

Portland General Electric

TROJAN NUCLEAR PLANT

FINAL SURVEY REPORT FOR THE ISFSI SITE

October 30, 1996

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EXECUTIVE SUMMARY

This report presents the results of the final survey measurements performed within a portion of the Trojan Nuclear Plant industrial area, located north and east of the power block, referred to as the ISFSI Survey Area. Completion of the ISFSI Survey Area final survey is intended to support release of the area from the requirements of license NPF-1 and 10 CFR 50 in preparation for the area being licensed under 10 CFR 72.

The survey area was categorized into five survey units, one of which was classified as affected, the other four as unaffected. The final survey of this area was performed in accordance with the TNP Final Survey Plan for the ISFSI Site and approved survey procedures.

The final survey of open land areas included the collection of 66 exposure rate measurements and 66 surface soil samples. The final survey of surfaces and structures included 120 direct measurements for total surface activity, 120 measurements for removable alpha and beta activity, and 120 measurements for exposure rates. All exposure rate measurements were less than 5 μ R/hr above background. All surface activity measurements were less than 25% of the release limit values for unrestricted use, and soil concentrations were equivalent to environmental background concentrations.

The boundaries of the ISFSI Survey Area have been defined by the existing industrial area security fence on the north and east, and temporary installed fencing on the south and west. In addition, administrative controls have been implemented to control personnel and material access to prevent licensed material from entering the area.

The results of the final survey data presented in this report demonstrate, with a high degree of confidence, that the criteria established for release of the defined area for unrestricted use have been satisfied.

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
Executive Summary	2
Table of Contents	3
1.0 Introduction	
1.1 Purpose and Scope	5
1.2 History	5
1.3 Survey Area Description	6
Figure 1-1 Trojan Industrial Area, Northeast Corner	7
2.0 Decommissioning Activities	8
3.0 Final Survey Overview	
3.1 General Approach	8
3.2 Identity of Contaminants	8
3.3 Release Limits	9
3.4 Instrumentation	10
3.5 Minimum Detectable Activity	11
3.6 Survey Design	12
3.7 Quality Assurance	15
3.8 Data Interpretation	16
Figure 3-1, ISFSI Survey Area	18
Table 3-1, Final Site Survey Procedures	19
Table 3-2, Surface Contamination Limits	20
Table 3-3, Final Survey Instrumentation	21
Table 3-4, Typical Detection Sensitivities	22
Table 3-5, Survey Units Classification	24
4.0 Final Survey Results	
4.1 Background Radiation Levels	25
4.2 Survey Unit: BES	26
4.3 Survey Unit: NAM	27

<u>Section</u>	<u>Page</u>
4.4 Survey Unit: WSH	29
4.5 Survey Unit: TIA	31
4.6 Survey Unit: RWA	32
Table 4-1, Background Values for Gamma Exposure Rates ...	34
Table 4-2, Background Total Surface Activity	35
Table 4-3, Background Radionuclide Concentrations in Soil ...	36
Table 4-4, Summary Results for Survey Unit BES	37
Table 4-5, Summary Results for Survey Unit NAM	38
Table 4-6, Summary Results for Survey Unit WSH	39
Table 4-7, Summary Results for Survey Unit TIA	40
Table 4-8, Summary Results for Survey Unit RWA	41
5.0 Summary	42
6.0 References	43
Appendix A, Survey Unit BES Survey Data	
Appendix B, Survey Unit NAM Survey Data	
Appendix C, Survey Unit WSH Survey Data	
Appendix D, Survey Unit TIA Survey Data	
Appendix E, Survey Unit RWA Survey Data	
Appendix F, Background Radiation Survey Data	

1.0 INTRODUCTION

1.1 Purpose and Scope

The purpose of this report is to present the results of the final survey of the proposed Independent Spent Fuel Storage Installation (ISFSI) area and the surrounding area that will have elevated gamma exposure rates when the ISFSI is fully loaded. It is PGE's intent that this report supports the eventual authorization by the Nuclear Regulatory Commission (NRC) to remove the surveyed area from the conditions of the 10 CFR 50 license, and satisfies, in part, condition number 5 of the Oregon Energy Facility Siting Council's Order Approving Decommissioning Plan.

Portland General Electric is planning to site an ISFSI in the northeast corner of the Trojan Nuclear Plant (TNP) industrial area. As preparation for this project, final survey measurements were collected in accordance with the TNP Final Survey Plan For The ISFSI Site, PGE-1074 (Reference 1), and approved implementing procedures. The survey operation was performed from August 5 through October 17, 1996 by trained PGE employees.

The scope of this report is limited to the final survey associated with surfaces and structures and open land area located within the northeast portion of the TNP industrial area, known as the ISFSI Survey Area. The report discusses the measurement requirements, implementation of the final survey for the identified area, and the results of the measurements.

1.2 History

TNP achieved initial criticality in November 1975 and began commercial operation in May 1976. The reactor output was rated at 3411 Mwt with an approximate net electrical output of 1130 Mwe. The nuclear steam supply system was a four-loop pressurized water reactor designed by Westinghouse Electric Corporation.

TNP was shutdown for the last time on November 9, 1992. On January 27, 1993, after approximately 17 years of operation, PGE notified the NRC of its decision to permanently cease power operations. This decision was predicated on both financial and reliability considerations. The NRC amended the TNP Facility Operation License (NPF-1) to a Possession Only License on May 5, 1993. Limited dismantlement activities commenced in 1995.

1.3 Survey Area Description

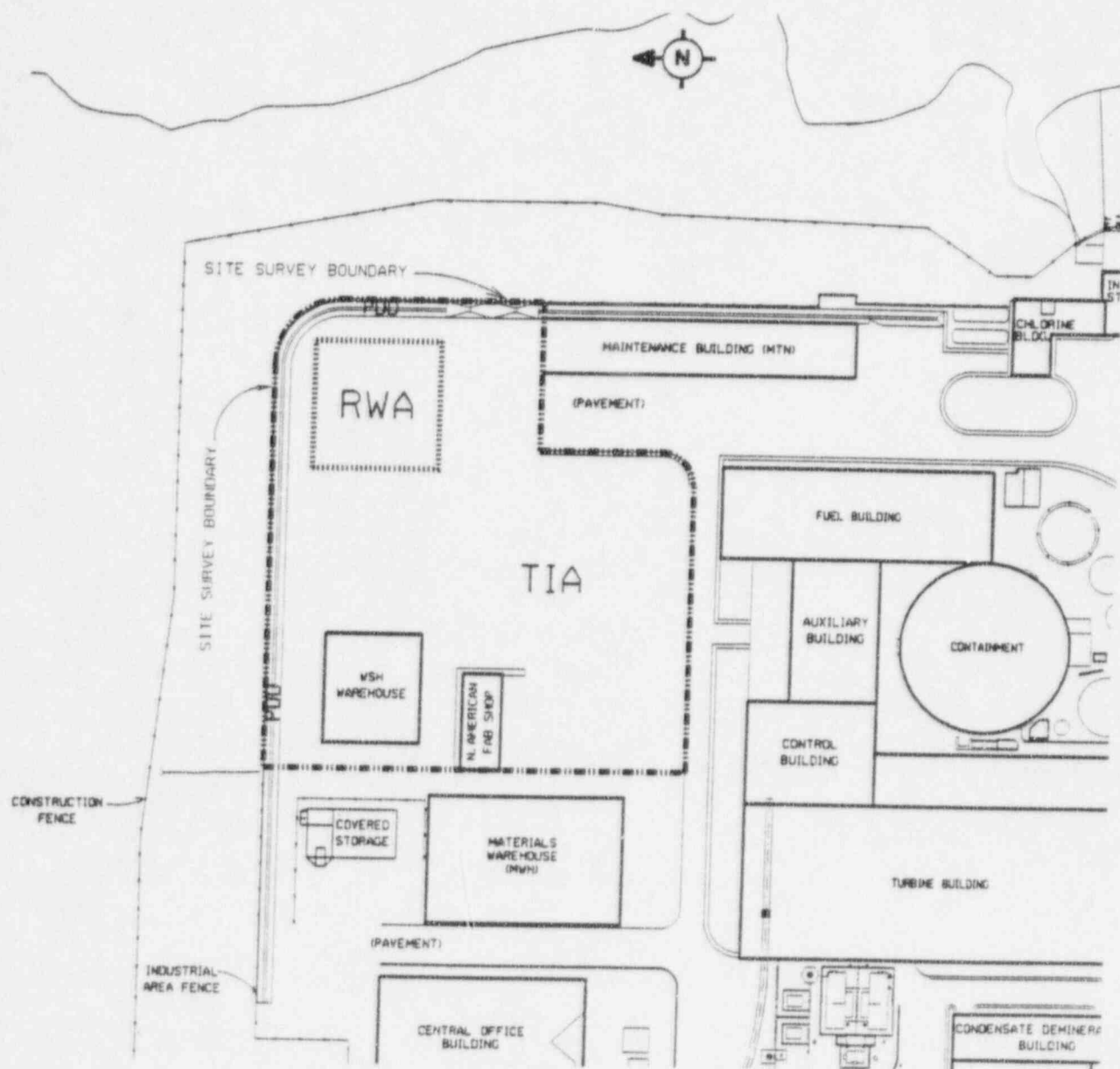
The ISFSI Survey Area is a section of land, approximately 10,000 square meters in size, located within the northeast end of the TNP industrial area, as shown in Figure 1-1, Trojan Industrial Area. The area includes the area that will be used for the proposed ISFSI, and additional area that will have radiation levels due to ISFSI fuel storage that will interfere with the final TNP site survey pursuant to 10 CFR 50.82, and over which positive control of the movement of personnel and materials can be reasonably maintained.

The ISFSI Survey Area has been isolated from the rest of the industrial area by a temporary chain link fence with locked gates along the west and south boundaries. The east and north boundaries are the original security protected area (now industrial area) fence. Approval and gate key must be obtained from TNP Security or Radiation Protection for access to the surveyed area. This combination of administrative and physical controls ensure that licensed radioactive material is not brought into the surveyed area.

A Low-Level Radioactive Waste Storage Building, that was located in the northeast corner of the survey area, approximately 50 feet of the Maintenance Building, and approximately 100 feet of the WSH Warehouse were dismantled and removed, including concrete slab floors, prior to commencing survey data collection. The remaining west portion of the WSH Warehouse, and the North American Fabrication Shop are the only two buildings within the survey area. Other accessible structural surfaces within the survey area include an open, concrete lined, storm water drainage ditch along the east and north boundaries, localized areas of concrete pavement, and utility fixtures (light poles, electrical transformers, fire water stations). The balance of the survey area is open land that is gravel fill.

Except for the location of the no longer existing Low-Level Radioactive Waste Storage Building, the survey area does not have a history of licensed radioactive material contamination. The Fabrication Shop had experienced naturally occurring radioactive material contamination in the past from grinding the tips of tungsten welding rods, which contained naturally occurring thorium. Based on this and the low probability of residual radioactive contamination, the survey area was classified as unaffected, except for the area on which the Low-Level Radioactive Waste Storage Building sat, which was classified as affected.

Figure 1-1

TROJAN INDUSTRIAL AREA
NORTHEAST CORNER

October 30, 1996

2.0 DECOMMISSIONING ACTIVITIES

PGE chose the DECON alternative for decommissioning. TNP is currently in the middle of a transition period of approximately six years to allow for decay heat dissipation, prior to transferring fuel to an ISFSI. A radiological characterization of the TNP site was performed in 1993 (Reference 2). The four steam generators and the pressurizer were removed and disposed of in 1995. Dismantlement activities in 1996 have included removal of reactor coolant system piping, and pumps, and miscellaneous Auxiliary Building equipment. Decommissioning activities are further described in the TNP Decommissioning Plan, PGE-1061 (Reference 3).

As already described in Section 1.3, one building and portions of two other buildings were removed from within the survey area prior to initiating the final survey data collection.

3.0 FINAL SURVEY OVERVIEW

3.1 General Approach

The purpose of the final survey was to demonstrate that NRC criteria for unrestricted use of the surveyed area are met. The survey was also to meet, in part, condition number 5 of the Oregon Energy Facility Siting Council's Order Approving Decommissioning Plan. This required evaluation of licensed radionuclide concentrations in soils, residual surface radioactivity levels, and radiation surface scans and exposure rates of structural surfaces and open land areas.

The final survey was performed in accordance with the TNP Final Survey Plan For The ISFSI Site, PGE-1074 (Reference 1), and approved plant procedures, which are listed in Table 3-1, Final Site Survey Procedures. The survey plan and procedures identify survey instrumentation requirements, measurement and sample collection, and data evaluation methods.

