Work Plan
for
Site Screening Process Investigation
at
Site 1 - Thorium Spill

Naval Support Facility,
Indian Head
Indian Head, Maryland

Naval Facilities Engineering Command
Washington

Contract Number N62472-03-D-0057
Contract Task Order 005

October 2005

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WORK PLAN
FOR
SITE SCREENING PROCESS INVESTIGATIONS

AT

SITE 1 - THORIUM SPILL

NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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LIST OF ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
bgs	below ground surface
CLEAN	Comprehensive Long-Term Environmental Action Navy
cpm	counts per minute
CTO	contract task order
CWAP	Comprehensive Work Approval Process
DCGL	derived concentration guideline level
DON	Department of the Navy
DOT	Department of Transportation
dps	disintegrations per second
DQO	data quality objective
EOD	explosive ordnance disposal
EPA	Environmental Protection Agency
FFA	Federal Facility Agreement
FOL	field operations leader
FS	feasibility study
FSP	field sampling plan
GIS	geographic information system
HASP	health and safety plan
IDW	investigation-derived waste
IHIRT	Indian Head Installation Restoration Team
IR	installation restoration
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCRD	minimum detectable count rate
NAD83	North American Datum 1983
NAVSCOLEOD	Naval School, Explosive Ordnance Disposal
NAVSEADET	Naval Sea Systems Command Detachment
NSF-IH	Naval Support Facility, Indian Head
NGVD29	National Geodetic Vertical Datum of 1929
pCi/g	pico Curies per gram
PNNL	Pacific Northwest National Laboratory
POC	point of contact
PPE	personal protective equipment
QA	quality assurance
QAPP	quality assurance project plan

QC	quality control
Ra-228	radium-228
RASO	Radiological Affairs Support Office
RESRAD	Residential Radiological Screening Software
RI	remedial investigation
RPM	Remedial Project Manager
SOP	standard operating procedure
SSP	site screening process
TtNUS	Tetra Tech NUS, Inc.
USAEC	United States Atomic Energy Commission
VSP	Visual Sampling Plan
WRS	Wilcoxon Rank Sum

1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

This Site Screening Process (SSP) Work Plan for investigations at Naval Support Facility, Indian Head (NSF-IH) in Indian Head, Maryland was prepared by Tetra Tech NUS, Inc. (TtNUS) in response to Contract Task Order (CTO) 005 under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62467-03-D-0057. NSF-IH is a Naval Support Activity, South Potomac Facility within the naval District Washington Region. The purpose of this work plan is to develop and describe the field sampling activities to be conducted at Site 1 – Thorium Spill.

1.2 SCOPE AND OBJECTIVE

TtNUS has been tasked to develop this work plan to support the SSP at NSF-IH Installation Restoration (IR) Site 1. The objective of the SSP is to acquire sufficient data to provide the basis for a determination that either (1) a remedial investigation/feasibility study (RI/FS), FS, another investigation, and/or a removal action, as appropriate, is required at the area addressed by the SSP or (2) the area does not pose a threat, or potential threat, to public health, welfare, or the environment and therefore the area should be removed from further study under the Federal Facility Agreement (FFA).

1.3 STATION BACKGROUND

NSF-IH is located in northwestern Charles County, Maryland. As shown on Figure 1-1, the NSF-IH is approximately 25 miles southwest of Washington, D. C. NSF-IH is a military facility consisting of the Main Area on the Cornwallis Neck Peninsula and the Annex on Stump Neck, which is located across Mattawoman Creek. The Stump Neck Annex is operated by a tenant. As shown on Figure 1-2, the Main Area is bounded by the Potomac River to the northwest, west, and south, Mattawoman Creek to the south and east, and the Town of Indian Head to the northeast. The Stump Neck Annex, also shown in Figure 1-2, includes approximately 1,000 acres and is separated from the Main Area by Mattawoman Creek. The location of Site 1 is shown in Figure 1-2.

The primary mission of the Indian Head Division, Naval Surface Warfare Center, the main tenant of NSF-IH, is as follows:

- Provide primary technical capability in energetics for all warfare centers through engineering, fleet and operational support, manufacturing technology, limited production, industrial base support, and secondary technical capability through research, development, testing, and evaluation for energetic materials, ordnance devices and components, and related ordnance engineering standards to include

chemicals, propellants and their propulsion systems, explosives, pyrotechnics, warheads, and simulators.

- Provide support including special weapons support, explosive safety, and ordnance environmental support to all warfare centers, military departments, and the ordnance industry.

- Execute other responsibilities as assigned by Commander, Naval Surface Warfare Center.

In 1951 the Navy was assigned the joint-service explosive ordnance disposal (EOD) responsibilities for basic training and research and development. In 1953 the research and development tasks were established as a separate organization, and redesigned the Naval Explosive Ordnance Disposal Technical Center. The training function was renamed the Naval School, Explosive Ordnance Disposal (NAVSCOLEOD). From 1955 on, all joint service EOD training was provided at Indian Head until the school moved to Eglin Air Force Base (AFB). In 1958, the NAVSCOLEOD moved from its Jackson Road location to Strauss Avenue. The NAVSCOLEOD command moved to Eglin AFB in 1993, and the NAVSCOLEOD Indian Head was designated as a detachment. The Commanding Officer and the Headquarters NAVSCOLEOD returned to Indian Head in 1994 while a construction project was being completed at Elgin AFB. In January 1999, the NAVSCOLEOD was consolidated at Elgin AFB. A detachment of EOD personnel remains at Indian Head.

1.4 DATA QUALITY OBJECTIVES

This Work Plan has been developed using the Data Quality Objective (DQO) Process. The DQO Process is a focused, iterative process for developing the data collection strategy to support decision making. The goal of the process is to conduct investigations in an efficient and effective manner without unnecessary precision and redundancy of data. The seven steps comprising this process are listed in Table 1-1 along with the sections of this Work Plan that address the steps.

1.5 PROJECT ORGANIZATION

The activities described in this Work Plan will be performed by TtNUS with support from the Navy. The Navy Remedial Project Manager (RPM) is:

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The TtNUS project organization chart is shown on Figure 1-3.

