMMARY

On May 30, 1997, Tetra Tech EM Inc. (Tetra Tech) received Work Assignment No. R09107 from the U.S. Environmental Protection Agency (EPA) Region 9, under Contract No. 68-W-02-021, Resource Conservation and Recovery Act Enforcement, Permitting, and Assistance, Zone III. Tetra Tech was tasked to perform an independent evaluation of the process used to assess the radiological status of Buildings T-012, T-023, T-028, T-029, and T-363 at the Boeing-Rocketdyne (Rocketdyne) Santa Susana Field Laboratory in Santa Susana, California.

The work assignment has three basic components: (1) technical review and documentation of measurements performed by Rocketdyne and the Department of Energy (DOE) contractor (Environmental Survey and Site Assessment Program, Energy/Environment Systems Division, Oak Ridge Institute for Science and Education [ORISE]); (2) independent measurements by the EPA contractor (Tetra Tech); and (3) evaluation of independent measurements performed by Tetra Tech. This report documents an initial and a final technical review of the following categories of documentation: (1) decommissioning survey work plans and final radiological survey reports prepared by Rocketdyne for five buildings selected by EPA for a technical review and (2) oversight and confirmation surveys performed by ORISE.

Tetra Tech's principal recommendation from the initial (Part I) review is that any future final status surveys should be performed and documented in accordance with EPA's Multi-agency Radiation Site Survey Investigation Manual (MARSSIM, Revision 1) (2000) guidance to establish consistency and broader acceptance of the techniques used for facility characterization. Use of MARSSIM also should allow conclusions to be based on sound, statistical principles that provide perhaps the clearest published approach for demonstration of compliance with radioactivity concentration limits. It is noted that surveys performed prior to the introduction of MARSSIM need not be repeated, as long as adequate quality can be supported and documented. Any future surveys should be performed in accordance with MARSSIM to facilitate full peer and public review.

With respect to the overall level of quality of the surveys and the thoroughness of the reports performed by Rocketdyne, Tetra Tech has identified some comments that if incorporated, could improve future survey documentation. These comments are summarized in Section 4.0. Tetra Tech also made minor recommendations concerning documentation of scan surveys performed by the DOE contractor, ORISE. These comments also are summarized in Section 4.0.

Based on reviews of survey procedures and reports, Tetra Tech concludes that the five buildings discussed herein (T-012, T-023, T-028, T-029, and T-363) were adequately surveyed and that the surveys were sufficiently documented. The acceptability of radiological surveys was based on a review of the practices that were ordinarily used within the industry at the time they were performed. The reviews considered:

- Sensitivity and reliability of the instruments used
- Frequency and rigor of instrument calibration
- Representativeness of sampling locations
- Level of detail
- Correlation between text and data tables
- Adequacy of documentation

1.0 INTRODUCTION

Under Work Assignment No. R09107 of the Resource Conservation and Recovery Act Enforcement, Permitting, and Assistance contract, Tetra Tech EM Inc. (Tetra Tech) was tasked to perform an independent evaluation of the process used to evaluate the radiological status of five selected buildings (T-012, T-023, T-028, T-029, and T-363) at the Boeing-Rocketdyne (Rocketdyne) Santa Susana Field Laboratory (SSFL) and the Department of Energy's (DOE) Energy Technology and Engineering Center in Santa Susana, California. The evaluation has three basic components: (1) technical review and evaluation of measurements performed by Rocketdyne and the DOE contractor (Environmental Survey and Site Assessment Program, Energy/Environment Systems Division, Oak Ridge Institute for Science and Education [ORISE]), (2) independent measurements by the U.S. Environmental Protection Agency (EPA) contractor (Tetra Tech), and (3) evaluation of independent measurements performed by Tetra Tech.

2.0 SCOPE OF WORK

The scope of this report includes radiological survey work plans and reports of radiological surveys related to Buildings T-012, T-023, T-028, T-029, and T-363. Documents reviewed for this project are identified in the Reference section.

The reviews presented herein are in two basic parts. This report documents an initial technical review (Part I) of the following categories of documentation (1) decommissioning survey work plans and final radiological survey reports prepared by the facility for five buildings selected by EPA for a technical review and (2) oversight and confirmation surveys performed by ORISE. This report also documents a final technical review (Part II) that made use of additional documentation obtained from Rocketdyne, ORISE, DOE, and the Department of Health Services (DHS).

3.0 REVIEW COMMENTS

The initial review (Part I) was performed in 1999. These were the first documents to be reviewed under this contract. The Tetra Tech reviewer raised a number of issues, both technical and administrative. A total of 29 general and site-specific comments were developed concerning the Rocketdyne documentation. An additional seven comments were developed concerning the ORISE oversight/verification survey documentation. A draft report of the document review was prepared. In September 1999, a meeting was held with personnel from Rocketdyne, DOE, EPA, and Tetra Tech to discuss the comments and to plan EPA's verification surveys. No personnel were present from ORISE, and the comments relative to ORISE documents were not discussed at that meeting. Four of the Tetra Tech comments relative to Rocketdyne

documents were resolved as a result of that meeting. The remaining 25 comments on the Rocketdyne documents and the 7 comments about ORISE documents required further research before they could be addressed. Meanwhile, during January 10 through 12, 2000, Tetra Tech performed oversight verification surveys in three of the Rocketdyne buildings (T-012, T-029, and T-363). The other two buildings that were part of the document review (T-023 and T-028) had been demolished. In May 2001, an addendum to the draft document review was prepared to incorporate revisions to the four comments resolved as a result of the 1999 meeting. Additionally, a draft report of the oversight/verification survey performed by Tetra Tech was prepared. In May 2001, three draft reports were prepared and provided to EPA:

- Final Rocketdyne Technical Support And Field Oversight Document Review (Buildings T012, T029, and T363). (The title addresses only three buildings, but the report covers documents relative to all five buildings.)
- Draft Addendum To The Final Rocketdyne Technical Support And Field Oversight Document Review (Buildings T012, T029, and T363). (The title addresses only three buildings but the report covers documents related to all five buildings.)
- Final Oversight Verification And Confirmation Radiological Survey Report (Buildings T012, T029, and T363). (The title addresses only three buildings. The other two buildings had been demolished.)