3.2 Identity of Contaminants

The primary radionuclides of interest for this survey were Co-60 and Cs-137, based on the data compiled in the TNP Radiological Site Characterization Report (Reference 2) and summarized in the Decommissioning Plan (Reference 3). Hard to detect radionuclides, such as Sr-90 and Pu-239/240, are considered potential contaminants at Trojan; however, such radionuclides are expected to be present with other beta/gamma emitting radionuclides that can easily be detected. This conclusion is based on a review of the radioactive waste sample data from the annual scaling factor samples, which showed that Co-60 was always present when alpha emitting transuranic radionuclides

were identified. Cesium 137 was present in 85% of the radwaste samples. The average proportion of Cs-137 to Sr-90 was 349, for dry active waste, based on the dirty waste filter analyses, and 33 based on clean waste demin analyses.

All final survey locations were evaluated to identify the presence of any radionuclide which may be attributed to licensed activities at TNP, specifically the gamma emitting radionuclides Co-60 and Cs-137.

Extensive background surveys were conducted to confirm the conclusions drawn from the radiological site characterization survey, and to further characterize radiation backgrounds for building surfaces, concrete and asphalt pavement, and gravel filled open land.

3.3 Release Limits

The results of final survey individual measurements within the survey area were compared to release limits to determine suitability for release for unrestricted use. For the unaffected area survey units, total and removable surface activity, or radionuclide soil concentrations were compared to 25% of the release limit values to verify area classification (unaffected versus affected). For the one affected area survey unit, radionuclide soil concentrations were compared to 75% of the release limit values. Additionally, the 95% upper confidence level of the mean for each type of measurement in each survey unit was compared to the applicable release limit.

To compare survey measurements to the release limits, background radiation and radioactivity data were collected from locations outside the plant industrial area and unaffected by licensed activities. Background levels were subtracted from final survey measurements to obtain net measurements.

3.3.1 Surface Activity

For total and removable surface radioactivity, release limits are given in Regulatory Guide 1.86, (Reference 4) and reproduced here in Table 3-2, Surface Contamination Limits. Individual fixed point measurements were compared to the table column labeled "Maximum," and smear samples were compared to the table column labeled "Removable." Action levels of 25% or 75% of the release limit for investigation survey were established for obtaining additional data, if required, to average over one square meter. The statistical mean and 95% upper confidence level values for total surface activity were compared to the Table column labeled "Average."

3.3.2 Exposure Rates

The acceptance criteria for exposure rates, measured at a distance of one meter from accessible surfaces in buildings and open land areas, are an average of 5 $\mu\text{R/hr}$ above background for the survey unit, with individual measurements not to exceed 10 $\mu\text{R/hr}$ above background. An action level of 5 $\mu\text{R/hr}$ above background was established for obtaining additional data by investigation survey to average over 10 square meters for structures and 100 square meters for open land areas.

3.3.3 Radionuclide Concentrations in Soil

Radiological analysis results of surface and subsurface samples were evaluated to demonstrate that the Total Effective Dose Equivalent (TEDE) to the average individual was below 15 mrem/yr using the default concentration values for soil residential scenario recommended in NUREG-1500 (Reference 5). For the principle gamma emitters, Co-60 and Cs-137, the release limit values are 2.97 and 10.70 picocurie per gram respectively. Action levels of 25% or 75% of a release limit were established for obtaining additional data by investigation survey.

3.4 Instrumentation

Selection and use of instrumentation ensured sensitivities were sufficient to detect the primary radionuclides of concern. A list of the instruments, radiation detected, and calibration sources used is provided in Table 3-3, Final Survey Instrumentation.

3.4.1 Field Instrumentation

The Eberline Model ESP-2 Smart Portable was used for total surface activity and exposure rate measurements. The ESP-2 is a data logging, microcomputer based, portable radiation survey instrument designed to operate with a variety of radiation detectors as a digital scaler or rate meter. Detector parameters (e.g., high voltage, calibration constant) are stored in the ESP-2 memory. For this survey, three detectors were used with the ESP-2 instrument:

- SPA-8, a 1" by 1" NaI(Tl) gamma scintillator for exposure rate measurements and scan surveys.
- BP-100, a 100 cm^2 plastic scintillator for total beta surface activity.

- AC-3-8, a 59 cm² ZnS(Ag) scintillator for total alpha surface activity. This detector was used for background characterization surveys only.

A Reuter-Stokes Model RSS-112 PIC portable environmental radiation monitor was used for exposure rate measurements. The RSS-112 PIC consists of a microcomputer based electronics enclosure, and a high pressurized ion chamber detector filled with ultra-high purity argon.

An NE Technology Limited Model CM11 contamination monitor was used for building surface scan surveys. The CM11 contamination monitor consists of a microcomputer based electronics enclosure, and a Type DP11A gas flow dual detector. The gas flow proportional detector has an active area of 100 cm², and is capable of detecting both alpha and beta contamination simultaneously.

3.4.2 Laboratory Instrumentation

Radionuclide sample analyses were performed on-site using the following counting systems:

- Tennelec Model LB5100 Low Background Alpha Beta Counter, a gas-flow proportional automatic counting system, to count smear samples for alpha and beta activity.
- Ortec/Canberra Gamma Spectroscopy system, equipped with liquid nitrogen cooled High Purity Germanium (HPGe) detector, to analyze soil samples for gamma emitting radionuclide concentrations.

3.5 Minimum Detectable Activity (MDA)

The MDA is defined as the minimum amount of activity that can be statistically detected above background with a 95% probability and with a maximum of 5% probability of falsely interpreting sample activity as activity due to background. The MDA is dependent on the counting times, detector efficiency, background count rate, and sample size, if applicable. The *a priori* MDA for each instrument and detector combination was calculated in accordance with the survey plan (Reference 1) and documented as specified in RP 454, Site Release Survey Background Determination. In addition to MDA, the critical level was also calculated, following the methodology contained in NCRP Report No. 58 (Reference 6). The critical level is the net activity for reaching the decision of detection or non-detection. Table 3-4 provides a summary of typical detection sensitivities for the instruments used to determine activity. The MDAs for fixed-point measurements of total beta surface activity were typically less than 230 dpm/100cm², and less than 90 dpm/100cm² for fixed-point total alpha surface

activity measurements.

The instrument used to perform alpha beta surface activity scan surveys for surfaces and structures was operated in the rate meter mode. The detector was held within 1 cm from the surface and moved at a rate not to exceed 5 cm per second, as specified in procedure RP 452, Site Release Survey Measurements. The detection sensitivity and survey technique were capable of detecting approximately 3850 dpm/100 cm². The alarm feature of the instrument was also used to alert the surveyor of counts greater than about 3 times expected background count rate.

The instrument used to perform exposure rate scan surveys for open areas was also used in the rate meter mode. The detector was held at approximately 1 to 2 inches from the surface and moved at a rate of 12 to 36 inches per second (slow walk), as specified in procedure RP 452, Site Release Survey Measurements. The alarm feature of the instrument was used to alert the surveyor of counts greater than about 2 times expected background count rate.

To ensure consistency in detection response, each survey instrument was source checked prior to and at the end of each day of use. The net instrument response was required to be within 10% of a predetermined count rate. An instrument would not be used if it failed the check at the start of the day. The survey data would require a determination of acceptability if the instrument failed the check at the end of the day.

A priori MDA values for laboratory instruments used to analyze survey samples were determined in accordance with approved plant procedures. The Tennelec LB5100, used to count smear samples for gross alpha and gross beta activity, had MDA values of 8 dpm per 100 cm² or less. The gamma spectroscopy system, used to isotopically analyze soil samples, automatically calculates MDA values. Soil samples were counted for 2 hours, yielding MDA values for Co-60 and Cs-137 of 0.01 pCi per gram or less.

3.6 Survey Design

In addition to the final survey plan (Reference 1), and approved plant procedures (see Table 3-1), the final survey was designed and implemented in accordance with the guidance provided in draft NUREG/CR-5849 (Reference 7). The areas surveyed included open land areas (grounds), and two structures within the plant industrial area, as shown in Figure 3-1, ISFSI Survey Area. This includes the area that will be used for the proposed ISFSI, and additional areas that will have radiation levels due to ISFSI fuel storage that will interfere with the final site survey pursuant to 10 CFR 50.82.

The boundaries of the survey area are defined by the existing industrial area security fence (the original protected area fence) along the north and east, and temporary fence

installed along the south and west prior to start of survey data collection. This area was secured to establish positive control of personnel and material access in accordance with plant procedure TPP 20-40, Control of Areas Surveyed for Final Release.

The survey area was divided into five survey units and classified as affected or unaffected, as shown in Table 3-5. Two survey units were categorized as open land areas, and three survey units were categorized as surfaces/structures. One survey unit was classified as affected, and four survey units as unaffected.

A walkdown of each survey unit was performed and survey instruction sheets and maps prepared identifying measurements and measurement locations. To aid in determining measurement locations, a 10 meter by 10 meter grid system was superimposed on the survey maps for the two open land area survey units, and a 10 foot by 10 foot grid on building survey maps. Measurement locations within the affected survey unit were systematically selected as 4 points within each 10 meter grid, equidistant from the grid center and its 4 corners. Measurement locations within the unaffected survey units were randomly selected by lottery method using the survey map grid identification numbers. Generally, 30 measurement locations were selected. All survey locations were physically marked and labeled after data collection.

The radiological parameters measured included:

- Surface scans to identify areas of elevated radiation.
- Surface contamination measurements.
- Gamma exposure rate measurements.
- Soil samples for radioisotopic analysis.

3.6.1 Background Radiation Surveys

Background levels were determined for exposure rate, alpha and beta surface activity and soil concentrations. These measurements were obtained from areas outside the plant industrial area, in accordance with procedure RP 454, Site Release Survey Background Determination. The survey instruments and methods used for background measurements were similar to that used for fixed point measurements. Background levels were determined for the following media:

- Concrete Surfaces
- Sheet Metal Building Surfaces
- Sheet Metal with Fiber Glass Insulation Building Surfaces
- Surface Soil/Gravel

For documentation purposes, the background survey was treated as a survey unit, with a survey package developed to define the type and number of background measurements, and to organize and manage the background data collected.

3.6.2 Open Land Survey

The final survey of the affected survey unit (RWA) included an exposure rate scan survey of 100% of the surface area. The intent of the exposure rate scan was to identify potentially elevated areas of activity requiring additional sampling. No elevated areas were detected during the exposure rate scan survey. Fixed point exposure rate measurements were collected with a Reuter-Stokes RSS-112 PIC at a distance of one meter from the surface at 36 systematically selected locations. Soil samples were collected at the same 36 locations, after exposure rate measurements. Six soils samples were split with a contractor laboratory for independent verification analysis. This survey unit was physically gridded into 10 meter by 10 meter sections.

The final survey of the unaffected survey unit (TIA) included an exposure rate scan survey of greater than 10% of the accessible surface area, and 100% of the accessible surface area of the concrete lined, storm drainage ditch. No elevated areas were detected during the exposure rate scan survey. Fixed point exposure rate measurements were collected with the RSS-112 PIC at a distance of one meter from the surface at 60 randomly selected locations (30 over gravel ground, 25 over concrete surfaces, and 5 from utility structures). Soil samples were collected at the 30 gravel ground locations, after exposure rate measurements. Three soils samples were split with a contractor laboratory for independent verification analysis. Surface contamination measurements (total beta activity and smears) were obtained from the 25 concrete and 5 utility surfaces, after exposure rate measurements. This survey unit was not physically gridded.

3.6.3 Surveys of Structural Surfaces

Each structural survey unit (BES, NAM and WSH) received a surface activity scan survey over a minimum of 10% of the surface area to identify any areas of elevated radioactivity requiring additional measurement. Scan surveys were performed using a NE Technology Model CM11 gas-flow proportional dual alpha/beta contamination monitor. The detector was placed approximately 1 cm from the surface being surveyed and moved at a rate of 5 cm/sec or less.

Exposure rate measurements were obtained from 30 randomly selected locations for each survey unit, using an Eberline ESP-2 meter with SPA-8 NaI detector.

Measurements were obtained one meter from each measurement location. Following the exposure measurements, total beta surface activity was measured using an Eberline ESP-2 meter with the BP-100 plastic detector placed on contact with the surface being surveyed. A smear for removable surface activity was collected at the location of each total surface activity measurement. Smear samples were collected over an area of 100 cm² using standard smear sample media and collection techniques. Smear samples were analyzed for gross alpha and gross beta-gamma activity using a Tennelec LB5100 gas-flow proportional counter.

3.7 Quality Assurance

Conduct of this final survey was subject to the requirements of the Trojan Nuclear Quality Assurance Program (NQAP) (Reference 8). The applicable quality assurance program elements were described in the final survey plan (Reference 1) and include the training of survey personnel, selection, calibration and operation of survey instrumentation, survey documentation, sample chain of custody, independent quality checking, and records management. In addition, Trojan Nuclear Oversight provided an independent review of all survey packages to verify that documentation is complete, and that the documented results meet the release limits.

Personnel involved in survey data collection, evaluation and/or review received classroom training covering an overview of the survey plan, and survey data collection methods and procedures. In addition, the survey technicians performed practice surveys covering all the survey techniques.