1.6 DOCUMENT ORGANIZATION

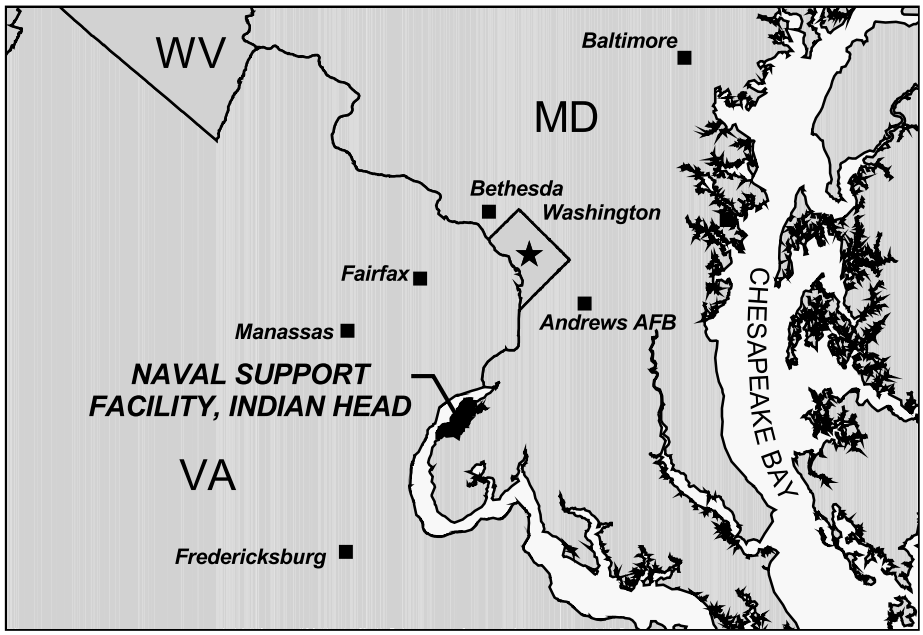
This Work Plan is intended for use in conjunction with the Master Plans for Installation Restoration Program Environmental Investigations at NSF-IH (TtNUS, 2004), which includes the Master Work Plan, Master Field Sampling Plan (FSP), and Master Quality Assurance Project Plan (QAPP), each of which provides general information applicable to all sites at NSF-IH. This Work Plan includes site-specific information to be used for the SSP investigation at Site 1. Section 1.0 is the introduction to this site-specific Work Plan and describes the purpose of the document, outlines the scope and objectives of the work, summarizes the background of the Indian Head facility, explains how the DQO process is addressed in this Work Plan, and describes the project organization. Section 2.0 develops the rationale for and outlines the investigation to be implemented at Site 1 and provides a general overview of the field investigation to be implemented. Section 3.0 describes the details regarding field operations, and Section 4.0 covers the sampling procedures. Appendix A contains the historic chronology for Site 1. Appendix B contains the project-specific Health and Safety Plan (HASP). Appendix C contains the project-specific QAPP. Appendix D contains the Standard Operating Procedures (SOPs).

TABLE 1-1

INTEGRATION OF DQO PROCESS INTO SITE-SPECIFIC WORK PLAN
SITE SCREENING PROCESS SITE 1
NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND

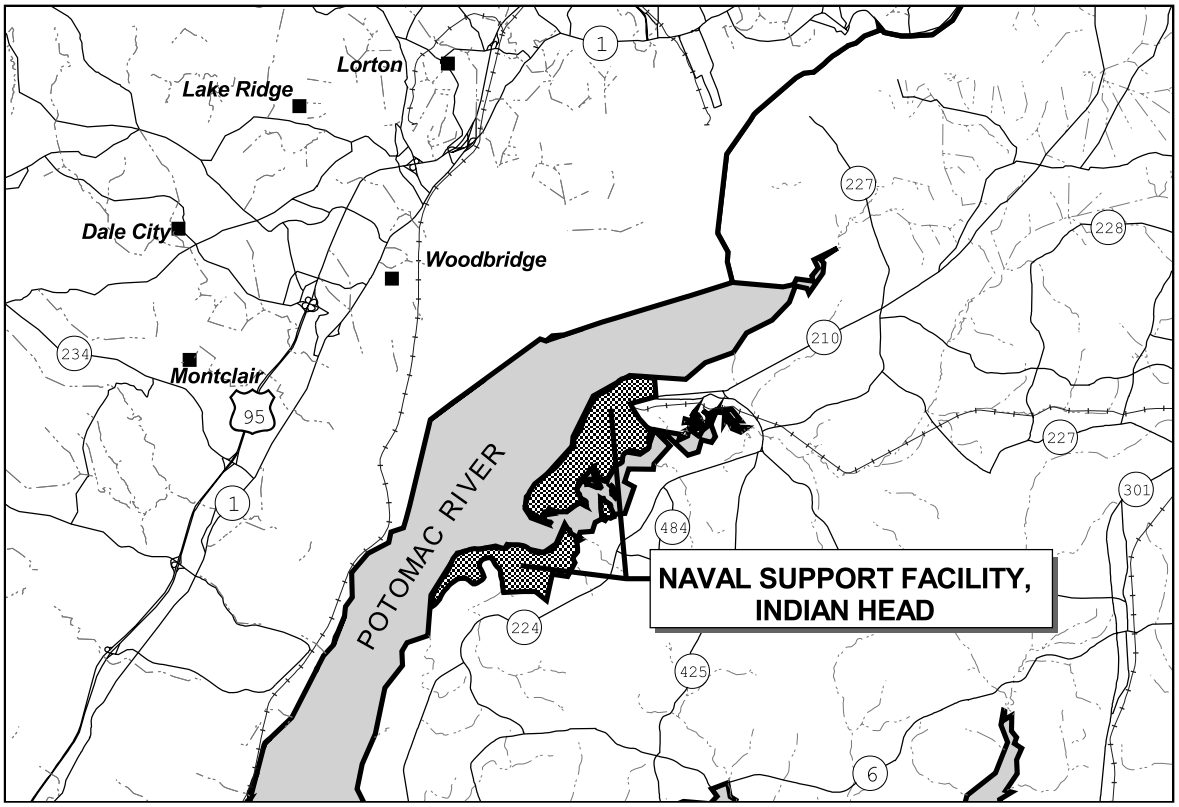
DQO Step[1]	Location in Work Plan Document
1. State the Problem	Section 2.3.1
2. Identify the Decision	Section 2.3.2
3. Identify the Inputs to the Decision	Section 2.3.3
4. Define the Boundaries of the Study	Section 2.3.4
5. Develop a Decision Rule	Section 2.3.5
6. Specify Tolerable Limits on Decision Efforts	Section 2.3.6
7. Optimize the Design for Obtaining Data	Section 2.3.7