None of the above three reports have been finalized. Although two of the reports have "Final" in the title, they are still considered to be draft because EPA had further comments that needed to be addressed. Subsequent to preparation of the draft documents, personnel changes took place at both Tetra Tech and EPA.

Because there were a significant number of unresolved comments following the Part I (initial) review and because changes in personnel at Tetra Tech and EPA necessitated follow-up investigation of the outstanding comments, a final (Part II) review of all original comments was initiated in late 2001. This Part II review made use of all of the originally reviewed documents from both Rocketdyne and ORISE and in addition, included pertinent information obtained from Rocketdyne, ORISE, DOE, and DHS. The discussion in the following sections addresses each individual comment. Comments are divided into: (1) general comments related to the adequacy of the measurement process or the general quality of the report and (2) specific comments related to the measurement process or survey report for a specific site. Additionally, as discussed above, this document is a compilation of the initial (Part I) and final (Part II) reviews. Initial and subsequent review and resolution are indicated. Four of the original comments to Rocketdyne documents were resolved based on the supplemental information provided by Rocketdyne following the September 1999 meeting. Each of the remaining 25 comments to Rocketdyne documents has been specifically reviewed, and based on additional investigation, has been resolved. For purposes of

identifying the significance of the comment, each comment has been placed in one of four categories, as follows:

- Category 1, Essential. Resolution is essential to achieve the goal of determining if the original surveys were appropriately performed so that the overall conclusion (that the buildings achieved the standard) can be supported.
- Category 2, non-Essential. Resolution is not essential to achieving the goal.
- Category 3. The comment deals with future surveys and reports and is a recommendation for future improvement.
- Category 4. The comment was resolved as a result of the September 1999 meeting of Rocketdyne, DOE, EPA, and Tetra Tech.

Each comment is listed, followed by a brief discussion of the comment, the recommended category for the comment, and the recommended disposition. For continuity purposes, the comment number is the same as used in the two draft document review reports previously mentioned. The comments from the 1999 reviews are identified in **bold face type** and identified as **R-XX** for Rocketdyne-related documents and **O-XX** for ORISE-related documents.

3.1 GENERAL COMMENTS TO ROCKETDYNE DOCUMENTS

Comment R-1: Subsequent final survey reports should include a more detailed description of the basis for release of the facility. Supplemental information should be provided to EPA for buildings where final survey reports have already been issued.

Category 1, Essential.

Part I Review: Supplemental information provided at the September 1999 meeting and in the Rocketdyne letter of October 21,1999, resolved all issues, except a request for Rocketdyne to clearly document to EPA the rationale for use of uranium limits for the five buildings involved. Actual use of uranium limits was considered to be technically acceptable. The October 21, 1999, Rocketdyne letter to EPA noted that after the initial decommissioning and decontamination, the building was used for uranium-oxide melting experiments and was recontaminated in local areas. Therefore, the use of uranium contamination limits was appropriate.

Part II Review: Review of survey procedures for the other four buildings reveals:

1. For Building T-012, the final survey procedure issued in July 1995 clearly identifies Co-60 (Cobalt-60) and enriched uranium as the primary isotopes of interest; therefore, the use of uranium limits are appropriate for Building T-012.

2. For Building T-023, the survey report issued in March 1994 erroneously indicates that uranium limits are appropriate for this building. A June 1994 letter from Rocketdyne, responding to DOE and ORISE comments to survey data, notes that the survey report for Building T-023 will be revised to indicate that the contaminants of concern (COC) for that building are Mn-54 (manganese-54), Co-60, and Cs-137 (cesium-137). The contamination criteria applied to Building T-023 were those for the COCs.

3. For Building T-029, the contamination criteria used by Rocketdyne were for Radium-226 (Ra-226). These criteria are appropriate, because the only contamination history for the facility was a spill of Ra-226 caused by inadvertent dropping of a calibration source.

4. For Building T-363, the final radiological survey report clearly identifies the COCs as Cs-137 and low-enrichment uranium. The contamination criteria contained in the survey plan are appropriate for the isotopes of concern.

The survey plans and reports for three buildings (T-012, T-028, and T-363) clearly identify uranium as a COC and therefore use the contamination criteria applicable to uranium. For one building (T-023), the survey report was identified by Rocketdyne to be in error when listing the uranium criteria. For the fifth building (T-029), the contamination criteria clearly were identified as applicable to radium, not uranium.

Rocketdyne correctly applied the contamination criteria to each of the five buildings. No further documentation of the rationale for selection of contamination criteria is required.

Recommended Disposition: No further action (see also Comment R-3).

Comment R-2: Provide information to EPA to demonstrate that release criteria and instrument sensitivity used were appropriate for the specific radionuclide mixture present in each building.

Category 1, Essential.

Part I Review: Correspondence from Rocketdyne following the September 1999 meeting resolved the questions of release criteria and instrument sensitivities for fixed counts. The addendum to the document review recommended that Rocketdyne document the radionuclide mixtures present in each building at the time of closure and provide the instrument scan sensitivity.

Part II Review: The COCs were well documented in the Rocketdyne procedures (see discussion of Comment R-1 above). A similar comment on scan sensitivity is resolved in Comment R-8.

Recommended Disposition: No further action (see also Comment R-8).

Comment R-3: Provide information to the EPA to support use of uranium release limits and document the absence of transuranic contaminants for each facility.

Category 1, Essential.

Part I Review: In addition to the question concerning the use of the correct contamination criteria, a question was raised regarding whether transuranic contaminants (transuranics are elements with an atomic number greater than uranium) were used in any of the five buildings.

Part II Review: See discussion under Comment R-1. Use of the correct contamination criteria was addressed and resolved in Comment R-1. In addition, COCs for each of the buildings were identified. No transuranic elements were included in those contaminants.

Recommended Disposition: No further action.

Comment R-4: Provide all information necessary to allow independent evaluation of method sensitivity for scanning and fixed measurements.

Category 1, Essential.