Radiation detection and counting instruments, and calibration and check sources are controlled, maintained and calibrated in accordance with the existing Trojan Radiation Protection Program (Reference 9). All instruments used for this final survey were properly calibrated prior to the start of data collection. Field instruments were checked for acceptable operation with radioactive sources (source checks) prior to and at the end of each day of use. Analytical laboratory instruments received the routine prescribed QC checks each day of use. All radioactive sources used for calibration, source checks and QC checks are traceable to NIST.

3.7.1 Survey Documentation

Survey records are contained in a survey package for each survey unit, and maintained as Quality records and Decommissioning records in accordance with Plant procedure TPP 18-4 (Reference 10). Survey package records include:

- Independent review check sheet

- Survey package documentation checklist
- Documentation of survey data evaluations
- Survey data summary tables
- Survey instruction sheets, maps and diagrams
- Scan survey results
- Exposure rate results
- Surface activity results
- Soils analysis results
- Sample chain of custody records
- Independent quality checking documentation sheets

3.7.2 Independent Quality Checking

Independent quality checking of field and laboratory measurements was performed for quality control purposes and to verify that survey measurements were being collected and documented correctly. Quality checking was performed by qualified plant personnel not directly responsible for or otherwise involved in final survey data collection. Quality checking included direct observations and record reviews of survey data and sample collections, and sample analyses of approximately 10% of the survey measurements. Results of quality checking activities are documented in the applicable survey packages.

In addition to quality checking by plant personnel, six background and nine survey unit soils samples were sent to Thermo Nutech, a contracted radiochemistry laboratory, to provide independent verification of gamma spectroscopy analysis. This contractor laboratory has an acceptable quality assurance program audited by Trojan Nuclear Oversight. Results of this split sample analysis confirmed the results obtained from in-house gamma analysis.

The survey data collection program was also observed by regulatory personnel with split samples shared.

3.8 Data Interpretation

The guidance provided in Section 8 of draft NUREG/CR-5849 (Reference 7) was used to assist in data interpretation. Measurements are reported in units appropriate for comparison to the release limits by correcting for background, efficiency, detector area, and sample size as applicable. The reporting units are as follows:

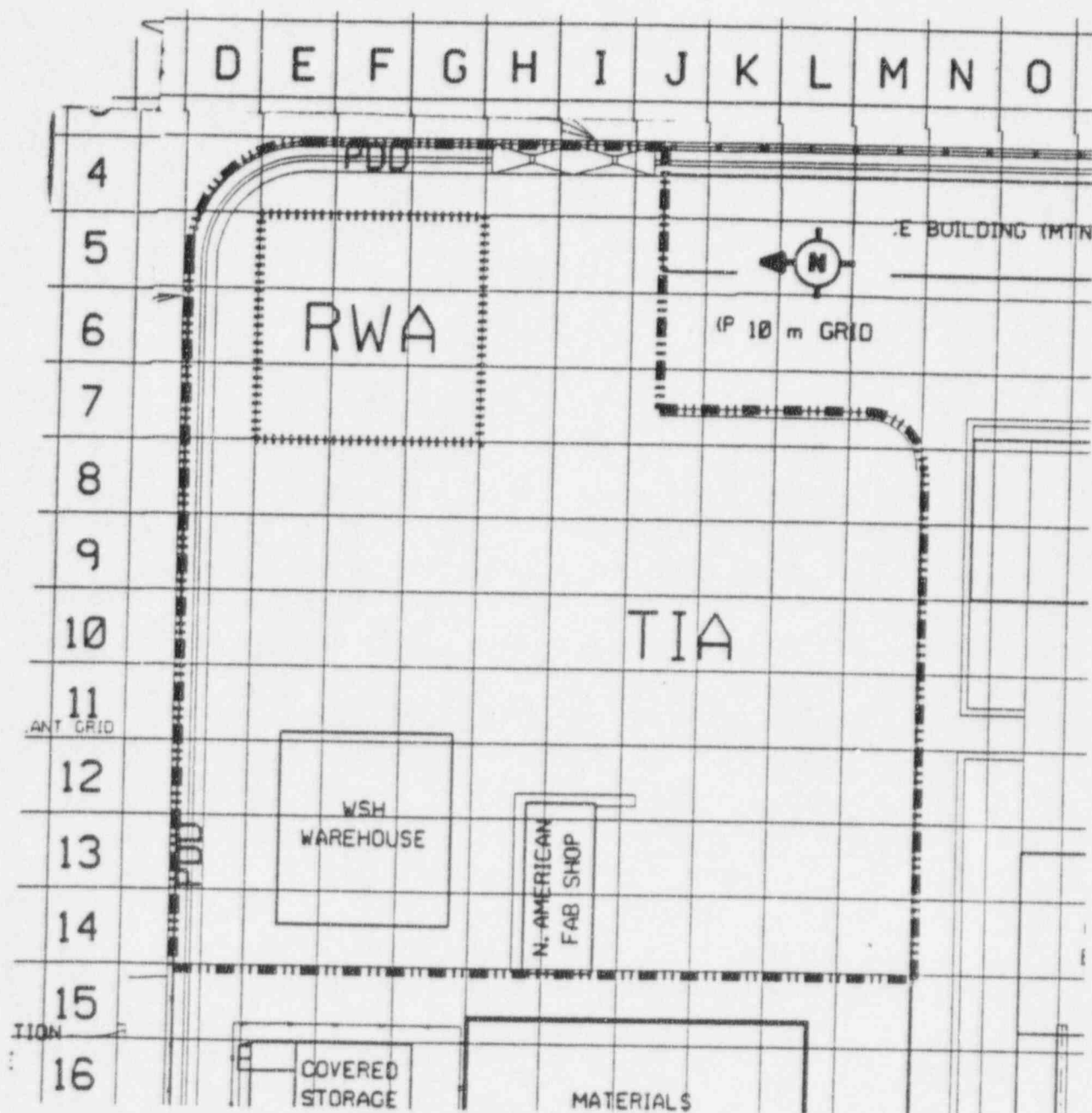
- Surface Contamination: dpm/100 cm²
- Exposure Rate: μ R/hr
- Radionuclide Concentrations: pCi/g

Mean values and 95% confidence level values were calculated for each type of measurement performed within a given survey unit and compared to the action levels and release limits as described in the survey plan (Reference 1) and plant procedure RP 453, Site Release Survey Data Evaluation.

Survey data from field instruments and sample analysis results acquired from laboratory measurements were input into a computer spreadsheet database for statistical evaluation and report preparation.

Figure 3-1

ISFSI SURVEY AREA



October 30, 1996

TABLE 3-1

Final Site Survey Procedures

Procedure Number	Procedure Title
TPP 20-40	Control of Areas Surveyed for Final Release
RP 450	Site Release Survey Administrative & Quality Controls
RP 451	Site Release Survey Package Preparation
RP 452	Site Release Survey Measurements
RP 453	Site Release Survey Data Evaluation
RP 454	Site Release Survey Background Determination
RP 40	Calibration Procedure - RP Equipment Calibration Records and Instrument Source Check Data Sheets
RP 90	RSS-112 Pressurized Ion Chamber
RP 92	Operation of Eberline ESP-2 "Smart Meter"
RP 94	Contamination Monitor CM-11
RP 111	Portable Radiation Instrument Source Checks
RP 159	Conduct of Portable/Semi-Portable RP Instrument Program
CL 153	Calibration Check & Efficiency Calibration of Germanium Gamma Detectors
CL 161	LB5100 Planchet Counting System Calibration Procedure
LI 162	LB5100 Planchet Counting System Operation
LI 175	Liquid Scintillation
LI 187	ND-9900 Count Procedure

TABLE 3-2
Surface Contamination Limits ^(a)

NUCLIDE ^(b)	AVERAGE ^(c,d)	MAXIMUM ^(c,e)	REMOVABLE ^(c,f)
U-nat, U-235, U-238 and associated decay products	5,000 dpm α /100 cm ²	15,000 dpm α /100 cm ²	1,000 dpm α /100 cm ²
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm ²	300 dpm/100 cm ²	20 dpm/100 cm ²
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm ²	3,000 dpm/100 cm ²	200 dpm/100 cm ²
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm/100 cm ²	15,000 dpm/100 cm ²	1,000 dpm/100 cm ²

- a. Reproduced from Regulatory Guide 1.86, Table 1, June 1974. Referred to throughout this survey plan as release limits.
- b. Where surface contamination by both alpha and beta-gamma-emitting nuclides exists, the limits established for alpha and beta-gamma emitting nuclides should apply independently.
- c. As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.
- d. Measurements of average contaminant should not be averaged over more than 1 m². For objects with less surface area, the average should be derived for each object.
- e. The maximum contamination level applies to an area of not more than 100 cm².
- f. The amount of removable material per 100 cm² of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects with less surface area is determined, the pertinent levels should be reduced proportionately and the entire surface should be wiped.

TABLE 3-3

Final Survey Instrumentation

Instrument Manufacturer and Model #	Detector Model & Type	Calibration Source	Measurement Type
Eberline Smart Portable, ESP-2	AC-3-8, ZnS(Ag) Scintillator	Pu-239	Fixed-point, total alpha surface activity
Eberline Smart Portable, ESP-2	BP-100, Plastic Scintillator	Tc-99	Fixed-point, total beta surface activity
Eberline Smart Portable, ESP-2	SPA-8, NaI(Tl) Scintillator	Cs-137	Gamma exposure rate and scan survey
Reuter-Stokes RSS-112 PIC	High Pressurized Ion Chamber	Cs-137	Gamma exposure rate
NE Technology Contamination Monitor CM11	Type DP11A Dual Gas Flow 100 cm ² detector	Alpha: Pu-239 Beta: Tc-99	Surface scan survey
Tennelec LB5100 Series 2 Counter	Gas Flow Proportional Counter	Alpha: Am-241 Beta: Cs-137	Removable surface activity
Ortec/Canberra Multi-channel Analyzer	High-Purity Germanium	Mixed Gamma Standard	Radionuclide analysis of soil/gravel samples

TABLE 3-4

Typical Detection Sensitivities

INSTRUMENT	BKG ⁽¹⁾ (CPM)	EFF ⁽²⁾ (CPM/DPM)	COUNT TIME (MIN)	MDA ⁽³⁾ (DPM/100 CM ²)	CRITICAL LEVEL ⁽⁵⁾ (DPM/100 CM ²)
ESP-2 with AC-3-8 (α)	6	0.22 Pu-239	2	75	31
ESP-2 with BP-100 (β)	500	0.49 Tc-99	1	220	106
Tennelec LB5100 (α)	1	0.22 Am-241	10	7.9	3.3
Tennelec LB5100 (β)	2.4	0.33 Cs-137	10	7.7	3.4
CM11 with DP11A (β)	200	0.147 Tc-99	0.022 ⁽⁴⁾	3850 ⁽⁴⁾	N/A
CM11 with DP11A (α)	1	0.04 Pu-239	0.022 ⁽⁴⁾	3860 ⁽⁴⁾	N/A

- (1) BKG = Background count rate.
- (2) EFF = Instrument efficiency. Sources used for efficiencies are traceable to NIST. Calibration radionuclides are listed in this column.
- (3) MDA = Minimum Detectable Activity.
- (4) Scan Survey MDA, assumes detector width of 6.5 cm and scan rate of 5 cm/second, which gives a count time of 0.022 minute.
- (5) NCRP Report 58 defines the *decision limit*, L_c , as the net number of counts (total minus background) for reaching a decision of no detection of signal if the actual net counts are less than L_c , and detection if the actual net counts are larger than L_c . The NCRP 58 decision limit is essentially the same as the *critical level*, L_c , defined below, except that the critical

TABLE 3-4 (continued)

level is calculated as the net activity, in dpm/100 cm², rather than the net number of counts. The equation for critical level determination is:

$$L_c = \frac{1.64 \sqrt{\frac{BR}{T_s} + \frac{BR}{T_b}}}{E * \frac{A}{100}}$$

Where:

- L_c = minimum amount of activity that can be statistically detected above background with a 95% probability (dpm/100cm²),
- BR = background count rate in counts per minute (cpm),
- T_s = sample counting time (minutes),
- T_b = background counting time (minutes),
- E = counting efficiency, (cpm/dpm), and
- A = detector area or the area sampled for smear samples, (cm²).

When $T_s = T_b$:

$$I_c = \frac{2.32 \sqrt{\frac{BR}{T_b}}}{E * \frac{A}{100}}$$

TABLE 3-5

Survey Units Classification

SURVEY UNIT DESCRIPTION	AFFECTED	UNAFFECTED
BES - Exterior surfaces of two buildings within survey area		xxx
NAM - North America Fabrication Shop, interior structural surfaces		xxx
WSH - WSH Warehouse, interior structural surfaces		xxx
RWA - RadWaste building site area, contains open land area only	xxx	
TIA - Open land area within the Trojan Industrial Area, contains ground, concrete surfaces and utility fixtures		xxx

4.0 FINAL SURVEY RESULTS

A summary of the survey results is provided in this section. The tables included in this section summarize the data collected for each survey unit and the background survey. In accordance with NUREG/CR-5849 (Reference 7), actual analysis results (positive or negative) are presented rather than reporting the MDA, unless the MDA is the value reported from sample analysis. The measurement and sample data used to generate the tables are provided in Appendices A through F. The ISFSI Survey Area was divided into five survey units. The background radiation survey was treated as an additional survey unit. The results presented in this section are arranged by survey unit.