1 Source: EPA, 2000b.
NSF-IH: Naval Support Facility – Indian Head
DQO: Data Quality Objectives



LEGEND

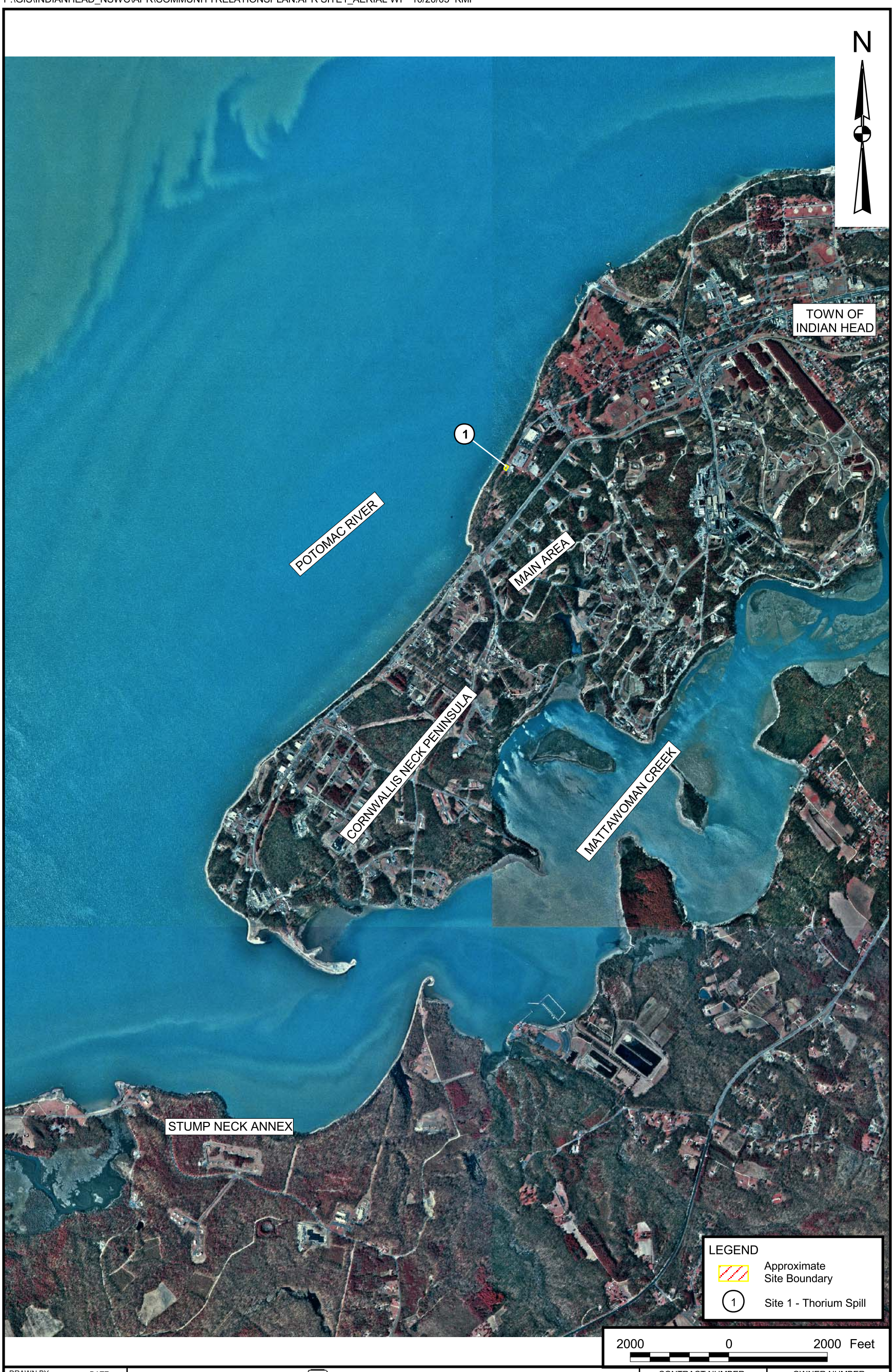
- City
- Highway
- Railroad
- River



DRAWN BY K. PEILA — DATE 2/2/04	Tetra Tech NUS, Inc.	CONTRACT NUMBER 2144	OWNER NO. 005
CHECKED BY G. LATULIPPE — DATE 2/2/04	FACILITY LOCATION MAP SITE 1 - THORIUM SPILL NAVAL SUPPORT FACILITY, INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY GJL — DATE 6/4/04	
COST/SCHEDULE-AREA		APPROVED BY — — DATE —	
SCALE AS NOTED		DRAWING NO. FIGURE 1-1	REV 0