Part I Review: The original comment indicated that scan sensitivity should be stated as distinct from fixed-count sensitivity.

Part II Review: As noted in Comment R-2, the question of fixed-count sensitivity was resolved. A similar comment on scan sensitivity is discussed and resolved in Comment R-8.

Recommended Disposition: No further action (see also Comment R-8).

Comment R-5: Describe the sampling and analytical methods.

Category 1, Essential.

Part I Review: The original comment indicates that the analytical method used should be described or referenced, if in accordance with a standard method.

Part II Review: Review of the survey procedures and survey reports for the five buildings in question reveals the following:

1. For Building T-012, the final survey report of 1995 identifies all instruments used and the method used for collecting swipe samples that subsequently were analyzed in the laboratory.

2. For Building T-023, the final survey report identifies instruments used, methods for analyzing swipe samples, and the method used for analyzing soil samples.

3. For Building T-028, the Radiological Survey Procedure identifies detectors to be used and provides methods for determining total and removable contamination levels.

4. For Building T-029, the Final Decontamination and Radiological Survey report identifies instruments used and methods used, including the method for analysis of soil samples in the vicinity of the removed source holders.

5. For Building T-363, the Final Survey Procedure identifies instruments to be used and laboratory methods used to determine removable contamination levels.

For each of the five buildings, therefore, documentation exists identifying laboratory methods used, when applicable.

Recommended Disposition: No further action.

Comment R-6: Describe how the sampling plan combination of field measurements and samples provides assurance that the activity criteria are not exceeded both for hot spots and on an average activity basis.

Category 4. The comment is resolved as a result of the September 1999 meeting.

Part I Review: This comment was resolved by Rocketdyne information provided in the October 1999 letter. The letter discussed use of both qualitative and quantitative frisk surveys, plus smear or swipe samples.

Part II Review: Not applicable.

Recommended Disposition: No further action.

Comment R-7: Provide to EPA the justification for the methodology used, along with the scan sensitivity.

Category 1, Essential.

Part I Review: Tetra Tech considered the justification of the methodology to be satisfactory. Scan sensitivity for both qualitative and quantitative scans remained an open issue.

Part II Review: A similar comment regarding scan sensitivity is contained and resolved in Comment R-8.

Recommended Disposition: No further action (refer to Comment R-8).

Comment R-8: Provide demonstration that the sensitivity was substantially below the release criteria.

Category 1, Essential.

Part I Review: Tetra Tech was satisfied in 1999 that the methodology described (for fixed counts) also could meet the criteria for scanning measurements. The outstanding issue at the time was a suggestion that Rocketdyne should document the rationale clearly in an additional response to EPA.

Part II Review: The original review indicated a recommendation for Rocketdyne to issue a separate document to EPA detailing instrument sensitivities for scan surveys. The original review also indicated satisfaction with the Rocketdyne methodology. The Rocketdyne letter to EPA, issued as a result of the September 1999 meeting, provided typical survey technique sensitivities. There is no need for an additional report to EPA.

Recommended Disposition: No further action.

Comment R-9: Provide an explicit statement of probability for the likelihood that significant areas of elevated radioactivity were not identified and revise the statistical methodology for future surveys.

Category 1, Essential. (Significant areas of elevated radioactivity were probably not identified.)

and

Category 3. For future reports only (revise the statistical methodology for future surveys).

Part I Review: The original comment raised the possibility that there was a high probability that significant contamination could be missed as a result of the statistical analysis chosen to be used for the Rocketdyne surveys. That comment also recommended use of revised statistical methods for future surveys.

Part II Review: The statistical basis for the survey data analysis is explained in detail in the 1985 Rocketdyne document Radiological Survey Plan for SSFL. Individual survey procedures or survey reports for each of the five buildings make use of this same statistical analysis. As noted in the Final Decontamination and Radiological Survey of Building T029, "In sampling inspection by variables, the number of data points on which measurements are obtained is first chosen to be large so that the

distribution of the data is normal (i.e., gaussian). The mean of the distribution, $\overline{X}$ and its standard distribution, s, are then related to a *test statistic*, as follows:

$$TS = \overline{X} + ks$$

TS and $\overline{X}$ are then compared with the applicable limit… to determine acceptance or other plans of actions, including rejection of the area. The value of k is determined from the sample size and two other statistical sampling coefficients which are related to a consumer's risk of accepting a lot, given that a fraction of the lot has rejectable items in it. … It suffices to say here that the values chosen for the coefficients correspond to assuring, with 90% confidence, that 90% of the facility has residual contamination below 100% of the applicable limit (a 90/90/100 test)". In addition to the statistical analysis of the survey point data, and as further discussed in Comment R-25 below, Rocketdyne actually performed a 100 percent scan survey in addition to the fixed-point surveys for which statistical data were analyzed. Therefore, sufficient data exist to support the Rocketdyne conclusions reached based on the statistical analysis performed.

Recommended Disposition: No further action.

3.2 SITE-SPECIFIC COMMENTS TO ROCKETDYNE DOCUMENTS

Comment R-10: Explain why only 20 percent of structural surfaces were surveyed in T-363.

Category 1, Essential.

Part I Review: The justification for the extent of survey in Building T-363 needs to be documented to EPA.

Part II Review: Further review of the specific Building T-363 Final Radiological Survey Report reveals that the building was divided for survey purposes into two lots. Lot 1 consisted of Bay 4, and Lot 2 consisted of the remainder of the building, plus outside concrete areas. Bay 4 had a previous history of contamination. Because of that contamination history, Bay 4 was specifically decontaminated in July 1995. The Final Radiological Survey Report states that the structural surfaces of Bay 4 (pipes, conduits, light fixtures, and so on) were removed during decontamination and decommissioning of that bay. The remainder of the bay was quantitatively surveyed over 100 percent of all surfaces. For Sample Lot 2, a 20 percent sample of all structural surfaces was surveyed for total and removable alpha and beta activity. Lot 2 had no previous history of contamination and was therefore surveyed on an 11 percent sampling basis.

Recommended Disposition: No further action.