4.1 Background Radiation Levels

Background levels were determined for exposure rate, alpha and beta surface activity and soil concentrations, from areas outside the plant industrial area for concrete pavement, concrete floor, sheet metal building wall surfaces, and surface soil. Background measurements were also collected from other types of construction materials that are not present within the defined survey area (e.g., asphalt pavement). The areas and buildings selected for background measurement locations included the Asset Recovery Building and Yard area, the Trojan North Building and parking lot area, the Switch Yard, the Meteorological Tower Yard, and an open land area identified as the South Yard area, comprising the area north of the plant sewer treatment facility, south of the main access road, and east of the Burlington Northern railroad tracks. The arithmetically calculated average (mean) background value is applied to the final survey measurement to obtain the net measurement value.

4.1.1 Exposure Rates

Gamma exposure rates were measured with a Reuter-Stokes RS-112 PIC and/or an Eberline EPS-2 with SPA-8 detector. At several of the measurement locations, multiple individual readings were recorded to evaluate instrument precision. For these locations, the averages of the multiple readings were used to evaluate background. The results of these gamma background evaluations are provided in Table 4-1.

4.1.2 Total Surface Activity

Background values for total surface activity are dependent upon the contribution from naturally occurring radionuclides in construction materials, the local area exposure rate where the survey measurement is collected, and instrument noise. Measurements were made separately for both alpha and beta surface activity. For this survey no corrections were made for the contribution from naturally

occurring radionuclides in construction materials, or the instrument background count rate. At several of the measurement locations, multiple individual readings were recorded to evaluate instrument precision. For these locations, the averages of the multiple readings were used to evaluate background. Background measurements obtained are listed in Table 4-2. Smear samples were also collected following each surface activity measurement. Smears were analyzed for gross alpha and gross beta activity. All removable contamination results were less than 8 dpm/100 cm² for both alpha and beta activity.

4.1.3 Radionuclide Concentrations in Soil

Radionuclide concentrations were measured in 35 soil samples collected from four locations outside the plant industrial area, where the soil consisted of gravel sand fill material similar to the survey area. Each sample was counted for two hours (7200 seconds). For the mean activity determination, each sample result was rounded to the nearest hundredth of a picocurie per gram (E-02 pCi/g). If no activity was detected, the reported MDA value, rounded to the nearest E-02 pCi/g, was used. The only radionuclide identified consistently in soil, other than naturally occurring radionuclides, was Cs-137, with an average value of 0.02 pCi/g. Seven samples reported Mn-54 with activity from 0.005 to 0.008 pCi/g (rounded to 0.01 pCi/g for analysis). The Mn-54 values had large variances of 35% to 67%, indicative of possibly false positive identifications; however, 0.01 pCi/g was estimated for background subtraction purposes. Six samples were split with a contractor laboratory for independent verification analysis. No radionuclides above counting system MDAs (<0.1 pCi/g) were reported by the contractor for these six samples. The results of the background evaluations are provided in Table 4-3. Results of verification analysis are documented in the survey package.

4.2 Survey Unit: BES

Survey Unit BES covers the exterior surfaces of the two buildings in the defined survey area. The buildings are identified from their previous use as the North American Fabrication Shop, and the WSH Warehouse. Only approximately 80 feet of the original WSH Warehouse remains standing in the survey area. Since the total exterior surface area of the two buildings is less than 1500 m², 30 survey locations were randomly selected for exposure rate and surface activity measurements. The measurement locations included 2 for the Fab Shop roof (BES001 & BES002), 13 for the exterior walls of the Fab Shop (BES003 - BES015), and 15 for the exterior walls of WSH (BES016 - BES030). A summary of the survey results is provided in Table 4-4 and discussed below. It is concluded from the survey results, that survey unit BES meets the applicable release limits for unrestricted use.

4.2.1 Surface Scan Survey

The total surface area of the lower walls (ground level up to 6 feet height) of these two buildings is approximately 2185 ft² (203 m²). A total of approximately 400 ft² (37 m²) of exterior surface area was surface scanned with the CM11 gas flow proportional counter. The threshold set for indicating potential elevated radiation levels was 4000 dpm/100cm² for beta radiation and 3000 dpm/100cm² for alpha radiation. The surface scans detected no areas of elevated radiation. The surface scan survey is documented in the survey unit survey package.

4.2.2 Exposure Rates

Gamma exposure rates were measured with an Eberline ESP-2 portable meter with SPA-8 NaI detector one meter from each measurement location. A background value of 4.4 μ R/hr was applied to each survey to obtain the net measurement. No individual exposure rate measurement exceeded the release criterion of 5 μ R/hr. The net average exposure rate for the survey unit was 1.2 μ R/hr, and 1.3 μ R/hr for the 95% upper confidence level.

4.2.3 Surface Activity

Total beta surface activity was measured with an Eberline ESP-2 portable meter with BP-100 plastic detector following each exposure rate measurement. A background value of 527 dpm/100cm² was applied to each reading to obtain the net measurement. No individual measurement exceeded the administrative action level of 3750 dpm/100cm². The net average total surface activity for the survey unit was 188 dpm/100cm², and 249 dpm/100cm² for the 95% upper confidence level, which are below the release criterion of 5000 dpm/100cm².

Smear samples were obtained following total surface activity measurements for each location. The smears were analyzed for gross alpha and gross beta activity. No smear sample exceeded the release criterion of 20 dpm/100cm² for alpha and 1000 dpm/100cm² for beta.

4.3 Survey Unit: NAM

Survey Unit NAM is comprised of the interior structural surfaces of the North American Fabrication Shop. The building's sheet metal walls are covered with plastic faced fiberglass insulation. Since the total surface area of the building interior is less than 1500 m², 30 survey locations were randomly selected for exposure rate and surface activity measurements. The measurement locations included 15 on the concrete slab floor (NAM001 - NAM015), and 15 on the interior walls (NAM016 - NAM030). A

summary of the survey results is provided in Table 4-5 and discussed below. It is concluded from the survey results, that survey unit NAM meets the applicable release limits for unrestricted use.

This building had previously been used by contracted craftsmen to fabricate a variety of materials for plant maintenance and modifications. It was known that one area of the shop had been used to grind thorium-tungsten welding rod tips. Naturally Occurring Radioactive Material (NORM) had been found and removed from this area in the past. At the start of this survey this suspected area was surveyed for NORM contamination in accordance with routine Radiation Protection procedures and practices, and NORM contamination was found in a small area at the base of the west wall and immediately outside this wall location. The area was decontaminated of the NORM by removing the particles of weld rod filings that had accumulated at the junction of the building base plate and concrete floor, removing a small section of the base plate and wall insulation, and removing a small amount of soil material. Routine radiation surveys after this decontamination effort indicated the residual NORM had been removed.

4.3.1 Surface Scan Survey

The total surface area of the floor and lower walls (ground level up to 6 feet height) of this building is approximately 3385 ft² (314 m²). A total of approximately 340 ft² (32 m²) of interior surface area was surface scanned with the CM11 gas flow proportional counter. The threshold set for indicating potential elevated radiation levels was 4000 dpm/100cm² for beta radiation and 3000 dpm/100cm² for alpha radiation. A gamma scan of 100% of the floor area (approximately 2160 ft²) was performed with an ESP-2 with SPA-8 detector, with 3000 cpm set as the level indicating potentially elevated radiation. The surface scans detected no areas of elevated radiation. The surface scan surveys are documented in the survey unit survey package.

4.3.2 Exposure Rates

Gamma exposure rates were measured with an Eberline ESP-2 portable meter with SPA-8 NaI detector one meter from each measurement location. Background values of 4.3 μ R/hr for locations NAM001 - NAM015, and 3.8 μ R/hr for locations NAM016 - NAM030 were applied to each survey to obtain net measurements. No individual exposure rate measurement exceeded the release criterion of 5 μ R/hr. The net average exposure rate for the survey unit was 3.5 μ R/hr, and 3.6 μ R/hr for the 95% upper confidence level.

At the time the exposure rate measurements were collected, the general area radiation background on the north side of the industrial area was elevated by

approximately 1 - 2 μ R/hr due to the presence of reactor coolant piping in shipping containers at various locations within the power block outside of the survey area. Since all of the survey measurements were less than the release criteria, it was decided to not correct for this elevated general area background. A resurvey at the floor measurement locations after the majority of this piping had been shipped off-site showed the average net exposure rate had decreased to approximately 1.0 μ R/hr.

4.3.3 Surface Activity

Total beta surface activity was measured with an Eberline ESP-2 portable meter with BP-100 plastic detector following each exposure rate measurement. Background values of 934 dpm/100cm² for locations NAM001 - NAM015 and 722 dpm/100cm² for locations NAM016 - NAM030 were applied to each reading to obtain net measurements. No individual measurement exceeded the administrative action level of 3750 dpm/100cm². The net average total surface activity for the survey unit was -43 dpm/100cm², and -22 dpm/100cm² for the 95% upper confidence level, which are below the release criterion of 5000 dpm/100cm².

Smear samples were obtained following total surface activity measurements for each location. The smears were analyzed for gross alpha and gross beta activity. No smear sample exceeded the release criteria of 20 dpm/100cm² for alpha and 1000 dpm/100cm² for beta.

4.4 Survey Unit: WSH

Survey Unit WSH is comprised of the interior structural surfaces of the remaining portion of the WSH Warehouse. Since the total surface area of the building interior is less than 1500 m², 30 survey locations were randomly selected for exposure rate and surface activity measurements. The measurement locations included 16 on the concrete slab floor (WSH001 - WSH016), and 14 on the interior walls (WSH017 - WSH030). A summary of the survey results is provided in Table 4-6 and discussed below. It is concluded from the survey results, that survey unit WSH meets the applicable release limits for unrestricted use.

4.4.1 Surface Scan Survey

The total surface area of the floor and lower walls (ground level up to 6 feet height) of this building is approximately 6960 ft² (647 m²). A total of approximately 700 ft² (65 m²) of interior surface area was surface scanned with the CM11 gas flow proportional counter. The threshold set for indicating

potential elevated radiation levels was 4000 dpm/100cm² for beta radiation and 3000 dpm/100cm² for alpha radiation. A gamma scan of 100% of the floor area (approximately 6000 ft²) was performed with an ESP-2 with SPA-8 detector, with 3000 cpm set as the level indicating potentially elevated radiation. The surface scans detected no areas of elevated radiation. The surface scan surveys are documented in the survey unit survey package.

4.4.2 Exposure Rates

Gamma exposure rates were measured with an Eberline ESP-2 portable meter with SPA-8 detector one meter from each measurement location. Background values of 4.3 μ R/hr for locations WSH001- WSH016, and 4.4 μ R/hr for locations WSH017- WSH030 were applied to each survey to obtain net measurements. No individual exposure rate measurement exceeded the release criterion of 5 μ R/hr. The net average exposure rate for the survey unit was 2.6 μ R/hr, and 2.7 μ R/hr for the 95% upper confidence level.

At the time the exposure rate measurements were collected the general area radiation background was elevated by approximately 1 - 2 μ R/hr, as already discussed in Section 4.3.2. A resurvey at the floor measurement locations after the majority of this piping had been shipped off-site showed the average net exposure rate had decreased to 1.3 μ R/hr.

4.4.3 Surface Activity

Total beta surface activity was measured with an Eberline ESP2 portable meter with BP-100 plastic detector following each exposure rate measurement. Background values of 934 dpm/100cm² for locations WSH001 - WSH016 and 527 dpm/100cm² for locations WSH017 - WSH030 were applied to each reading to obtain net measurements. No individual measurement exceeded the administrative action level of 3750 dpm/100cm². The net average total surface activity for the survey unit was 79 dpm/100cm², and 125 dpm/100cm² for the 95% upper confidence level, which are below the release criterion of 5000 dpm/100cm².

Smear samples were obtained following total surface activity measurements for each location. The smears were analyzed for gross alpha and gross beta activity. No smear sample exceeded the release criteria of 20 dpm/100cm² for alpha and 1000 dpm/100cm² for beta.

4.5 Survey Unit: TIA

Survey Unit TIA is comprised of open land area, concrete pavement and utility structures within the defined survey area. Since the survey unit contains both open land and structural surfaces, 30 survey locations were randomly selected for soil sampling (TIA037 - TIA066), and 30 locations for surface activity measurements (TIA067 - TIA096). Gamma exposure rates were also measured at each of the 60 locations. The area was not physically gridded. A summary of the survey results is provided in Table 4-7 and discussed below. It is concluded from the survey results, that survey unit TIA meets the applicable release limits for unrestricted use.