P:\GIS\NSWC_INDIAN_HEAD\SITE42_SITELOCATION.APR FACILITY LOCATION MAP 10/24/05 AJ ARCHIVE

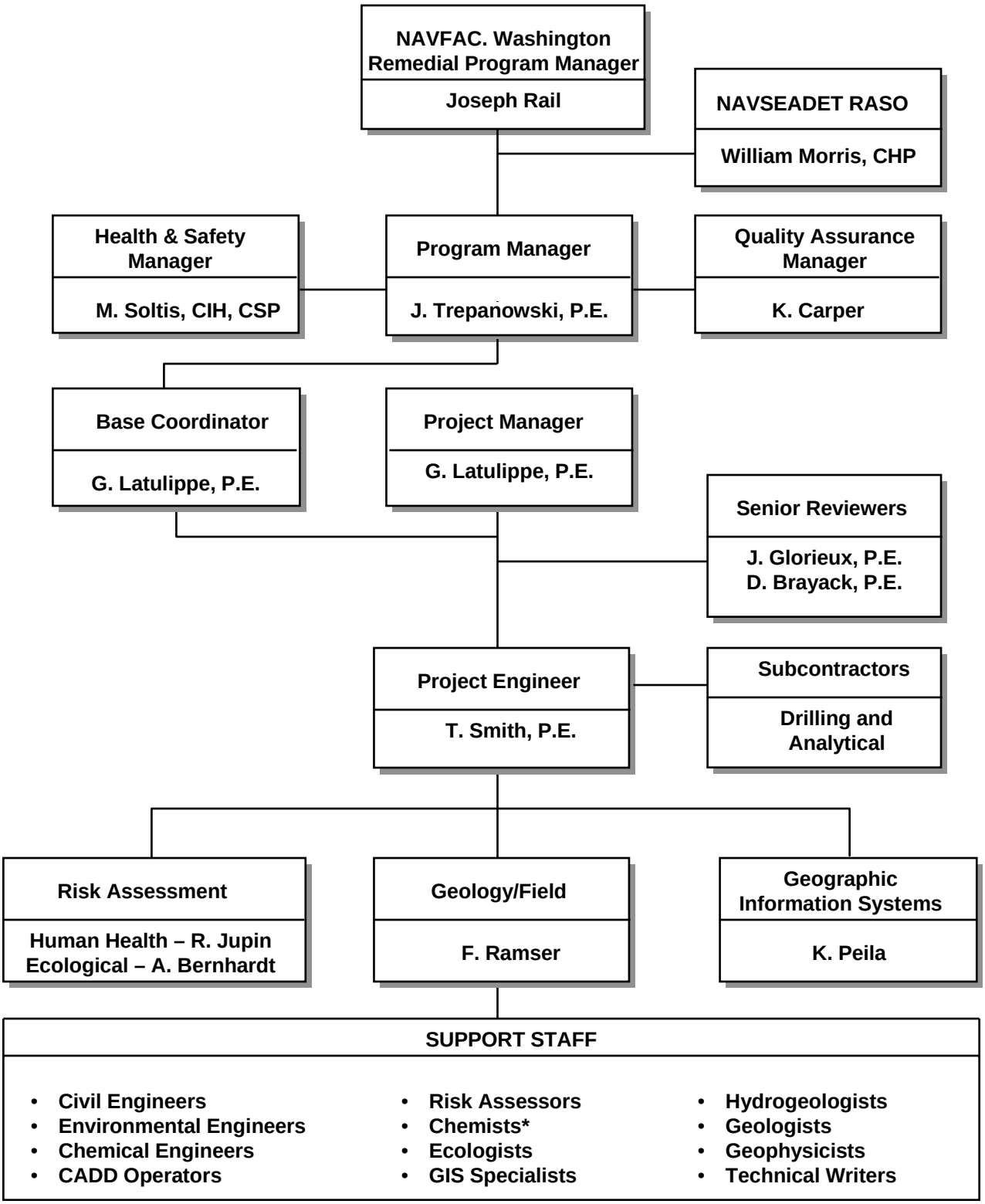
P:\GIS\INDIANHEAD_NSWC\APR\COMMUNITYRELATIONSPLAN.APR SITE1_AERIAL WP 10/20/05 KMP



DRAWN BY K. PEILA — DATE 6/8/04	Tetra Tech NUS, Inc.	CONTRACT NUMBER 2144	OWNER NUMBER 005
CHECKED BY J. LUCAS — DATE 6/8/04	SITE LOCATION MAP SITE 1 - THORIUM SPILL NAVAL SUPPORT FACILITY, INDIAN HEAD INDIAN HEAD, MARYLAND	APPROVED BY JHL	DATE 6/8/04
COST/SCHEDULE-AREA		APPROVED BY —	DATE —
SCALE AS NOTED		DRAWING NO. FIGURE 1-2	REV 0

FIGURE 1-3

TETRA TECH NUS PROJECT ORGANIZATION CHART
SITE SCREENING PROCESS WORK PLAN
SITE 1 - THORIUM SPILL
NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND



* J. Samchuck will be responsible for data validation.

2.0 SSP INVESTIGATION RATIONALE

This section provides the rationale for development of the site-specific sampling activities for Site 1.

2.1 SITE BACKGROUND

Site 1 is located near the western corner of Building 1662, between the building and Strauss Avenue as shown on Figure 2-1. It occupies an area approximately 60 feet by 90 feet. Thorium was first placed on the ground in this area in 1962 in connection with radiation training exercises conducted by the NAVSCOLEOD then at the Facility. Thorium ore from approximately five drums of 30- to 50-gallon capacity was spread over the site. No United States Atomic Energy Commission (USAEC) license was issued at the time the ore was purchased.

The Naval Sea Systems Command Detachment (NAVSEADET) Radiological Affairs Support Office (RASO) provided the historical information that served as the basis for the background discussion in this document regarding Site 1. A chronology of Site 1 is included in this document as Appendix A. The documents supporting the chronology and the historical summary in Section 2.2.1 are cited in the chronology. The construction of Building 1662 was completed in 1983. Building 900, located northeast of Building 1662, was in place prior to 1962.

Thorium is a soft, silvery white metal that dissolves slowly in water. Thorium-232 has a half-life of 14 billion years and decays by alpha emission with accompanying gamma radiation. Thorium-232 is at the top of a long decay series that contains key radionuclides such as radium-228, its direct decay product, and radon-220. Two other isotopes of thorium are thorium-230 and thorium-228. Both belong to other decay series. They also decay by alpha emission with accompanying gamma radiation, and have half-lives of 75,400 years and 1.9 years, respectively.
(http://www.epa.gov/radiation/radionuclides/thorium.htm)

2.2 HISTORICAL ENVIRONMENTAL DATA

Thorite ore was first placed on Site 1 in 1962. Early in 1967, some of the thorite ore was removed from the site, placed into barrels, and transferred to an unknown destination. The residual soil on the site was then disked and harrowed several times to uniformly incorporate any residual thorite ore into the soil. It was reported that the soil was affected to a depth of about 8 to 12 inches.