Comment R-11: Explain why structural surfaces were not amenable to the survey in Building T-028.

Category 1, Essential.

Part I Review: The original comment noted that an explanation of why structural surfaces are not amenable to surface activity measurements should be provided. Detectors are now available in large and small configurations to accommodate most surfaces.

Part II Review: The Building T-028 Radiological Survey Procedure states, in part, "Structural surfaces will consist of beams, pipes, conduits, and other surfaces that are not amenable to large surface measurements. Twenty percent of the structural surfaces shall be surveyed. The selection of the surfaces to survey should again be biased toward those expected to have the highest contamination levels." The original comment noted that because of the variety of survey instruments now available for use, there should be no reason to perform a sampling survey. The Multi-Agency Radiation Site Survey Investigation Manual (MARSSIM) (EPA 2000) recognizes the existence of such difficult-to-survey surfaces and states "Process information, operating history, and preliminary monitoring at available access points will assist in evaluating the extent of sampling and measurements included in the survey." Rocketdyne selected a 20 percent sample and required the surveyors to survey surfaces expected to have the highest contamination levels. Over 2000 removable contamination wipes were collected and analyzed for the building. No alpha or beta contamination above release limits was detected. Follow-on surveys by ORISE and DHS also found no radioactivity above release limits. The 20 percent sampling by Rocketdyne was adequate and effective.

Recommended Disposition: No further action.

Comment R-12: Explain the basis for equivalency between scanning and average measurements in conjunction with detection limits in Building T-028.

Category 4. The comment was resolved as a result of the September 1999 meeting.

Part I Review: This comment was resolved by Rocketdyne information provided in the October 1999 letter. Briefly, Rocketdyne provided information showing the approximate sensitivity of the survey instruments when used for direct frisk surveys and for integrated scan measurements. The sensitivities were well below the required detection limits.

Part II Review: Not applicable.

Recommended Disposition: No further action.

Comment R-13: Explain how the sampling method provides a reliable estimate of the areas not sampled or re-surveyed in Building T-028.

Category 4. This comment was resolved as a result of the September 1999 meeting.

Part I Review: This comment was resolved by Rocketdyne information provided in the October 1999 letter. Briefly, Rocketdyne forwarded a description of the sampling methods used and noted that the methods used met the State of California guidelines.

Part II Review: Not applicable.

Recommended Disposition: No further action.

Comment R-14: For subsequent survey plans and procedures, consider revising survey work procedures to address correction of gross measurement data to activity.

Category 3. For future reports only.

Part I Review: The comments are recommendations for future reports.

Part II Review: Not applicable.

Recommended Disposition: No further action.

Comment R-15: Justify the basis for the statement that a 100 percent survey would be unacceptably time consuming and not cost-effective for Building T-028.

Category 2. Nonessential.

Part I Review: The original comment was in reference to a statement in the Rocketdyne survey document that the "cost of a 100 percent survey would be unacceptably time consuming and not cost-effective."

Part II Review: This comment was an opinion expressed by Rocketdyne contained in a 1991 document that refers back to a survey performed in 1988 and 1989. As noted above, the extent of survey is related to the potential for contamination. The above-grade portion of the building has been demolished. Verification surveys were performed by ORISE, and additional surveys were performed by DHS. The surveys performed were sufficient.

Recommended Disposition: No further action.

Comment R-16: Evaluate all locations where soil was allowed to remain in place based on this methodology, compared to isotope-specific techniques for Building T-028.

Category 1, Essential.

Part I Review: This comment relates to the reported use of an exposure meter (Eberline E-510) as the partial basis for a statement that all contamination and activation had been removed. Release of soil and concrete should not be based on a gross activity measurement made with an exposure ratemeter. Surface activity measurements should be made for surfaces, and the status of soil and concrete should be determined by a combination of field measurements and laboratory analysis.

Part II Review: Further review clarified that the comment refers to information contained in a May 1976 Rocketdyne internal letter that summarizes the survey results later reported in the initial decontamination and disposition report. The internal letter indicates that soil samples (quantity not listed) were laboratory analyzed and contained 23.7 +/- 2.6 picocuries per gram (pCi/g) beta radioactivity. The August 1976 report, STIR Facility Decontamination and Disposition Final Report, indicates that 25 soil samples were collected under and around the excavated reactor cavity and had beta radioactivity ranging from 14.4 to 30.8 pCi/g. Rocketdyne reported background soil radioactivity levels of 20 to 30 pCi/g of beta activity. The samples collected from the area of the reactor cavity compare favorably with the background data. The excavated cavity was filled with dirt and paved to the level of the adjacent basement. Therefore, the status of the soil for Building T-028 was determined by a combination of field measurements and laboratory analysis. In 1985, the Radiological Survey Plan for SSFL was published. This document clearly requires nuclide-specific concentration limits for soil. Therefore, soil sampling and laboratory analysis was specifically required subsequent to 1985.

Recommended Disposition: No further action. Soil data exist for the soil closest to the actual reactor location in Building T-028. The generic criteria for conducting radiological surveys as of 1985 requires soils analysis.

Comment R-17: Resurvey or reevaluate all remaining areas where exposure rates were used to obtain clearance for Building T-029.

Category 1, Essential.

Part I Review: This comment originated at ORISE in 1992. A 1993 letter reported ORISE conclusions based on their verification surveys. In the 1993 letter, ORISE stated that the building satisfies the requirements for release without radiological restriction.

Part II Review: A final decontamination and decommissioning report was published by Rocketdyne in 1996 that summarizes the Rocketdyne surveys and decommissioning of Building T-029. This report states that upon removal of the below grade source holder tubes, four soil samples were collected for isotopic analysis. All four samples met the acceptance criteria. The excavation was filled in and cemented over. In 1995, DHS surveyed the building and confirmed the ORISE conclusion. Finally, Tetra Tech performed additional surveys of Building T-029 in January 2000. The Tetra Tech surveys further confirmed that no radioactivity was present above the release criteria. Rocketdyne procedures used surface contamination limits (total and removable), gamma exposure rates, and soil activity to determine acceptability for release.

Recommended Disposition: No further action.