4.5.1 Surface Scan Survey

More than 25% of the open land area, and 100% of the concrete paved surfaces in the survey unit received a gamma scan survey, performed with an ESP-2 with SPA-8 detector, with 3000 cpm set as the level indicating potentially elevated radiation. The surface scans detected no areas of elevated radiation. The surface scan surveys are documented in the survey unit survey package.

4.5.2 Exposure Rates

Gamma exposure rates were measured with a Reuter-Stokes RS-112 PIC and an Eberline ESP-2 portable meter with SPA-8 detector one meter from each measurement location. Only the PIC measurements are reported in the summary table and discussed here. Background values of $6.9 \mu\text{R/hr}$ for locations TIA037- TIA066, and $7.3 \mu\text{R/hr}$ for locations TIA067- TIA096 were applied to each survey to obtain net measurements. No individual exposure rate measurement exceeded the release criterion of $5 \mu\text{R/hr}$. The net average exposure rate for the survey unit was $0.6 \mu\text{R/hr}$, and $0.7 \mu\text{R/hr}$ for the 95% upper confidence level.

4.5.3 Surface Activity

Total beta surface activity was measured with an Eberline ESP-2 portable meter with BP-100 plastic detector following each exposure rate measurement. A background value of $1057 \text{ dpm}/100\text{cm}^2$ was applied to each reading to obtain net measurements. No individual measurement exceeded the administrative action level of $3750 \text{ dpm}/100\text{cm}^2$. The net average total surface activity for the survey unit was $-85 \text{ dpm}/100\text{cm}^2$, and $-36 \text{ dpm}/100\text{cm}^2$ for the 95% upper confidence level, which are below the release criterion of $5000 \text{ dpm}/100\text{cm}^2$.

Smear samples were obtained following total surface activity measurements for each location. The smears were analyzed for gross alpha and gross beta activity. No smear sample exceeded the release criteria of 20 dpm/100cm² for alpha and 1000 dpm/100cm² for beta.

4.5.4 Radionuclide Concentrations in Soil

Cesium 137 was identified in the majority of the soil samples with gross activity ranging from MDA to 0.21 pCi/g. The net average Cs-137 concentration was 0.01 pCi/g, and 0.02 pCi/g for the 95% upper confidence level. No sample exceeded the action level for Cs-137 of 2.7 pCi/g or the release criterion of 10.7 pCi/g. Two samples initially reported Co-60 at greater than MDA (0.02 and 0.01 pCi/g), but were not confirmed on recounts. The average MDA for Co-60 for all the samples was 0.01 pCi/g, which is much less than the action level of 0.75 pCi/g.

Seven samples reported gross activity of Mn-54 above MDA, but within the same range of activity as background samples. The net activity for Mn-54 was zero for each of the seven samples. Two samples reported Nb-95 activity above MDA (0.02 and 0.01 pCi/g), which were orders of magnitude less than the action level of 15.6 pCi/g and the release limit of 62.3 pCi/g. Only Cs-137 is reported, since the unity value for Cs-137/Nb-95 is miniscule (less than 0.0001).

Three samples were split with a contractor laboratory, and the split sample analysis results reported no radionuclides above the counting system MDAs. Contractor verification analysis results are documented in the survey unit survey package.

4.6 Survey Unit: RWA

Survey Unit RWA is comprised of the open land area, measuring 30 meters by 30 meters, upon which the Low Level Radioactive Waste Storage Building had previously sat. This is the only affected area survey unit. The area was physically gridded into 10 meter by 10 meter sections. Four measurement locations were systematically selected within each of the 9 sections. A summary of the survey results is provided in Table 4-8 and discussed below. It is concluded from the survey results, that survey unit RWA meets the applicable release limits for unrestricted use.

4.6.1 Surface Scan Survey

One hundred percent of the survey unit area received a gamma scan survey, performed with an ESP-2 with SPA-8 detector, with 3000 cpm set as the level

indicating potentially elevated radiation. The exposure rate scan survey detected no areas of elevated radiation. The area was also 100% surface scan surveyed with the CM11 gas flow contamination counter, with no elevated radiation detected. The scan surveys is documented in the survey unit survey package.

4.6.2 Exposure Rates

Gamma exposure rates were measured with a Reuter-Stokes RS-112 PIC and an Eberline ESP-2 portable meter with SPA-8 detector one meter from each measurement location. Only the PIC measurements are reported in the summary table and discussed here. A background value of $6.9 \mu\text{R/hr}$ was applied to each survey to obtain net measurements. No individual exposure rate measurement exceeded the release criterion of $5 \mu\text{R/hr}$. The net average exposure rate for the survey unit was $0.2 \mu\text{R/hr}$, and $0.3 \mu\text{R/hr}$ for the 95% upper confidence level.

4.6.3 Radionuclide Concentrations in Soil

Cesium 137 was identified in the majority of the soil samples with gross activity ranging from MDA to 0.06 pCi/g . The net average Cs-137 concentration was -0.01 pCi/g , and -0.01 pCi/g for the 95% upper confidence level. No sample exceeded the action level for Cs-137 of 8.0 pCi/g or the release criteria of 10.7 pCi/g . The average MDA for Co-60 for all the samples was 0.01 pCi/g , which is much less than the action level of 2.3 pCi/g .

Three samples reported gross activity of Mn-54 above MDA, but within the same range of activity as background samples. The net activity for Mn-54 was zero for each of the three samples. Four samples reported Nb-95 activity above MDA (0.01 pCi/g each), and one sample reported Ru-103 activity above MDA (0.006 pCi/g), which were orders of magnitude less than the action level for Nb-95 of 46.7 pCi/g and for Ru-103 of 69.5 pCi/g , and the release limits of 62.3 and 93.0 pCi/g respectively. Only Cs-137 is reported, since the unity values for Cs-137/Nb-95 and Cs-137/Ru-103 are miniscule (less than 0.0001).

Six samples were split with a contractor laboratory, and the split sample analysis results reported no radionuclides above the counting system MDAs. Contractor verification analysis results are documented in the survey unit survey package.

TABLE 4-1

Background Values for Gamma Exposure Rates ($\mu\text{R/hr}$)

Material / Instrument	Number of Locations	Mean Result	Standard Deviation	Maximum Result	Minimum Result
Concrete Pavement with PIC	30	7.3	0.4	7.9	6.4
Concrete Pavement with ESP2	30	5.0	0.4	6.12	3.9
Concrete Floor with PIC	12	7.0	0.3	7.5	6.5
Concrete Floor with ESP2	12	4.3	0.3	4.8	3.8
Gravel Soil With PIC	35	6.9	0.3	7.5	6.3
Gravel Soil With ESP2	35	5.0	0.6	7.1	4.2
Sheet Metal Walls with ESP2	28	4.4	0.3	5.0	3.5
Sheet Metal Walls ⁽¹⁾ with EPS2	7	3.8	0.6	4.6	2.9

(1) Interior sheet metal walls covered with plastic surfaced fiber glass insulation.

TABLE 4-2

Background Total Surface Activity (dpm/100cm²)

Material Type	N	Mean Result	Standard Deviation	Maximum Result	Minimum Result
Concrete Pavement	30	Beta: 1057 Alpha: 39	247 10	1444 64	574 21
Concrete Floor	12	Beta: 934 Alpha: 38	292 26	1664 113	455 21
Sheet Metal Walls	28	Beta: 527 Alpha: 112	92 38	740 174	399 33
Sheet Metal Walls ⁽¹⁾	7	Beta: 722 Alpha: 74	471 25	1736 119	264 54

(1) Interior sheet metal walls covered with plastic surfaced fiber glass insulation.

TABLE 4-3

Background Radionuclide Concentrations in Soil (pCi/gram)

Radionuclide	Number of Locations	Mean Result	Standard Deviation	Maximum Result	Minimum Result
Cs-137	35	0.02	0.01	0.05	0.01
Mn-54	35	<0.01	0.001	0.01	MDA
Co-60	35	<0.01	0.001	MDA	MDA
Ce-144	35	<0.07	0.01	MDA	MDA

TABLE 4-4

Summary Results for Survey Unit BES

Radiological Parameter	Units	N	MDA	Critical Level	Mean	Std Dev	Max	UCL (95%)
Gamma Exposure Rate	$\mu\text{R/hr}$	30	N/A	N/A	1.2	0.3	1.8	1.3
Total Beta Surface Activity	dpm/100cm ²	30	226	110	188	197	673	249
Removable Beta Surface Activity	dpm/100cm ²	30	6.8	3.4	7.2	1.5	13.3	7.7
Removable Alpha Surface Activity	dpm/100cm ²	30	6.2	5.5	6.2	0.0	6.2	N/A

TABLE 4-5

Summary Results for Survey Unit NAM

Radiological Parameter	Units	N	MDA	Critical Level	Mean	Std Dev	Max	UCL (95%)
Gamma Exposure Rate	$\mu\text{R/hr}$	30	N/A	N/A	3.5	0.4	4.3	3.6
Total Beta Surface Activity	dpm/100cm ²	30	226	110	-43	68	95	-22
Removable Beta Surface Activity	dpm/100cm ²	30	8.3	4.2	8.3	0.0	8.3	N/A
Removable Alpha Surface Activity	dpm/100cm ²	30	4.1	3.4	4.1	0.0	4.1	N/A

TABLE 4-6

Summary Results for Survey Unit WSH

Radiological Parameter	Units	N	MDA	Critical Level	Mean	Std Dev	Max	UCL (95%)
Gamma Exposure Rate	$\mu\text{R/hr}$	30	N/A	N/A	2.6	0.4	3.4	2.7
Total Beta Surface Activity	dpm/100cm ²	30	226	110	79	149	543	125
Removable Beta Surface Activity	dpm/100cm ²	30	5.6	2.8	7.0	3.3	23.7	8.0
Removable Alpha Surface Activity	dpm/100cm ²	30	6.5	5.5	6.5	0.0	6.5	N/A

TABLE 4-7
Summary Results for Survey Unit TIA

Radiological Parameter	Units	N	MDA	Critical Level	Mean	Std Dev	Max	UCL (95%)
Gamma Exposure Rate	$\mu\text{R/hr}$	60	N/A	N/A	0.6	.05	1.8	0.7
Total Beta Surface Activity	dpm/100cm ²	30	226	110	-85	156	79	-36
Removable Beta Surface Activity	dpm/100cm ²	30	8.0	4.0	8.0	0.0	8.0	N/A
Removable Alpha Surface Activity	dpm/100cm ²	30	5.4	4.6	5.4	0.0	5.4	N/A
Cs-137 Soil Activity	pCi/g	30	N/A	N/A	0.01	0.04	0.19	0.02

TABLE 4-8

Summary Results for Survey Unit RWA

Radiological Parameter	Units	N	Mean	Std Dev	Max	UCL (95%)
Gamma Exposure Rate	μ R/hr	36	0.2	0.5	1.2	0.3
Cs-137 Soil Activity	pCi/g	36	-0.01	0.01	0.04	-0.01

5.0 SUMMARY

This report documents the final survey results of a small area of the Trojan site that is proposed for use as an ISFSI. It also documents the background characterization surveys performed to derive radiation background subtraction values. The survey area was divided into five survey units, and the collected survey data was analyzed, summarized and reported for each survey unit separately. The data presented in this report supports the conclusion that the survey area meets the criteria for release of the area from the requirements of 10 CFR 50 and for unrestricted use. It is noted, however, that about one third of the surveyed area will be dedicated to a future ISFSI under 10 CFR 72. The remainder of the surveyed area will have elevated background radiation levels due to fuel storage on the future ISFSI that will make a future final site release survey pursuant to 10 CFR 50 difficult.

The final survey of open land areas included the collection of 66 exposure rate measurements and 66 surface soils samples. All exposure rate measurements were less than 5 μ R/hr above background. Analysis of the soil samples for the principal gamma emitters indicated that, after correction for environmental concentrations, no activity from licensed radionuclides exceeded any action level or release limit.

The final survey of surfaces and structures included 120 direct measurements for total surface activity, 120 measurements for removable alpha and beta activity, and 120 measurements for exposure rates. All exposure rate measurements were less than 5 μ R/hr above background. All surface contamination measurements indicated no action levels or release limits were exceeded.

The final survey for the ISFSI site area was performed in accordance with the TNP Final Survey Plan For The ISFSI Site (Reference 1), and approved plant procedures. The implementation of the final survey plan and the results of the data acquired, analyzed and presented in this report demonstrate, with a high degree of confidence, that the criteria established for release of the defined area for unrestricted use have been satisfied.

6.0 REFERENCES

1. Trojan Nuclear Plant Final Survey for the ISFSI Site, PGE-1074, August 13, 1996.
2. Trojan Nuclear Plant Radiological Site Characterization Report, Revision 0.1, 2/8/95.
3. Trojan Nuclear Plant Decommissioning Plan, PGE-1061.
4. Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, June 1974.
5. NUREG-1500, Working Draft Regulatory Guide on Release Criteria for Decommissioning: NRC Staff's Draft for Comment, August 1994.
6. NCRP Report No. 58, A Handbook of Radioactivity Measurements Procedures, Second Edition, 1985.
7. NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination, June 1992 draft.
8. Trojan Nuclear Quality Assurance Program, PGE-8010.
9. TPP 20-2, Radiation Protection Program.
10. TPP 18-4, Nuclear Division Quality Assurance Records Management Program.