In 1971, a sample of the thorite ore was assayed for thorium content by the Engineering Division, United States Army Engineer Power Group, Fort Belvoir, Virginia. The results were reported as, "Thorium content 2.5 w/o thorium with a specific activity of 100 disintegrations per second (dps) per gram."

A radiological survey conducted at Site 1 on March 28, 1972, determined that the affected areas included seven locations covering a total of approximately 600 square feet. The depths of the affected soil ranged from 12 to 18 inches below ground surface (bgs).

During the period from July 7 through 19, 1972, the radioactive soil was excavated, placed into fifty 55-gallon drums, and staged at the Facility's radiation training area. The drums were shipped on October 18, 1972 for disposal at the Nuclear Engineering Company, Inc. in Morehead, Kentucky. Subsequent radiological surveys, each followed by the removal of radioactive material, occurred on November 3 and November 9, 1972. Subsequently, the excavated area was backfilled with 18 to 24 inches of clean soil to reestablish the original ground contour.

A final radiological survey of the area was performed by RASO personnel on February 12, 1976. In a March 1, 1976, memorandum, RASO indicates that "Based on the above survey, the subject area has been returned to background and may be released for unrestricted use."
In 1983, as reported by the first-hand account of Mr. Ben Redmond (Jorgensen, 2002), two buried drums containing thorium material, dirt, and gravel were discovered near the site during construction of Building 1662. The drums were shipped off-site for disposal as low-level radioactive waste.

In anticipation of the construction of an addition to Building 900, a radiological survey was performed along the southeastern side of the building where the site was initially thought to be located on October 18, 2001. The report on that survey indicated that 10 samples of subsurface soil (0.5 to 2 feet deep) were collected. The report concluded that "Based on the laboratory results, no further actions regarding thorium are required at this time. Soil remediation will not be required as part of Building #900 Joint Interoperability Project."

In November 2004, RASO indicated that it considered all known drums of thorium ore to have been accounted for and properly disposed (RASO, 2004). However, RASO indicated in the same communication that "Radiation measurements made in 1972 are not definitive as to the thorium concentrations remaining after the cleanup. Characterization surveys are still necessary."

Following a search of historical files, RASO provided a description of the location of Site 1 (RASO, 2004), which is illustrated on Figure 2-1. The current condition of the site is that clean soil covers the 60-foot by 90-foot area to a depth of 12 to 18 inches as a result of the 1972 removal of contaminated soil and its

replacement with clean soil. No drums currently exist at the site based on RASO's determination that all drums of material have been accounted for. If contamination exists at the site, it will be found below the 12 to 18 inches of clean soil and within the next 12 inches of depth (i.e., the bottom of the interval in question is 24 to 30 inches bgs).

2.3 FIELD INVESTIGATION SCOPE DEVELOPMENT

2.3.1 Statement of the Problem

Site 1 had been used in the past for radiation training. The first effort to prepare the site for training purposes occurred in 1962 when the site's soil was seeded with thorite ore. As described in Section 2.2 and in Appendix A, several sequences of radiological surveying and thorite ore/contaminated soil removal occurred from 1967 through 1972. At some time after the removal and disposal of thorite ore and soil, the excavated areas were covered with 12 to 18 inches of clean soil. Based on the results of a final radiological survey in 1976, the site was returned to unrestricted use. In 1983, two additional drums containing thorite ore were discovered and were shipped for disposal. In 2001, an additional radiological survey was conducted along the southeastern side of Building 900. That survey determined that "no further actions regarding thorium are required at this time."

Information provided by RASO (2004) indicates that:

- The site covers an area measuring approximately 60 by 90 feet.
- The site is located as illustrated on Figure 2-1.
- The site was covered with 12 to 18 inches of clean soil following excavation and removal of thorite ore and contaminated soil.
- Contamination may exist in the 12 inches of soil below the 12 to 18 inches of previously placed clean backfill soil.
- All drums of radioactive material have been accounted for and have been properly disposed off site.
- According to RASO's review of historical information, a final site characterization survey is necessary to verify that Site 1 is not in need of further action (RASO, 2004).

2.3.2 Identify the Decision

A radiological survey of the site is needed to determine if radiological contamination is present in subsurface soil located between 18 and 30 inches bgs. Actually, samples will be collected down to 36 inches bgs rather than stopping at 30 inches bgs to provide additional assurance, in consideration of the fact that thorium dissolves slowly in water, that the potential presence of radiological contamination has been investigated thoroughly. If radiological contamination is detected, it will be necessary to address the following questions:

- Are the identified contaminant levels acceptable such that a no-action determination is appropriate?
- Are the identified contaminant levels unacceptable such that further action is required?

Restating the above questions as DQO decision statements results in the following:

- Determine if the identified contaminant concentrations are acceptable such that a no-action determination is appropriate.

- Determine if the identified contaminant concentrations are unacceptable such that further action is required.

2.3.3 Inputs to the Decision

The information required to make the decision includes:

- An action level that serves as a trigger for one action or another when it is exceeded.
- Analytical data regarding the level of radioactivity in on-site soil between depths of 18 to 36 inches.

Based on computer model runs by RASO using Residential Radiological Screening (RESRAD) software and a residential risk scenario, a thorium-232 concentration of 1 pico Curies per gram (pCi/g) above background was determined to be a suitable derived concentration guideline level (DCGL) which is defined in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (EPA et al., 2000a) as “A derived, radionuclide-specific activity concentration within a survey unit corresponding to the release criterion.” MARSSIM also described DCGLs as “…average levels of radiation or radioactivity above appropriate background levels.” The action level for this investigation will be defined as 1 pCi/g of thorium-232 above background.