Comment R-18: Provide a satisfactory basis for the use of gross alpha measurements or re-perform the study using isotope specific measurements for Building T-029.

Category 4. The comment was resolved as a result of the September 1999 meeting.

Part I Review: This comment was resolved by Rocketdyne information provided in the October 1999 letter. Briefly, Rocketdyne discussed the historical development of specific soil limits for alpha and beta emitters and indicated that the gross alpha limit of 21 pCi/g included background concentrations and therefore was actually a net limit of about 5 pCi/g.

Part II Review: Not applicable.

Recommended Disposition: No further action.

Comment R-19: Justify the use of a single energy calibration source or evaluate the error that could result for Building T-029.

Category 2, Nonessential.

Part I Review: The original comment noted that a single photon source (Cs-137) was used to calibrate the sodium iodide (NaI) detector. A recommendation was made that Rocketdyne should show by study or analysis that use of a single photon source provides a conservative result.

Part II Review: Cs-137 emits a single gamma at 0.661 mega electron volts (in the range detectable by the NaI detector). The isotopes for which the survey was performed (Ra-226 and daughters) emit several gammas with energies above and below the Cs-137 value. Therefore, the issue is whether or not the NaI detector calibrated for Cs-137 is linear and repeatable for gammas of energy different from the Cs-137. The Rocketdyne procedure states that in addition to the 6-month periodic calibration to a Cs-137 source, the NaI instruments were response checked three times daily using a Ra-226 source. Additionally, the calibration included cross-calibration to a Reuter-Stokes High-pressure Ion Chamber. The cross-calibration allowed calculating a conversion factor for the normal NaI detector reading of counts per minute to exposure rate in units of microRem per hour (μR/hr). Using the calculated conversion factor, Rocketdyne survey data ranged from 10.45 to 12.77 μR/hr. DHS surveys, performed several years later in the same location and using a similar type of NaI detector, ranged from 10 to 12 μR/hr. Area background levels during the DHS survey were 14 μR/hr. Finally, Tetra Tech performed oversight-verification surveys in January 2000. Using a larger (and more sensitive) NaI detector, Tetra Tech exposure rate values in the same area ranged from 14.3 to 16.08 μR/hr. Background levels measured for this survey were 17.7 μR/hr. Therefore, the exposure rate data collected by three different surveys during three different time periods are all comparable.

Recommended Disposition: No further action.

Comment R-20: Use a data logger to perform outdoor scan surveys.

Category 3. For future reports only.

Part I Review: The comments are recommendations for future reports.

Part II Review: Not applicable.

Recommended Disposition: See Section 4.0, Summary and Recommendations for Future Surveys.

Comment R-21: For subsequent reports, consider revising the method for reporting results below the analytical detection limits.

Category 3. For future reports only.

Part I Review: The comments are recommendations for future reports.

Part II Review: Not applicable.

Recommended Disposition: See Section 4.0, Summary and Recommendations for Future Surveys.

Comment R-22: In subsequent reports, calculate and report uncertainty in accordance with standard practices.

Category 3. For future reports only.

Part I Review: The comments are recommendations for future reports.

Part II Review: Not applicable

Recommended Disposition: See Section 4.0, Summary and Recommendations for Future Surveys.

Comment R-23: Identify to EPA the contaminants of concern for the facility T-023.

Category 1, Essential.

Part I Review: This comment originated in the ORISE review of survey documentation for Building T-023. Briefly, Table 2 of the survey document for Building T-023 presented uranium guidelines as applicable for survey limits. However, the text of the survey document indicated that the criteria were based on beta-gamma emitters (mixed-fission and activation products). ORISE questioned the basis for selection of uranium guidelines, as listed in Table 2 of the survey document.

Part II Review: In a 1998 letter to EPA, Rocketdyne forwarded a summary of the ORISE and DOE Oakland comments to the Rocketdyne final survey report for Building T-023. Rocketdyne responses to the ORISE and DOE comments also were provided. Rocketdyne addressed the ORISE comment about the basis for the uranium limits and stated that the Table 2 of the survey document was in error. Rocketdyne stated that the COCs for Building T-023 were Co-60, Mn-54, and Cs-137 (all mixed-fission and activation products). EPA has therefore been advised of the COCs for Building T-023.

Recommended Disposition: No further action.

Comment R-24: Explain why only 20 percent of the structural surfaces were surveyed in T-023.

Category 1, Essential.

Part I Review: The original comment states that "The basis for only surveying 20 percent of the structural surfaces should be justified; it is not clear why they have a lower potential for contamination."

Part II Review: The specific survey procedure for Building T-023 calls for a 20 percent survey of all structural surfaces (beams, conduits, pipes and other surfaces not amenable to large surface measurements). The survey report of Building T-023 identifies one location where fixed contamination was detected on the floor of the control room. This area was decontaminated by concrete scabbling. No radioactivity above limits was detected on the walls or ceilings. The confirmation survey performed by ORISE in 1994 discovered two locations on the floor of the control room with fixed beta activity above the guideline limits. One area (less than 15 square centimeters was decontaminated by Rocketdyne, resurveyed, and verified to be under the limits. The second location was determined to be acceptable based on activity averaged over a 1 square-meter (m^2) area. Surface scans performed on portions of the lower walls (at least 25 percent) and upper walls and ceilings (approximately 5 percent) of Building T-023 did not detect any radioactivity above limits. Based on the data, there is no indication that a more rigorous survey of the ceiling or structural surfaces would have detected above-limit radioactivity. Building T-023 has been demolished. There is no need to pursue this subject further for Building T-023.

Recommended Disposition: No further action.

Comment R-25: Explain why less than 100 percent of surfaces were surveyed in T-023.

Category 1, Essential.