APPENDIX A

SURVEY UNIT BES SURVEY DATA

The following tables present data for each measurement and sample performed in the survey unit BES. The data were manually entered into a computer spreadsheet database from survey data collection sheets and sample analysis reports for statistical evaluation and report preparation.

Table A-1
Survey Unit BES
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Location	Net	Location	Net
BES001	0.7	BES016	1.7
BES002	1.3	BES017	1.4
BES003	1.3	BES018	1.6
BES004	1.1	BES019	1.0
BES005	1.4	BES020	1.8
BES006	0.9	BES021	1.3
BES007	1.4	BES022	1.1
BES008	0.12	BES023	1.8
BES009	1.4	BES024	0.8
BES010	1.4	BES025	0.8
BES011	1.3	BES026	1.1
BES012	1.1	BES027	1.1
BES013	1.3	BES028	0.6
BES014	1.6	BES029	0.6
BES015	1.6	BES030	0.9
		Total Points	30
		Mean	1.2
		Std Deviation	0.3
		Min Value	0.6
		Max Value	1.8
		95% UCL	1.3

Table A-2
Survey Unit BES
Surface Contamination Data
(Units: dpm/100 cm²)

Location	Direct	Removable		Location	Direct	Removable	
	Beta	Alpha	Beta		Beta	Alpha	Beta
BES001	20	<6.2	<6.8	BES016	375	<6.2	<6.8
BES002	-39	<6.2	<6.8	BES017	313	<6.2	<6.8
BES003	-33	<6.2	<6.8	BES018	439	<6.2	<6.8
BES004	70	<6.2	<6.8	BES019	563	<6.2	<6.8
BES005	55	<6.2	<6.8	BES020	219	<6.2	<6.8
BES006	-54	<6.2	<6.8	BES021	73	<6.2	<6.8
BES007	31	<6.2	<6.8	BES022	663	<6.2	<6.8
BES008	21	<6.2	<6.8	BES023	673	<6.2	<6.8
BES009	40	<6.2	<6.8	BES024	298	<6.2	10.3
BES010	84	<6.2	<6.8	BES025	277	<6.2	10.3
BES011	111	<6.2	7.3	BES026	84	<6.2	<6.8
BES012	111	<6.2	<6.8	BES027	158	<6.2	<6.8
BES013	156	<6.2	<6.8	BES028	246	<6.2	13.3
BES014	105	<6.2	<6.8	BES029	260	<6.2	<6.8
BES015	25	<6.2	<6.8	BES030	294	<6.2	<6.8
				Total Pts	30	30	30
				Mean	188	<6.2	7.2
				Std Dev	197	0.0	1.5
				Min Value	-54	<6.2	<6.8
				Max Value	673	<6.2	13.3
				95% UCL	249	N/A	7.7

APPENDIX B

SURVEY UNIT NAM SURVEY DATA

The following tables present data for each measurement and sample performed in the survey unit NAM. The data were manually entered into a computer spreadsheet database from survey data collection sheets and sample analysis reports for statistical evaluation and report preparation.

Table B-1
Survey Unit NAM
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Location	Net	Location	Net
NAM001	3.1	NAM016	2.9
NAM002	3.1	NAM017	3.1
NAM003	3.2	NAM018	3.2
NAM004	3.6	NAM019	3.0
NAM005	3.4	NAM020	2.8
NAM006	3.6	NAM021	3.8
NAM007	4.0	NAM022	3.4
NAM008	3.9	NAM023	4.3
NAM009	3.0	NAM024	3.8
NAM010	3.7	NAM025	3.7
NAM011	3.3	NAM026	3.7
NAM012	4.0	NAM027	3.9
NAM013	3.2	NAM028	3.6
NAM014	4.1	NAM029	3.3
NAM015	2.4	NAM030	3.6
		Total Points	30
		Mean	3.5
		Std Deviation	0.4
		Low Value	2.4
		High Value	4.3
		95% UCL	3.6

Table B-2
Survey Unit NAM
Surface Contamination Data
(Units: dpm/100 cm²)

Location	Direct	Removable		Location	Direct	Removable	
	Beta	Alpha	Beta		Beta	Alpha	Beta
NAM001	-43	<4.1	<8.3	NAM016	-49	<4.1	<8.3
NAM002	-90	<4.1	<8.3	NAM017	62	<4.1	<8.3
NAM003	-45	<4.1	<8.3	NAM018	-152	<4.1	<8.3
NAM004	-71	<4.1	<8.3	NAM019	95	<4.1	<8.3
NAM005	-83	<4.1	<8.3	NAM020	79	<4.1	<8.3
NAM006	-56	<4.1	<8.3	NAM021	19	<4.1	<8.3
NAM007	-135	<4.1	<8.3	NAM022	-145	<4.1	<8.3
NAM008	-131	<4.1	<8.3	NAM023	-61	<4.1	<8.3
NAM009	-88	<4.1	<8.3	NAM024	46	<4.1	<8.3
NAM010	-88	<4.1	<8.3	NAM025	11	<4.1	<8.3
NAM011	-91	<4.1	<8.3	NAM026	-16	<4.1	<8.3
NAM012	-63	<4.1	<8.3	NAM027	59	<4.1	<8.3
NAM013	-91	<4.1	<8.3	NAM028	-24	<4.1	<8.3
NAM014	-80	<4.1	<8.3	NAM029	12	<4.1	<8.3
NAM015	-76	<4.1	<8.3	NAM030	15	<4.1	<8.3
				Total Pts	30	30	30
				Mean	-43	4.1	8.3
				Std Dev	68	0.0	0.0
				Min Value	-152	<4.1	<8.3
				Max Value	95	<4.1	<8.3
				95% UCL	-22	N/A	N/A

APPENDIX C

SURVEY UNIT WSH SURVEY DATA

The following tables present data for each measurement and sample performed in the survey unit WSH. The data were manually entered into a computer spreadsheet database from survey data collection sheets and sample analysis reports for statistical evaluation and report preparation.

Table C-1
Survey Unit WSH
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Location	Net	Location	Net
WSH001	2.6	WSH016	3.0
WSH002	2.6	WSH017	2.1
WSH003	2.4	WSH018	1.9
WSH004	2.9	WSH019	2.8
WSH005	3.4	WSH020	1.8
WSH006	3.2	WSH021	1.7
WSH007	2.6	WSH022	2.0
WSH008	2.6	WSH023	1.9
WSH009	2.7	WSH024	2.5
WSH010	2.8	WSH025	2.7
WSH011	2.9	WSH026	2.7
WSH012	2.9	WSH027	2.8
WSH013	2.7	WSH028	2.7
WSH014	3.1	WSH029	2.5
WSH015	3.1	WSH030	2.8
		Total Points	30
		Mean	2.6
		Std Deviation	0.4
		Low Value	1.7
		High Value	3.4
		95% UCL	2.7

Table C-2
Survey Unit WSH
Surface Contamination Data
(Units: dpm/100 cm²)

Location	Direct	Removable		Location	Direct	Removable	
	Beta	Alpha	Beta		Beta	Alpha	Beta
WSH001	116	<6.5	<5.6	WSH016	-107	<6.5	7.3
WSH002	-178	<6.5	6.7	WSH017	226	<6.5	6.1
WSH003	176	<6.5	<5.6	WSH018	543	<6.5	7.0
WSH004	-47	<6.5	<5.6	WSH019	232	<6.5	<5.6
WSH005	-62	<6.5	<5.6	WSH020	206	<6.5	<5.6
WSH006	-36	<6.5	6.4	WSH021	40	<6.5	<5.6
WSH007	-39	<6.5	6.7	WSH022	-51	<6.5	6.7
WSH008	76	<6.5	8.2	WSH023	-14	<6.5	<5.6
WSH009	86	<6.5	<5.6	WSH024	167	<6.5	6.7
WSH010	55	<6.5	<5.6	WSH025	37	<6.5	<5.6
WSH011	-35	<6.5	<5.6	WSH026	142	<6.5	7.9
WSH012	6	<6.5	9.4	WSH027	206	<6.5	<5.6
WSH013	-2	<6.5	6.1	WSH028	104	<6.5	6.7
WSH014	-43	<6.5	<5.6	WSH029	329	<6.5	23.7
WSH015	-16	<6.5	8.8	WSH030	239	<6.5	<5.6
				Total Pts	30	30	30
				Mean	79	6.5	7.0
				Std Dev	149	0.0	3.3
				Min Value	-178	<6.5	<5.6
				Max Value	543	<6.5	23.7
				95% UCL	125	N/A	8.0

APPENDIX D

SURVEY UNIT TIA SURVEY DATA

The following tables present data for each measurement and sample performed in the survey unit TIA. The data were manually entered into a computer spreadsheet database from survey data collection sheets and sample analysis reports for statistical evaluation and report preparation.

Table D-1
Survey Unit TIA
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Location	Net	Location	Net	Location	Net
TIA037	0.8	TIA057	1.2	TIA077	0.0
TIA038	0.9	TIA058	-0.2	TIA078	0.8
TIA039	0.9	TIA059	-0.3	TIA079	0.4
TIA040	0.9	TIA060	0.7	TIA080	0.2
TIA041	1.1	TIA061	0.0	TIA081	0.4
TIA042	1.2	TIA062	0.8	TIA082	0.3
TIA043	1.8	TIA063	0.7	TIA083	0.3
TIA044	0.3	TIA064	0.5	TIA084	-0.3
TIA045	0.7	TIA065	0.3	TIA085	0.3
TIA046	0.9	TIA066	1.1	TIA086	0.4
TIA047	1.6	TIA067	1.0	TIA087	0.6
TIA048	1.0	TIA068	0.9	TIA088	-0.3
TIA049	0.5	TIA069	0.7	TIA089	0.0
TIA050	1.4	TIA070	0.7	TIA090	0.5
TIA051	1.0	TIA071	0.7	TIA091	0.4
TIA052	1.1	TIA072	0.8	TIA092	0.5
TIA053	-0.1	TIA073	0.8	TIA093	0.7
TIA054	0.2	TIA074	0.3	TIA094	1.0
TIA055	0.5	TIA075	0.1	TIA095	1.1
TIA056	0.7	TIA076	0.6	TIA096	0.9
				Total Points	60
				Mean	0.6
				Std Deviation	0.5
				Low Value	-0.3
				High Value	1.8
				95% UCL	0.7

Table D-2
Survey Unit TIA
Soil Activity Concentration Data
(Units: pCi/g)

Location	Cs-137 Net	Reference MDAs		Location	Cs-137 Net	Reference MDAs	
		Co-60	Ce-144			Co-60	Ce-144
TIA037	0.01	0.01	0.08	TIA052	-0.01	0.01	0.07
TIA038	-0.01	0.01	0.07	TIA053	0.01	0.01	0.09
TIA039	0.02	0.01	0.08	TIA054	0.01	0.01	0.09
TIA040	0.03	0.01	0.09	TIA055	-0.01	0.01	0.08
TIA041	0.02	0.01	0.09	TIA056	-0.01	0.01	0.07
TIA042	-0.01	0.01	0.08	TIA057	0.12	0.01	0.08
TIA043	-0.01	0.01	0.09	TIA058	-0.01	0.01	0.07
TIA044	0.00	0.01	0.08	TIA059	-0.01	0.01	0.08
TIA045	-0.01	0.01	0.08	TIA060	0.01	0.01	0.08
TIA046	0.04	0.01	0.09	TIA061	0.04	0.01	0.09
TIA047	-0.01	0.01	0.08	TIA062	-0.01	0.01	0.08
TIA048	-0.01	0.01	0.10	TIA063	-0.01	0.01	0.08
TIA049	0.00	0.01	0.08	TIA064	0.19	0.01	0.10
TIA050	-0.01	0.01	0.09	TIA065	0.01	0.01	0.07
TIA051	0.02	0.01	0.08	TIA066	0.00	0.01	0.09
				Total Pts	30		
				Mean	0.01		
				Std Dev	0.04		
				Low Value	-0.01		
				High Value	0.19		
				95% UCL	0.02		

Table D-3
Survey Unit TIA
Surface Contamination Data
(Units: dpm/100 cm²)

Location	Direct	Removable		Location	Direct	Removable	
	Beta	Alpha	Beta		Beta	Alpha	Beta
TIA067	75	<5.4	<8.0	TIA082	-175	<5.4	<8.0
TIA068	43	<5.4	<8.0	TIA083	1	<5.4	<8.0
TIA069	7	<5.4	<8.0	TIA084	-80	<5.4	<8.0
TIA070	79	<5.4	<8.0	TIA085	-143	<5.4	<8.0
TIA071	-29	<5.4	<8.0	TIA086	-143	<5.4	<8.0
TIA072	51	<5.4	<8.0	TIA087	-233	<5.4	<8.0
TIA073	-76	<5.4	<8.0	TIA088	-586	<5.4	<8.0
TIA074	-102	<5.4	<8.0	TIA089	-534	<5.4	<8.0
TIA075	41	<5.4	<8.0	TIA090	-46	<5.4	<8.0
TIA076	-9	<5.4	<8.0	TIA091	-26	<5.4	<8.0
TIA077	-200	<5.4	<8.0	TIA092	-88	<5.4	<8.0
TIA078	7	<5.4	<8.0	TIA093	-131	<5.4	<8.0
TIA079	-54	<5.4	<8.0	TIA094	-58	<5.4	<8.0
TIA080	-9	<5.4	<8.0	TIA095	-216	<5.4	<8.0
TIA081	47	<5.4	<8.0	TIA096	51	<5.4	<8.0
				Total Pts	30	30	30
				Mean	-85	<5.4	<8.0
				Std Dev	156	0.0	0.0
				Min Value	-586	<5.4	<8.0
				Max Value	79	<5.4	<8.0
				95% UCL	-36	N/A	N/A

APPENDIX E

SURVEY UNIT RWA SURVEY DATA

The following tables present data for each measurement and sample performed in the survey unit RWA. The data were manually entered into a computer spreadsheet database from survey data collection sheets and sample analysis reports for statistical evaluation and report preparation.