Radioactivity levels will be measured in the field using a gamma probe scintillator as described in Section 4.1.1. One soil sample from each Site 1 boring will be analyzed in a fixed-base laboratory. Soil will be

collected from each of three 6-inch boring intervals between 18 and 36 inches bgs. The sample from the boring interval exhibiting the highest level of radioactivity will be shipped to a fixed-base laboratory for analysis. In the absence of any apparent high radioactivity reading, a soil sample will be randomly selected from a boring depth between 18 and 36 inches bgs. The fixed-base laboratory will perform a gamma spectral analysis for each sample and will report the results for thorium-232. An equal quantity of locations in a background reference area will be sampled using a similar sample collection technique. (See Section 4.1.1)

2.3.4 Study Boundaries

The study boundary for Site 1 is the rectangular area measuring approximately 60 feet by 90 feet and located generally between Building 1662 (to the east) and Strauss Avenue (to the west) as shown on Figure 2-1. The vertical boundary for the study extends from the ground surface to approximately 36 inches bgs. The 36-inch depth provides a measure of conservativeness in making field determinations regarding the presence of thorium-232 contamination. The selected area and depth define the volume of soil that may be unacceptably contaminated and could potentially pose a threat to human health and the environment.

The reference area within the facility will be identified immediately prior to the field investigation. The background sample set will be similar to the Site 1 sample set with respect to the quantity of sample locations, the method of collection, and the analytical technique. The reference area will be selected so as to be approximately the same size as Site 1 (within 20 percent of the area covered by Site 1).

2.3.5 Decision Rule

The fixed-base-laboratory analytical results will be evaluated in an SSP report to determine what action, if any, may be appropriate for Site 1. The presence or absence of residual contamination at Site 1 will be determined by comparing the Site 1 analytical results to the reference area analytical results using the approach described in MARSSIM Section 8.4.1.

The Site 1 data set and the reference area data set will be compared using the Wilcoxon Rank Sum (WRS) test. Prior to initiating the WRS test, 1 pCi/g (the DCGL described in Section 2.3.3) will be added to each of the analytical results in the reference area data set.

The decision rules for the Site 1 investigation are as follows:

- If the result of the WRS test indicates that the Site 1 thorium-232 concentration does not exceed the sum of the reference area thorium-232 concentration plus 1 pCi/g, Site 1 will be recommended for no action.

- If the result of the WRS test indicates that the Site 1 thorium-232 concentration exceeds the sum of the reference area thorium-232 concentration plus 1 pCi/g, Site 1 will be subjected to further evaluation.

Should it be determined that further evaluation is appropriate for the site, the form and extent of the evaluation will be discussed within the Indian Head Installation Restoration Team (IHIRT). Those discussions may consider the detected radiation levels, the apparent pattern of radiation, the size of the site, and the application of available guidance documents, and risk management considerations. Potential actions may include a reevaluation of the analytical data, further field sampling, an RI and an FS, or a removal action.

2.3.6 Limits on Decision Errors

The parameters and the process used to develop the Site 1 sampling scheme were based in part on guidance in the MARSSIM (EPA, et al., 2000a), and the calculation capabilities of Visual Sampling Plan (VSP), a statistically based software for sampling plan development (PNNL, 2002). The calculation of the quantity of samples is based on the VSP MARSSIM module that uses the WRS test for non-parametric random sampling.

There are two possible decision errors that can be made:

- Type I: taking no corrective action when correction action is warranted
- Type II: taking corrective action when it is not warranted.

The Type I error is considered to be the more egregious error because it would leave behind an unacceptable environmental condition and thus pose a potential threat to human health and the environment. Therefore, the null hypothesis defined for the Site 1 investigation is as follows: The median thorium-232 concentration in Site 1 soil exceeds the median thorium-232 concentration in the reference area soil by more than 1 pCi/g. The null hypothesis assumes that Site 1 is “dirty.” Stated another way, the concentration of thorium-232 in Site 1 soil must be equal to or less than the threshold concentration defined as the sum of the median concentration of thorium-232 in reference area soil plus 1 pCi/g if Site 1 is to be declared “clean”.

The sample allocation, collection, transport, storage, and radiation measurements will be subject to random uncertainties. These uncertainties require that multiple samples be collected to characterize the site. A statistical treatment was used to determine the number of samples needed so that the effects of the uncertainties on decision making could be accounted for. Several statistical parameters, including the tolerable rates of committing either of the two error types expressed above (i.e., alpha and beta), are required for these calculations.

- Alpha (α) is the probability of rejecting the null hypothesis when it is true. Stated another way for the Site 1 null hypothesis, alpha is the probability of determining that the site is clean (i.e., contaminant concentrations equal to or less than the threshold concentration) when it is actually dirty (i.e., contaminant concentrations greater than the threshold concentration).

- Beta (β) is the probability of accepting the null hypotheses when it is false. Stated another way for the Site 1 null hypothesis, beta is the probability of determining that the site is dirty when it is actually clean.

Additional parameters include an estimated standard deviation (σ) for the data sets (Site 1 and background) under consideration, and an estimated delta (Δ) or "shift," the width of the "grey region" in a decision performance curve, which is the range of possible true parameter values where the consequences of a false acceptance decision error are considered tolerable. That is, the grey region represents values that may exceed the specified threshold value but are "too close to call" with certainty and for which the cost of additional samples needed to resolve the "call" is not worth the additional expense.

The VSP software allows the user to enter estimated values for alpha, beta, standard deviation, and delta and then calculates the quantity of samples required in the site area and the background area in order for the resulting data set to be sufficiently robust to support the statistical verification of the estimated input parameters. For the development of a Site 1 sampling plan, input parameters were estimated as follows:

- Alpha was assigned a value of 5 percent. This value of alpha indicates that, if the characterization could be repeated many times, 5 percent of the time, the site data may indicate that Site 1 is clean when it is actually dirty.

- Beta was assigned a value of 10 percent. This value of beta indicates that, if the characterization could be repeated many times, 10 percent of the time, the site data may indicate that Site 1 is dirty when it is actually clean.

- The standard deviation is estimated to be 0.4 pCi/g. This value was estimated from a literature background value (1.2 pCi/g for Thorium-232) (Considine, 1976) and an assumed relative standard deviation of 30 percent as suggested in the MARSSIM manual (EPA et al., 2000a) as a reasonable assumption for the coefficient of variation ($\frac{\sigma}{\bar{x}}$ where $\bar{x}$ is the mean of the data set).

- The delta, or shift, was assumed to be $1 \times \sigma$ as a reasonably conservative value for delta (i.e., $\Delta = \sigma$).

The sampling scheme resulting from entering the above parameters into the VSP software is described in the next section.