Part I Review: The original comment notes that "Use of less than 100 percent surveys should be justified. A simple statement that it is not economical does not suffice. It appears that all 1- by 1-square-meter grids were actually surveyed…"

Part II Review: Review of the report of survey of Building T-023 indicates that a 100 percent direct frisk survey was performed using a G-M frisker probe, which is the probe used when surveying for beta-gamma radioactivity. In a 1999 letter to EPA, Rocketdyne reported that the 100 percent direct frisk survey was conducted routinely as an "initial step in the final release survey process," and that "the results of the survey were not subjected to rigorous statistical analysis." Therefore, if a 100 percent direct frisk survey was performed and detected no areas of elevated activity, a statement was made that the direct frisk was performed but no detailed results were reported. Rocketdyne therefore documented the performance of the 100 percent frisker survey.

Recommended Disposition: No further action.

Comment R-26: Provide the scan and fixed-count minimum detectable concentrations (MDCs) and the method of calculation for MDCs for Building T-023.

Category 1, Essential.

Part I Review: This comment was initially raised by ORISE in a 1994 letter containing comments to Rocketdyne survey reports. That letter questioned whether the detector efficiencies determined in the stationary mode are applicable when the detector is used for scanning measurements. Rocketdyne responded in 1994 that they "know of no reason why moving the detector should affect its response to radiation". ORISE did not at that time pursue the comment or the Rocketdyne response further. In the 1999 letter from Rocketdyne to EPA, Rocketdyne responded to the Tetra Tech comment and provided both the method used for performing the scan survey and the calculated "statistically significant activity" measurable using the survey instrument. At that time, Tetra Tech considered the justification to be satisfactory and that only the scan MDCs (sensitivity) remained an open issue.

Part II Review: The statistically significant activity value is equivalent to the term later used in MARSSIM as "MDC". MARSSIM defines MDC as "the *a priori* activity level that a specific instrument and technique can be expected to detect 95% of the time". For Building T-023, the Rocketdyne calculated statistically significant activity value for the beta-gamma pancake probe was reported to be about 316 disintegrations per minute per 100 centimeters squared (dpm/100 cm^2). The current version of MARSSIM (EPA 2000) discusses the factors that affect the scan MDC and gives an estimate of about 1,080 dpm/100 cm^2 for the beta-gamma pancake probe. However, the surface activity limit for beta-gamma activity in Building T-023 was 5,000 dpm/100 cm^2. Therefore, whether the Rocketdyne calculated statistically significant activity value or the MARSSIM scan MDC value is more accurate, the ability to detect beta-gamma surface activity well below applicable limits has been demonstrated.

Recommended Disposition: No further action.

Comment R-27: Explain the basis for the claim that the statistical techniques are consistent with industrial sampling practices for Building T-023.

Category 2, Nonessential.

Part I Review: The original comment challenged the basis for the Rocketdyne claim that the statistical techniques used were consistent with industrial sampling practices.

Part II Review: The 1985 Rocketdyne document, Radiological Survey Plan for SSFL, explains the statistical analysis process and provides examples of application of the statistical analysis to survey data. The Building T-023 survey report references both a DOE manual on implementing residual radioactive material guidelines and a Military Standard for inspection by variables. A basis has been established for application of the statistical methods employed to evaluate the Building T-023 survey data.

Recommended Disposition: No further action.

Comment R-28: Revise the methodology for subsequent reports so that a statistical conclusion addresses the final condition of the entire building.

Category 3. For future reports only.

Part I Review: The comments are recommendations for future reports.

Part II Review: Not applicable.

Recommended Disposition: See Section 4.0, Summary and Recommendations for Future Surveys.

Comment R-29: A resurvey is recommended for the ceiling of Building T-023.

Category 1, Essential.

Part I Review: The original comment suggested the need for a resurvey of the ceiling of building T-023. The comment then noted that the building had been demolished and the rubble disposed of off site and therefore resurvey is not practicable.

Part II Review: As reported in the Building T-023 survey report, there were two fires in the old control room (Lot 1) of the building. There is no indication that a survey of the ceiling was performed by Rocketdyne following either of the fires. The final clearance survey reported by Rocketdyne in 1994 also did not include surveys of the ceiling. In the 1994 letter from Rocketdyne to DOE, Rocketdyne responded to comments from both DOE Oakland and ORISE concerning the Building T-023 survey report. DOE specifically questioned if ceiling surveys were performed. Rocketdyne stated that no ceiling surveys were performed in Lot 1 but that the walls (20 feet high) were surveyed and there was no contamination above the limits. Building T-023 has been demolished. There is no need to pursue this issue any further.

Recommended Disposition: No further action.

3.3 GENERAL COMMENTS TO ORISE DOCUMENTS

Comment O-1: Provide additional information to the EPA to provide a clearer description of areas that were scanned for each building.

Category 1, Essential.

Part I Review: The original comment noted that "It was not possible to discern clearly from the published verification survey reports which areas received 100 percent scans. The areas which received 100 percent scans should be clearly stated in each report."

Part II Review: Survey reports published by ORISE for each of the five buildings in question were specifically reviewed to determine the extent of surveys conducted. This review revealed:

1. For Building T-012, "surface scans for alpha, beta, and gamma activity were performed on 100 percent of floor and lower wall surfaces and 5 percent of upper surfaces…".
2. For Building T-023, "Interior surface scans for alpha, beta, and gamma activity were performed on floors, lower walls, upper walls and ceilings of each building, and on portions of concrete exterior surfaces" and "Scan coverage, with the exception of upper walls and ceilings, ranged from 25% in rooms or areas without a radiological use history, up to 100 percent for radiological use areas. Approximately 5% of accessible upper wall and ceiling surfaces were scanned."
3. For Building T-028, the ORISE report does not detail the extent of the scan survey; however, the survey diagram shows the entire above-grade concrete pad and the below-grade floor and walls to 2 meters gridded, which indicates a 100 percent scan of those areas.
4. For Building T-029, "performed scans of the floor surfaces contiguous with the source well's former location" (the location of the radium source holders previously removed by Rocketdyne). A field survey map of the area scanned also shows that scan surveys were performed on the floor surrounding the former location of the source wells.
5. For Building T-363, "Surface scans for alpha, beta, and gamma activity were performed on 100 percent of floor and lower wall surfaces and five percent of upper surfaces."