Table E-1
Survey Unit RWA
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Location	Net	Location	Net
RWA001	0.0	RWA019	0.1
RWA002	-0.4	RWA020	-0.4
RWA003	-0.6	RWA021	0.0
RWA004	-0.5	RWA022	0.8
RWA005	-0.5	RWA023	0.6
RWA006	0.0	RWA024	0.3
RWA007	-0.6	RWA025	0.5
RWA008	-0.3	RWA026	0.4
RWA009	-0.2	RWA027	0.8
RWA010	0.5	RWA028	1.2
RWA011	0.2	RWA029	0.5
RWA012	0.1	RWA030	0.6
RWA013	0.0	RWA031	0.3
RWA014	-0.5	RWA032	0.3
RWA015	-0.1	RWA033	0.5
RWA016	0.7	RWA034	0.8
RWA017	-0.3	RWA035	0.8
RWA018	-0.4	RWA036	0.3
		Total Points	36
		Mean	0.2
		Std Deviation	0.5
		Low Value	-0.6
		High Value	1.2
		95% UCL	0.3

Table E-2
Survey Unit RWA
Soil Activity Concentration Data
(Units: pCi/g)

Location	Cs-137 Net	Reference MDAs		Location	Cs-137 Net	Reference MDAs	
		Co-60	Ce-144			Co-60	Ce-144
RWA001	0.03	0.01	0.07	RWA019	0.00	0.01	0.07
RWA002	-0.01	0.01	0.08	RWA020	-0.01	0.01	0.07
RWA003	-0.01	0.01	0.07	RWA021	-0.01	0.01	0.06
RWA004	-0.01	0.01	0.08	RWA022	-0.01	0.01	0.07
RWA005	-0.01	0.01	0.07	RWA023	0.02	0.01	0.07
RWA006	-0.01	0.01	0.07	RWA024	-0.01	0.01	0.08
RWA007	-0.01	0.01	0.06	RWA025	0.00	0.01	0.07
RWA008	-0.01	0.01	0.07	RWA026	-0.01	0.01	0.07
RWA009	-0.01	0.01	0.06	RWA027	-0.01	0.01	0.08
RWA010	0.04	0.01	0.08	RWA028	-0.01	0.01	0.08
RWA011	0.00	0.01	0.07	RWA029	-0.01	0.01	0.06
RWA012	-0.01	0.01	0.07	RWA030	-0.01	0.01	0.07
RWA013	-0.01	0.01	0.07	RWA031	-0.01	0.01	0.07
RWA014	-0.01	0.01	0.06	RWA032	-0.01	0.01	0.07
RWA015	-0.01	0.01	0.07	RWA033	-0.01	0.01	0.07
RWA016	-0.01	0.01	0.06	RWA034	-0.01	0.01	0.08
RWA017	0.01	0.01	0.07	RWA035	-0.01	0.01	0.07
RWA018	0.00	0.01	0.07	RWA036	-0.01	0.01	0.07
				Total Pts	36		
				Mean	-0.01		
				Std Dev	0.01		
				Low Value	-0.01		
				High Value	0.04		
				95% UCL	-0.01		

APPENDIX F

BACKGROUND RADIATION SURVEY DATA

The following tables present data for each background measurement and sample performed. The data were manually entered into a computer spreadsheet database from survey data collection sheets and sample analysis reports for statistical evaluation and report preparation.

Table F-1
Background Radiation Survey
Open Land Areas - Soil/Gravel Fill
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Location	PIC	ESP2	Location	PIC	ESP2
AY001	6.9	4.6	YY018	7.3	5.6
AY002	6.4	4.7	YY019	7.2	5.4
AY003	6.3	5.1	YY020	6.9	5.0
AY004	6.7	4.8	YY021	6.8	4.7
AY005	6.8	4.5	YY022	7.2	5.3
AY006	6.5	4.2	YY023	7.2	5.2
AY007	6.5	4.3	YY024	7.0	4.9
AY008	6.8	5.0	YY025	6.7	4.6
AY009	6.9	4.8	YY026	7.2	5.4
AY010	7.0	4.7	YY027	6.8	4.5
SY011	7.2	6.8	YY028	7.0	4.7
SY012	6.8	5.1	YY029	6.9	4.9
SY013	6.6	4.6	YY030	7.2	4.9
SY014	6.9	5.2	MM031	7.2	5.1
SY015	7.5	7.1	MM032	6.7	4.8
YY016	6.8	4.8	MM033	6.8	4.9
YY017	7.1	5.5	MM034	7.2	5.8
			MM035	6.6	5.0
			Total Points	35	35
			Mean	6.9	5.0
			Std Deviation	0.3	0.6
			Low Value	6.3	4.2
			High Value	7.5	7.1

Table F-2
Background Radiation Survey
Open Land Areas - Soil/Gravel Fill
Soil Activity Concentration Data
(Units: pCi/g)

Location	Cs-137	Mn-54	Co-60	Ce-144	Location	Cs-137	Mn-54	Co-60	Ce-144
AY001	0.01	<0.01	<0.01	<0.07	YY018	0.04	<0.01	<0.01	<0.07
AY002	0.01	<0.01	<0.01	<0.07	YY019	0.01	<0.01	<0.01	<0.07
AY003	0.01	0.01	<0.01	<0.07	YY020	0.02	<0.01	<0.01	<0.07
AY004	0.01	<0.01	<0.01	<0.07	YY021	0.01	<0.01	<0.01	<0.07
AY005	0.01	<0.01	<0.01	<0.07	YY022	0.03	<0.01	<0.01	<0.07
AY006	0.01	<0.01	<0.01	<0.07	YY023	0.03	<0.01	<0.01	<0.07
AY007	0.01	<0.01	<0.01	<0.07	YY024	0.01	<0.01	<0.01	<0.07
AY008	0.01	0.01	<0.01	<0.07	YY025	0.05	<0.01	<0.01	<0.07
AY009	0.01	<0.01	<0.01	<0.07	YY026	0.01	0.01	<0.01	<0.07
AY010	0.01	0.01	<0.01	<0.07	YY027	0.03	<0.01	<0.01	<0.07
SY011	0.02	<0.01	<0.01	<0.07	YY028	0.03	<0.01	<0.01	<0.07
SY012	0.02	<0.01	<0.01	<0.07	YY029	0.02	<0.01	<0.01	<0.07
SY013	0.02	<0.01	<0.01	<0.07	YY030	0.02	<0.01	<0.01	<0.07
SY014	0.05	<0.01	<0.01	<0.07	MM031	0.04	0.01	<0.01	<0.07
SY015	0.02	0.01	<0.01	<0.07	MM032	0.02	<0.01	<0.01	<0.07
YY016	0.01	<0.01	<0.01	<0.07	MM033	0.03	<0.01	<0.01	<0.07
YY017	0.02	<0.01	<0.01	<0.07	MM034	0.03	0.01	<0.01	<0.07
					MM035	0.05	<0.01	<0.01	<0.07
					Tot Pts	35	35	35	35
					Mean	0.02	<0.01	<0.01	<0.07
					Std Dev	0.01	0.001	0.001	0.01
					Low	0.01	<0.01	<0.01	<0.01
					High	0.05	0.01	<0.01	<0.01

Table F-3
Background Radiation Survey
Asset Recovery Building Interior Surfaces
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Concrete Floors			Insulated Sheet Metal Walls		
Location	PIC	ESP2	Location	PIC	ESP2
IN036	7.0	4.4	IN039	5.9	3.2
IN038	6.8	4.2	IN041	6.9	4.1
IN040	6.8	4.3	IN042	6.4	3.6
IN043	6.7	4.0	IN046	6.1	2.9
IN044	7.1	4.3	IN049	6.7	3.8
IN045	6.5	3.8	IN053	7.1	4.3
IN048	7.0	4.5	IN055	6.9	4.6
IN050	7.3	4.8	Total Points	7	7
IN052	7.5	4.6	Mean	6.6	3.8
IN054	7.0	4.3	Std Deviation	0.4	0.6
IN061	6.8	4.2	Low Value	5.9	2.9
IN064	6.9	4.4	High Value	7.1	4.6
Total Points	12	12			
Mean	7.0	4.3			
Std Deviation	0.3	0.3			
Low Value	6.5	3.8			
High Value	7.5	4.8			

Table F-3 (continued)
Background Radiation Survey
Asset Recovery Building Interior Surfaces
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Sheetrocked Sheet Metal Walls		
Location	PIC	ESP2
IN037	6.8	3.9
IN047	6.9	4.2
IN051	7.0	4.4
IN057	6.6	3.9
IN060	6.7	3.5
IN062	6.4	3.9
IN063	6.7	3.9
IN065	6.8	4.3
Total Points	8	8
Mean	6.7	4.0
Std Deviation	0.2	0.3
Low Value	6.4	3.9
High Value	7.0	4.4

Table F-4
Background Radiation Survey
Asset Recovery Building Interior Surfaces
Surface Contamination Data
(Units: dpm/100 cm²)

Concrete Floors					Insulated Sheet Metal Walls				
Location	Direct		Removable		Location	Direct		Removable	
	Alpha	Beta	Alpha	Beta		Alpha	Beta	Alpha	Beta
IN036	33	925	<4.1	<8.0	IN039	67	1736	<4.1	<8.0
IN038	26	1664	<4.1	<8.0	IN041	61	522	<4.1	<8.0
IN040	23	996	<4.1	<8.0	IN042	62	264	<4.1	<8.0
IN043	28	822	<4.1	<8.0	IN046	54	558	<2.9	<8.0
IN044	23	835	<4.1	<8.0	IN049	57	587	<2.9	<8.0
IN045	27	862	<4.1	<8.0	IN053	101	738	<2.9	<8.0
IN048	30	898	<2.9	<8.0	IN055	119	650	<2.9	<8.0
IN050	23	873	<2.9	<8.0	Total Pts	7	7	7	7
IN052	56	1232	<2.9	<8.0	Mean	74	722	<4.1	<8.0
IN054	21	810	<2.9	<8.0	Std Dev	25	471	0.0	0.0
IN061	51	807	<2.9	<8.0	Lo Value	54	264	<2.9	<8.0
IN064	113	455	<2.9	<8.0	Hi Value	119	1736	<4.1	<8.0
Total Pts	12	12	12	12					
Mean	38	934	<4.1	<8.0					
Std Dev	26	292	0.0	0.0					
Lo Value	21	455	<2.9	<8.0					
Hi Value	113	1664	<4.1	<8.0					

Table F-4 (continued)
Background Radiation Survey
Asset Recovery Building Interior Surfaces
Surface Contamination Data
(Units: dpm/100 cm²)

Sheetrocked Sheet Metal Walls				
Location	Direct		Removable	
	Alpha	Beta	Alpha	Beta
IN037	73	529	<4.1	<8.0
IN047	52	481	3.6	<8.0
IN051	56	538	<2.9	<8.0
IN057	108	538	<2.9	<8.0
IN060	78	555	<2.9	<8.0
IN062	75	506	<2.9	<8.0
IN063	47	828	<2.9	<8.0
IN065	110	587	<2.9	<8.0
Total Pts	8	8	8	8
Mean	75	570	<4.1	<8.0
Std Dev	24	109	0.0	0.0
Lo Value	47	481	<2.9	<8.0
Hi Value	110	828	<4.1	<8.0