2.3.7 Design for Collecting the Data

After the parameters described in the preceding section were entered into the VSP software, the software calculated the quantity of samples necessary to statistically support the conditions described by the parameters and defined a set of random sample locations for a 60-foot by 90-foot area.

VSP calculated the need for 27 samples from Site 1. The VSP calculation includes an additional 20 percent added to the sample quantity as recommended by MARSSIM as a consideration for possible data point loss or rejection.

An analysis of the sensitivity of the sample quantity to the selection of values of alpha and beta was conducted and the results are shown on Table 2-1. As the table illustrates, the quantity of samples required tends to decrease with increases in the values for alpha and/or beta. Said another way, a reduction in sample quantity increases the probability of the following:

- For alpha, the site will be declared “clean” when it is actually “dirty.”
- For beta, the site will be declared “dirty” when it is actually “clean.”

Conversely, the quantity of samples must be increased in order to reduce the probability of erroneous decisions.

The required quantity of samples in the table decreases as the estimated standard deviation is reduced. The table appears to show that the quantity of samples can be reduced without affecting alpha or beta, simply by decreasing the estimated standard deviation. However, after the field samples are analyzed, the resulting data sets will be statistically tested for conformance with the statistical parameters assumed

during planning. Non-conformance will require an evaluation of the need to collect additional samples to cause the data set to statistically conform to the planning parameters. Selecting a standard deviation that is too small increases the possibility that an additional field sample collection effort will be required.

In addition to calculating the quantity of samples, VSP determines a random location for each of the samples within the Site 1 area. The locations are defined for Site 1 by VSP as x and y coordinates from the southeastern corner of a 60-foot by 90-foot rectangle defined as the site. Table 2-2 presents the sample coordinates. The locations are illustrated on Figure 2-1.

The sample collection technique is described in Section 4.1.1.

TABLE 2-1

SENSITIVITY ANALYSIS OF THE QUANTITY OF SAMPLES
SITE 1 - THORIUM SPILL
NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND

Quantity of Samples

AL = 0		**α = 5**		**α =10**		**α =15**	
		σ = 0.8	**σ = 0.4**	**σ = 0.8**	**σ = 0.4**	**σ = 0.8**	**σ = 0.4**
% of Δ = 90	**β = 5**	114	33	90	27	76	22
	β = 10	90	27	70	21	57	17
	β = 15	76	22	57	17	46	14
% of Δ = 80	**β = 5**	114	33	90	27	76	22
	β = 10	90	27	70	21	57	17
	β = 15	76	22	57	17	46	14
% of Δ = 70	**β = 5**	114	33	90	27	76	22
	β = 10	90	27	70	21	57	17
	β = 15	76	22	57	17	46	14

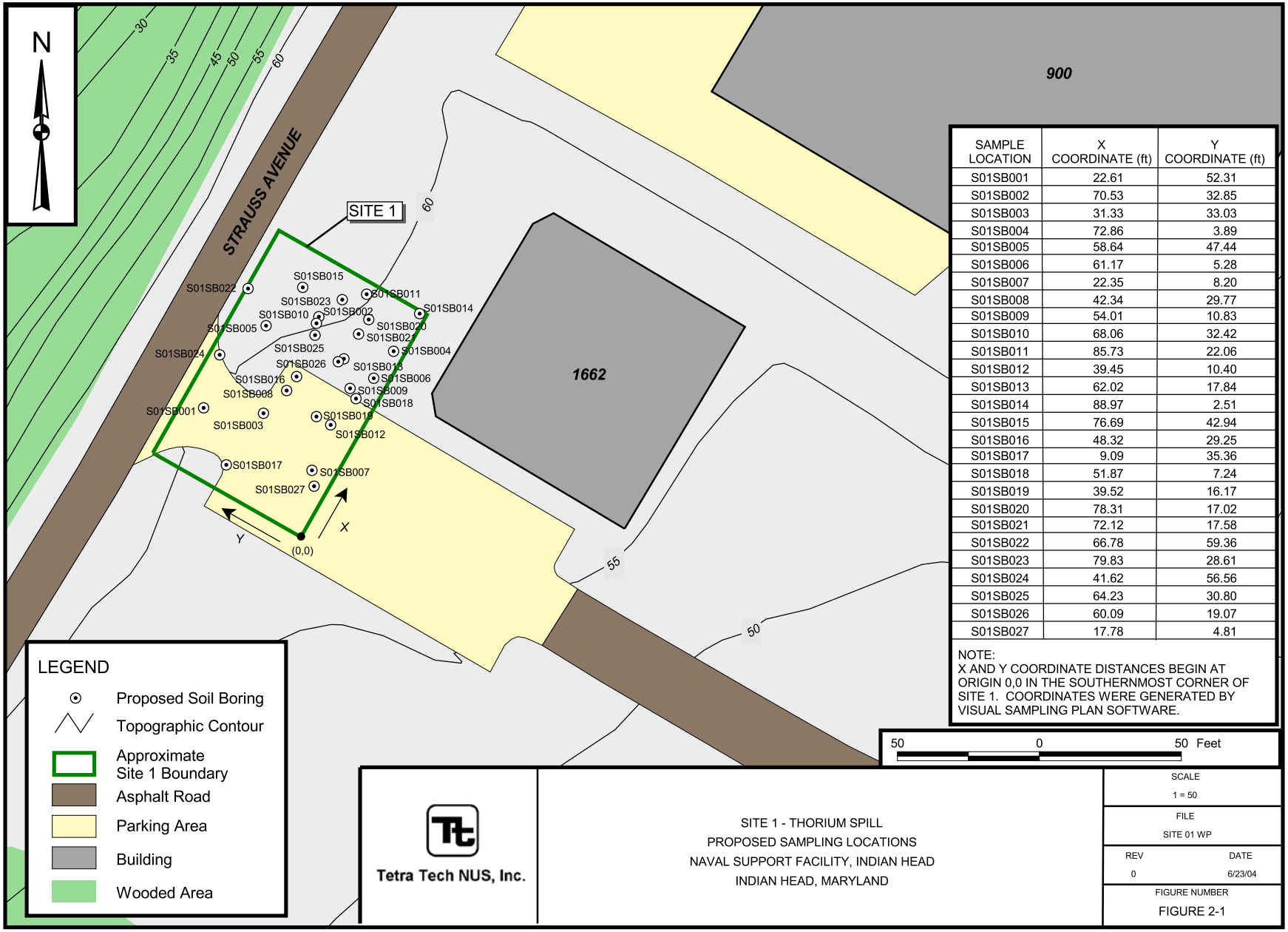
σ = Standard Deviation
Δ = Delta, or shift
α = Probability of determining that the site is "clean" when it is actually "dirty'
β = Probability of determining that the site is "dirty" when it is actually "clean'
AL = Action Level, or action threshold