Therefore, for three of the five buildings in question (T-012, T-023, and T-363), ORISE specifically stated that a 100 percent scan survey had been performed, at least in affected areas. For the remaining two buildings, the available grid maps and scanned area maps provide adequate information to show that the scan coverage was thorough.

Recommended Disposition: No further action.

Comment O-2: Review procedures for documentation of scan surveys and train staff to produce more detailed survey records.

Category 3. For future reports only.

Part I Review: The comments are recommendations for future reports.

Part II Review: Not applicable.

Recommended Disposition: No further action.

Comment O-3: Provide additional information to EPA, to include scan sensitivity information for each building, for ORISE surveys performed at Rocketdyne.

Category 1, Essential.

Part I Review: The original comment noted "…scan sensitivity (detection limit, scan rate, and detector efficiency) were not reported in the verification survey reports and were not always included in the supplemental data."

Part II Review: Survey reports published by ORISE were reviewed to identify scan sensitivity information such as detection limit, scan rate, and detector efficiency. This review revealed:

1. For Building T-012, specific detection limits and detector efficiencies were recorded, while the scan rate was identified as "passing the probes slowly over the surface".
2. For Building T-023, background rates, detector efficiencies, and effective detector surface areas were recorded along with the basic formula used for determining the detection limit; again the scan rate was identified as it was for Building T-012.
3. For Building T-028, background rates, detector efficiencies, and effective detector surface areas were recorded; again the scan rate was identified as it was for Building T-012.
4. For Building T-029, no scan sensitivity information is recorded.
5. For Building T-363, background rates, detector efficiencies, minimum detectable concentrations, and effective detector surface areas were recorded; once again the scan rate was reported as it was for building T-012.

The ORISE survey reports and their attached appendices provide sufficient scan sensitivity information for four of the five buildings in question. The ORISE report for Building T-029 is different from the other reports in that it is a two-page memorandum versus a technical report. The memorandum specifies, by attachment, the locations that were scanned by ORISE. In addition, the sketch of scan locations identifies that the survey instrument used was the same instrument used for surveys of Building T-028 on the same day. Sufficient information is available to determine the scan sensitivity data for all five buildings.

Recommended Disposition: No further action.

Comment O-4: Revise survey procedures to include documentation of comparability of fixed surveys and include comparability measurements in future work.

Category 3. For future reports only.

Part I Review: The comments are recommendations for future reports.

Part II Review: Not applicable.

Recommended Disposition: No further action.

3.4 SITE-SPECIFIC COMMENTS TO ORISE DOCUMENTS

Comment O-5: Provide to EPA documentation of the scan survey of Building T-363.

Category 1, Essential.

Part I Review: The October 1996 ORISE survey report states that "surface scans for alpha, beta, and gamma activity were performed on 100 percent of floor and lower wall surfaces and five percent of upper surfaces using NaI scintillation, gas proportional, and/or ZnS detectors coupled to ratemeters or ratemeter-scalers with audible indicators." The original comment noted that the quality and specific locations of these scans could not be ascertained because the actual scan locations were not documented by grid block.

Part II Review: The supplemental data (field notes) provided by ORISE in 1999 include a sketch of Building T-363 and notes that gamma scans were performed on 100 percent interior and exterior, alpha scans were performed on lower walls, beta scans were performed on lower walls, and alpha and beta scans were performed on the floors. There are no specific locations noted for the 5 percent of upper surfaces. The survey grid map from the 1996 survey report identifies the one location where an elevated beta reading was detected. The survey report goes on to state that the average activity of the 1-m^2 grid surrounding the elevated reading was well below the acceptance criteria. Because the grid location of the one elevated reading noted by ORISE is marked on the survey grid map in the 1996 survey report and is clearly identified, no additional detailed grid data are needed.

Recommended Disposition: No further action.

Comment O-6: Provide documentation to EPA of exposure rate and scan surveys in Building T-028.

Category 1, Essential.

Part I Review: The original comment notes that "based on the surveys executed, the statistical probability that remaining contaminated areas could be undetected remains unacceptably high; therefore, additional surveys of this facility are recommended."

Part II Review: This comment stated that no details were provided on the extent of the surface scans in the original survey data provided by ORISE. Further, the comment noted that surface scans were not documented in the supplemental data package and that exposure rate surveys were also not documented. The ORISE survey report does state that surface scans for alpha, beta, and gamma activity were performed on the concrete slab and below-grade floors, walls, and overhead structures using zinc sulfide (ZnS) scintillation, Geiger-Mueller, and NaI detectors. The survey report goes on to state that "Surface scans of the above-ground concrete slab, below-grade vault, and the stairwell for alpha, beta, and gamma activity did not identify any locations of elevated direct radiation." Review of the survey objectives for Building T-028 indicates ORISE's intent to perform surveys and arrive at an evaluation of cleanup procedures and survey methods used by Rocketdyne. ORISE concluded that Building T-028 met the requirements for release from radiological controls.

Recommended Disposition: No further action.

Comment O-7: List the locations that did not receive 100 percent survey coverage for Building T-023.

Category 1, Essential.

Part I Review: The original comment indicated the expectation for the ORISE survey to perform and report 100 percent surveys.

Part II Review: The ORISE procedure for the survey of Building T-023 states, in part, "The purpose of these verifications is to confirm that remedial actions have been effective in meeting established guidelines and that the documentation accurately and adequately describes the post-remedial action radiological conditions at the site." There was no intent for ORISE to conduct 100 percent surveys. ORISE included in its survey report sketches of the areas surveyed and grid maps showing grid blocks surveyed and the location of single point surveys.

Recommended Disposition: No further action.