Table F-5
Background Radiation Survey
Asset Recovery Building Exterior Surfaces
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Sheet Metal Walls			
Location	ESP2	Location	ESP2
OS067	4.3	OS082	4.4
OS068	4.8	OS083	4.7
OS069	4.4	OS084	4.5
OS070	4.8	OS085	4.6
OS071	4.2	OS086	4.7
OS072	4.6	OS087	4.4
OS073	4.4	OS088	4.7
OS074	4.4	OS089	4.7
OS075	4.3	OS090	5.0
OS076	4.3	OS091	4.6
OS077	4.2	OS092	4.7
OS078	4.1	OS093	4.3
OS079	4.4	OS094	3.5
OS080	4.5	OS095	4.1
		Total Points	28
		Mean	4.4
		Std Deviation	0.3
		Low Value	3.5
		High Value	5.0

Table F-6
Background Radiation Survey
Asset Recovery Building Exterior Surfaces
Surface Contamination Data
(Units: dpm/100 cm²)

Sheet Metal Walls									
Location	Direct		Removable		Location	Direct		Removable	
	Alpha	Beta	Alpha	Beta		Alpha	Beta	Alpha	Beta
OS067	89	434	<6.2	<7.0	OS082	127	517	<6.2	<7.0
OS068	113	516	<6.2	<7.0	OS083	150	620	<6.2	<7.0
OS069	108	399	<6.2	<7.0	OS084	113	665	<6.2	<7.0
OS070	33	407	<6.2	<7.0	OS085	145	532	<6.2	<7.0
OS071	94	534	<6.2	<7.0	OS086	113	702	<6.2	<7.0
OS072	117	518	<6.2	<7.0	OS087	127	730	<6.2	<7.0
OS073	113	465	<6.2	<7.0	OS088	159	740	<6.2	<7.0
OS074	131	509	<6.2	<7.0	OS089	174	575	<6.2	<7.0
OS075	136	494	<6.2	<7.0	OS090	70	567	<6.2	<7.0
OS076	122	427	<6.2	<7.0	OS091	169	567	<6.2	<7.0
OS077	33	484	<6.2	<7.0	OS092	66	519	<6.2	<7.0
OS078	94	467	<6.2	<7.0	OS093	141	483	<6.2	<7.0
OS079	38	464	<6.2	<7.0	OS094	84	448	<6.2	7.6
OS080	127	495	<6.2	<7.0	OS095	141	465	<6.2	<7.0
Total Pts						28	28	28	28
Mean						112	527	<6.2	<7.6
Std Dev						38	92	0.0	0.0
Lo Value						33	399	<6.2	<7.0
Hi Value						174	740	<6.2	7.6

Table F-7
Background Radiation Survey
Outside Trojan North Building - Concrete Surfaces
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Location	PIC	ESP2	Location	PIC	ESP2
TN001	6.4	4.2	TN016	7.2	5.0
TN002	6.8	4.7	TN017	7.3	5.1
TN003	7.1	5.0	TN018	7.6	5.1
TN004	7.3	5.2	TN019	7.4	4.9
TN005	7.4	5.6	TN020	7.6	5.0
TN006	7.7	5.5	TN021	7.4	4.5
TN007	7.9	5.4	TN022	7.7	4.9
TN008	7.3	5.0	TN023	7.2	5.2
TN009	7.7	5.2	TN024	7.3	3.9
TN010	7.3	4.8	TN025	7.2	4.4
TN011	7.6	5.0	TN026	6.6	4.8
TN012	7.4	5.2	TN027	6.4	5.3
TN013	7.6	5.4	TN028	7.4	4.5
TN014	7.9	6.1	TN029	7.5	5.1
TN015	7.5	4.6	TN030	7.2	4.7
			Total Points	30	30
			Mean	7.3	5.0
			Std Deviation	0.4	0.4
			Low Value	6.4	3.9
			High Value	7.9	6.1

Table F-8
Background Radiation Survey
Outside Trojan North Building - Concrete Surfaces
Surface Contamination Data
(Units: dpm/100 cm²)

Location	Direct		Removable		Location	Direct		Removable	
	Alpha	Beta	Alpha	Beta		Alpha	Beta	Alpha	Beta
TN001	39	904	<4.6	<8.0	TN016	23	1320	<4.6	<8.0
TN002	35	894	<4.6	<8.0	TN017	21	1384	<4.6	<8.0
TN003	41	986	<4.6	<8.0	TN018	26	1354	<4.6	<8.0
TN004	35	1013	<4.6	<8.0	TN019	35	1444	<4.6	<8.0
TN005	41	1036	<4.6	<8.0	TN020	52	1346	<4.6	<8.0
TN006	39	1056	<4.6	<8.0	TN021	42	951	<5.8	<8.0
TN007	31	1056	<4.6	<8.0	TN022	51	900	<5.8	<8.0
TN008	43	1013	<4.6	<8.0	TN023	56	848	<5.8	<8.0
TN009	26	1184	<4.6	<8.0	TN024	47	633	<5.8	<8.0
TN010	47	1250	<4.6	<8.0	TN025	64	643	<5.8	<8.0
TN011	30	1262	<4.6	<8.0	TN026	48	818	<5.8	<8.0
TN012	28	1232	<4.6	<8.0	TN027	54	687	<5.8	<8.0
TN013	30	1302	<4.6	<8.0	TN028	37	574	<5.8	<8.0
TN014	27	1350	<4.6	<8.0	TN029	42	748	<5.8	<8.0
TN015	37	1376	<4.6	<8.0	TN030	42	947	<5.8	<8.0
					Total Pts	30	30	30	30
					Mean	39	1057	<5.8	<8.0
					Std Dev	10	247	0.0	0.0
					Lo Value	21	574	<4.6	<8.0
					Hi Value	64	1444	<5.8	<8.0

Table F-9
Background Radiation Survey
Outside Trojan North Building - Asphalt Pavement
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Location	PIC	ESP2	Location	PIC	ESP2
TN031	6.3	3.4	TN046	6.3	3.8
TN032	6.1	3.6	TN047	6.5	3.5
TN033	6.5	3.4	TN048	6.2	3.5
TN034	6.3	3.5	TN049	6.0	3.7
TN035	6.3	3.5	TN050	6.0	3.8
TN036	6.8	3.8	TN051	6.0	3.6
TN037	6.4	3.6	TN052	6.7	3.6
TN038	6.3	4.0	TN053	6.3	3.8
TN039	6.4	3.7	TN054	6.6	3.7
TN040	7.5	3.9	TN055	6.3	3.8
TN041	6.5	3.8	TN056	6.4	3.7
TN042	6.2	3.4	TN057	5.8	4.0
TN043	6.2	3.7	TN058	6.5	3.7
TN044	6.3	3.6	TN059	6.6	3.9
TN045	6.7	3.6	TN060	6.6	4.0
			Total Points	30	30
			Mean	6.4	3.7
			Std Deviation	0.3	0.2
			Low Value	6.0	3.4
			High Value	7.5	4.0

Table F-10
Background Radiation Survey
Outside Trojan North Building - Asphalt Pavement
Surface Contamination Data
(Units: dpm/100 cm²)

Location	Direct		Removable		Location	Direct		Removable	
	Alpha	Beta	Alpha	Beta		Alpha	Beta	Alpha	Beta
TN031	36	938	<5.8	<8.0	TN046	44	906	<5.8	<8.0
TN032	35	935	<5.8	<8.0	TN047	57	920	<5.8	<8.0
TN033	37	964	<5.8	<8.0	TN048	47	950	<5.8	<8.0
TN034	33	1026	<5.8	<8.0	TN049	32	952	<5.8	<8.0
TN035	42	974	<5.8	<8.0	TN050	34	1015	<5.8	<8.0
TN036	43	956	<5.8	<8.0	TN051	37	1142	<5.8	<8.0
TN037	33	1023	<5.8	<8.0	TN052	51	1210	<5.8	<8.0
TN038	27	998	<5.8	<8.0	TN053	33	1220	<5.8	<8.0
TN039	37	1010	<5.8	<8.0	TN054	41	1240	<5.8	<8.0
TN040	32	918	<5.8	<8.0	TN055	42	1238	<5.8	<8.0
TN041	37	895	<5.8	<8.0	TN056	51	1314	<5.8	<8.0
TN042	37	934	<5.8	<8.0	TN057	37	1210	<5.8	<8.0
TN043	37	915	<5.8	<8.0	TN058	43	1186	<5.8	<8.0
TN044	46	924	<5.8	<8.0	TN059	33	1176	<5.8	<8.0
TN045	35	879	<5.8	<8.0	TN060	36	1244	<5.8	<8.0
					Total Pts	30	30	30	30
					Mean	39	1040	<5.8	<8.0
					Std Dev	7	135	0.0	0.0
					Lo Value	27	879	<5.8	<8.0
					Hi Value	57	1314	<5.8	<8.0

Table F-11
Background Radiation Survey
Trojan North Building Exterior Surfaces
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Window Glass			Concrete Walls		
Location	PIC	ESP2	Location	PIC	ESP2
TN061	7.5	5.4	TN062	7.8	5.8
TN063	8.0	5.7	TN068	7.4	5.6
TN067	8.2	5.7	TN071	7.7	5.4
TN069	7.4	5.2	TN074	7.5	5.7
TN070	7.5	5.7	TN076	7.6	5.1
TN072	8.0	6.0	TN083	7.4	5.4
TN073	7.4	5.3	TN085	7.4	5.6
TN075	7.4	5.6	TN086	7.3	6.0
TN077	7.2	5.4	TN088	7.1	6.2
TN078	7.4	5.3	TN090	7.3	6.2
TN079	7.8	5.4	Total Points	10	10
TN080	7.3	5.4	Mean	7.5	5.7
TN081	7.5	5.3	Std Deviation	0.2	0.4
TN082	7.2	6.0	Low Value	7.1	5.1
TN084	7.2	5.9	High Value	7.8	6.2
TN087	6.9	5.8			
TN089	7.4	6.2			
Total Points	17	17			
Mean	7.5	5.6			
Std Deviation	0.3	0.3			
Low Value	6.9	5.2			
High Value	8.2	6.2			

Table F-11 (continued)
Background Radiation Survey
Trojan North Building Exterior Surfaces
Gamma Exposure Rate Data
(Units: $\mu\text{R/hr}$)

Ceramic Tile Walls		
Location	PIC	ESP2
TN064	8.6	6.2
TN065	7.8	6.1
TN066	7.9	6.1
Total Points	3	3
Mean	8.1	6.1
Std Deviation	0.4	0.1
Low Value	7.8	6.1
High Value	8.6	6.2

Table F-12
Background Radiation Survey
Trojan North Building Exterior Surfaces
Surface Contamination Data
(Units: dpm/100 cm²)

Window Glass					Concrete Walls				
Location	Direct		Removable		Location	Direct		Removable	
	Alpha	Beta	Alpha	Beta		Alpha	Beta	Alpha	Beta
TN061	73	579	<5.4	<8.1	TN062	80	915	<5.4	<8.1
TN063	69	747	<5.4	<8.1	TN068	64	918	<5.4	<8.1
TN067	74	794	<5.4	<8.1	TN071	61	854	<5.4	<8.1
TN069	70	596	<5.4	<8.1	TN074	66	945	<5.4	<8.1
TN070	59	753	<5.4	<8.1	TN076	66	916	<5.4	<8.1
TN072	83	701	<5.4	<8.1	TN083	77	768	<5.4	<8.1
TN073	90	730	<5.4	<8.1	TN085	64	682	<5.4	<8.1
TN075	47	644	<5.4	<8.1	TN086	60	690	<5.4	<8.1
TN077	67	735	<5.4	<8.1	TN088	77	911	<5.4	<8.1
TN078	77	700	<5.4	<8.1	TN090	68	723	<5.4	<8.1
TN079	79	687	<5.4	<8.1	Total Pts	10	10	10	10
TN080	83	715	<5.4	<8.1	Mean	68	832	<5.4	<8.1
TN081	61	571	<5.4	<8.1	Std Dev	7	105	0.0	0.0
TN082	49	599	<5.4	<8.1	Lo Value	60	682	<5.4	<8.1
TN084	74	709	<5.4	<8.1	Hi Value	80	945	<5.4	<8.1
TN087	75	679	<5.4	<8.1					
TN089	58	727	<5.4	<8.1					
Total Pts	17	17	17	17					
Mean	70	686	<5.4	<8.1					
Std Dev	12	66	0.0	0.0					
Lo Value	47	571	<5.4	<8.1					
Hi Value	90	794	<5.4	<8.1					

Table F-12 (continued)
Background Radiation Survey
Trojan North Building Exterior Surfaces
Surface Contamination Data
(Units: dpm/100 cm²)

Ceramic Tile Walls				
Location	Direct		Removable	
	Alpha	Beta	Alpha	Beta
TN064	80	1226	<5.4	<8.1
TN065	81	1216	<5.4	<8.1
TN066	92	1304	<5.4	<8.1
Total Pts	3	3	3	3
Mean	84	1249	<5.4	<8.1
Std Dev	7	48	0.0	0.0
Lo Value	80	1216	<5.4	<8.1
Hi Value	92	1304	<5.4	<8.1