4.0 SUMMARY AND RECOMMENDATIONS FOR FUTURE SURVEYS

Based on reviews of survey procedures and reports, Tetra Tech concludes that Buildings T-012, T-023, T-028, T-029, and T-363 were adequately surveyed and that the surveys were sufficiently documented. No further survey action is considered to be necessary for the five buildings discussed in this report. The acceptability of radiological surveys was based on a review of the practices that were ordinarily used within the industry at the time they were performed. The reviews considered:

- Sensitivity and reliability of the instruments used
- Frequency and rigor of instrument calibration
- Representativeness of sampling locations
- Level of detail
- Correlation between text and data tables
- Adequacy of documentation

Recommendations for future surveys at Rocketdyne are summarized below:

- Survey plans and reports should be detailed regarding how the survey is performed and what the basis is for demonstrating whether results meet established release criteria.
- Survey plans and survey reports should clearly define the release criteria for each COC.
- Instrumentation used and the capabilities of each instrument should be clearly detailed, including both fixed-point and scan sensitivities, when applicable.
- Methods used to evaluate radiological data, including any statistical tests should be clearly detailed.
- If an oversight or verification survey is intended to achieve some specific purpose, such as establishing comparability with earlier surveys, this also should be clearly identified.
- Consider use of data logger equipment to perform outdoor scan and fixed-point surveys.

Tetra Tech considers that implementation of MARSSIM for future radiological surveys will satisfactorily resolve all of the comments and recommendations noted above (EPA 2000). In an October 2001 letter to EPA, Rocketdyne stated that all Rocketdyne Final Status Surveys performed since April 1999 have been designed and performed following MARSSIM guidelines.

All of the specific comments to Rocketdyne documents and ORISE documents for Buildings T-012, T-023, T-028, T-029 and T-363 have been reviewed and resolved. No further survey action is considered to be necessary for the five buildings discussed in this report.

REFERENCES

Boeing-Rocketdyne. 1998. Letter from Phil Rutherford (Boeing-Rocketdyne) to Tom Kelly (U.S. Environmental Protection Agency) Transmitting Rocketdyne Response to Environmental Survey and Site Assessment Program Comments. June 11.

Department of Health Services (DHS). 1995. Letter from Gerard Wong (DHS) to P.D. Rutherford (Rocketdyne). December 21.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. Van Nostrand Reinhold. New York.

ICF Kaiser. 1993. Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV, SSFL. Part 1, Volume I. October.

Jamieson, M.L. 1995. "Detection and Quantification Limits of Radiological Field Survey Instrumentation, Technical Basis." MK-Ferguson of Oak Ridge Company. November.

Oak Ridge Institute for Science and Education (ORISE). 1993. Letter from Timothy J. Vitkus (ORISE) to Anthony F. Kluk (DOE), titled Type A Verification of Building T029 Santa Susana Field Laboratory (SSFL), Rockwell International, Canoga Park, California. February 5.

ORISE. 1993. "Verification Survey of the Old Conservation Yard, Building T064 Side Yard, and Building T028, SSFL, Rockwell International, Ventura County, California. October.

ORISE. 1994. Verification Survey of Buildings 005, 023, and 064 SSFL, Rockwell International, Venture County, California. October.

ORISE. 1995. *Quality Assurance Manual for the Energy/Environment Systems Division Environmental Survey and Site Assessment Program*. January 31.

ORISE. 1996. Verification Survey of Building T012, SSFL, Rockwell International, Ventura County, California. October.

ORISE. 1996. Verification Survey of Building T363, SSFL, Rockwell International, Ventura County, California. October.

ORISE. 1999. Letter from T.J. Vitkus (ORISE) to M. Lopez (DOE OOO) Transmitting Field Data Sheets for Buildings T-012, T-023, T-028, T-029, and T-363. June 17.

Rocketdyne. 1985. Radiological Survey Plan for SSFL. No. 154SRR000001. September 25.

Rocketdyne. 1990. Final Decontamination and Radiological Survey of Building T029. No. N704SRR990029. June 28.

Rocketdyne. 1991. Building T028 Radiological Survey Procedure. No. N704DWP990095. February 28.

Rocketdyne. 1999. Letter from James Gary Barnes (Rocketdyne) to Tom Kelly (EPA) titled Response to EPA Comments on Rocketdyne's Final Survey Documentation. October 21.

Rocketdyne (ETEC). 1994. "Final Radiological Survey report of Building 023." No. 023-ZR-0001. March 1.

Rocketdyne (ETEC). 1994. Letter from G.G. Gaylord (Rocketdyne) to J. Cullen (U.S. Department of Energy) titled Response to Comments by ORISE and OAK on Rocketdyne Final Survey Reports for Buildings T005, T023, and T064. June 2.

Rocketdyne (ETEC). 1995. Building T012 Final Survey Procedure. No. 012-SP-0004. June 16

Rocketdyne (ETEC). 1996. "Final D & D Report for Building T029." No. 029-AR-0001. March 28.

Rocketdyne (ETEC). 1996. "Final Radiological Survey Report for Building T363." No. SSWA-ZR-0002. June 21.

Rockwell International. 1976. "STIR Facility Decontamination and Disposition Final Report. No. AI-ERDA-13168, Waste Management, UC-70." August 26.

Tetra Tech EM Inc (Tetra Tech). 2001a. "Final Rocketdyne Technical Support and Field Oversight Document Review (Buildings T012, T029, and T363)." May 21. (This document was not issued and is in draft form only.)

Tetra Tech. 2001b. "Draft Addendum to the Final Rocketdyne Technical Support and Field Oversight Document Review (Buildings T012, T029, and T363)." May 21. (This document was not issued and is in draft form only.)

Tetra Tech. 2001c. "Final Oversight Verification and Confirmation Radiological Survey Report (Buildings T012, T029, and T363)." May 21. (This document was not issued and is in draft form only.)

U.S. Environmental Protection Agency (EPA). 1988. "Development and Implementation of Data Quality Objectives for Radiologically Contaminated Superfund Sites." EPA/520/NV/V-8801. Volume I. January 1988.

EPA. 2000. "Multi-Agency Radiation Survey and Site Investigation Manual." MARSSIM (NUREG-1575). EPA402-R-97-016. August.

U.S. Nuclear Regulatory Commission (NRC). 1974. "Termination of Operating Licenses for Nuclear Reactors." Regulatory Guide 1.86, NRC. June.

NRC. 1992. *Manual for Conducting Radiological Surveys in Support of License Termination*. NUREG/CR-5849. Office of Nuclear Regulatory Research. June.

NRC. 1998. "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys." NUREG-1505. July.