TABLE 2-2

SAMPLE LOCATIONS
SITE 1 - THORIUM SPILL
NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND

Sample Location	Sample Number(1)	X Coordinate(2) (feet)	Y Coordinate(2) (feet)
S01SB001	S01SB0010101	22.6	52.3
S01SB002	S01SB0020101	70.5	32.8
S01SB003	S01SB0030101	31.3	33.0
S01SB004	S01SB0040101	72.9	3.9
S01SB005	S01SB0050101	58.6	47.4
S01SB006	S01SB0060101	61.2	5.3
S01SB007	S01SB0070101	22.3	8.2
S01SB008	S01SB0080101	42.3	29.8
S01SB009	S01SB0090101	54.0	10.8
S01SB010	S01SB0100101	68.1	32.4
S01SB011	S01SB0110101	85.7	22.1
S01SB012	S01SB0120101	39.4	10.4
S01SB013	S01SB0130101	62.0	17.8
S01SB014	S01SB0140101	89.0	2.5
S01SB015	S01SB0150101	76.7	42.9
S01SB016	S01SB0160101	48.3	29.2
S01SB017	S01SB0170101	9.1	35.4
S01SB018	S01SB0180101	51.9	7.2
S01SB019	S01SB0190101	39.5	16.2
S01SB020	S01SB0200101	78.3	17.0
S01SB021	S01SB0210101	72.1	17.6
S01SB022	S01SB0220101	66.8	59.4
S01SB023	S01SB0230101	79.8	28.6
S01SB024	S01SB0240101	41.6	56.6
S01SB025	S01SB0250101	64.2	30.8
S01SB026	S01SB0260101	60.1	19.1
S01SB027	S01SB0270101	17.8	4.8

(1) Refer to Section 4.2.2 for a description of the sample nomenclature. Sample interval indicated may vary.
(2) Coordinates are measured from the southernmost corner of the rectangular site area with X and Y coordinates being measured at 90 degrees from each other.



SAMPLE LOCATION	X COORDINATE (ft)	Y COORDINATE (ft)
S01SB001	22.61	52.31
S01SB002	70.53	32.85
S01SB003	31.33	33.03
S01SB004	72.86	3.89
S01SB005	58.64	47.44
S01SB006	61.17	5.28
S01SB007	22.35	8.20
S01SB008	42.34	29.77
S01SB009	54.01	10.83
S01SB010	68.06	32.42
S01SB011	85.73	22.06
S01SB012	39.45	10.40
S01SB013	62.02	17.84
S01SB014	88.97	2.51
S01SB015	76.69	42.94
S01SB016	48.32	29.25
S01SB017	9.09	35.36
S01SB018	51.87	7.24
S01SB019	39.52	16.17
S01SB020	78.31	17.02
S01SB021	72.12	17.58
S01SB022	66.78	59.36
S01SB023	79.83	28.61
S01SB024	41.62	56.56
S01SB025	64.23	30.80
S01SB026	60.09	19.07
S01SB027	17.78	4.81

NOTE:
X AND Y COORDINATE DISTANCES BEGIN AT ORIGIN 0,0 IN THE SOUTHERNMOST CORNER OF SITE 1. COORDINATES WERE GENERATED BY VISUAL SAMPLING PLAN SOFTWARE.

Tetra Tech NUS, Inc.

SITE 1 - THORIUM SPILL
PROPOSED SAMPLING LOCATIONS
NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND

SCALE: 1 = 50
FILE: SITE 01 WP
REV: 0
DATE: 6/23/04
FIGURE NUMBER: FIGURE 2-1

P:\GIS\INDIANHEAD_NSWC\APR\COMMUNITYRELATIONSPLAN.APR SITE 01 WP_LAYOUT 10/24/05 AJ ARCHIVE

3.0 FIELD OPERATIONS

A range of site evaluation techniques will be used to evaluate the data collected during the SSP investigation at Site 1. The Master FSP and Facility SOPs (TtNUS, 2004) describe the general techniques used to collect environmental samples and to document field activities.

This section provides specific field operations, methods, and procedures that will be conducted for this investigation.

3.1 MOBILIZATION/DEMOBILIZATION

During soil boring and sampling, the field crew will consist of a field operations leader (FOL) and a qualified environmental technician. The FOL will be assigned the role of site safety officer for the field activities. Mobilization and demobilization operations will be performed as described in the Master FSP, Section 2.1.1. The Comprehensive Work Approval Process (CWAP) will be followed prior to commencing any work at Indian Head or Stump Neck. The CWAP will identify constraints in the work area, such as the location of eagle's nests, archeological sites, wetlands, etc., that may affect work at the site; and other requirements that must be met prior to commencing work at the site, such as locating underground utilities, etc. The result of the CWAP will be a Dig Permit. If utility clearance is required, utilities that are not shown or are incorrectly located should be marked on the permit and the marked-up permit returned to the Activity point of contact (POC) for inclusion in the Facility's geographic information system (GIS).

The FOL will coordinate with Facility personnel and with a TtNUS subcontractor for the utility clearance of soil boring locations. Utility clearance is required to obtain Dig and Work Permits.

Security badges will be required for all field crew members to gain access to the study areas and will be obtained at the pass office (Building 1779). Prior to the arrival of the field crew at the facility main gate office, the TtNUS project manager will provide to the facility Environmental Division the TtNUS personnel information necessary to ensure that the security badges are obtained without delaying the project. This information will include the name, social security number, place of birth, date of birth, and citizenship of each individual.

The field crew will be required to attend a hazard control briefing administered by the Environmental Division POC.

3.2 SITE RESTORATION

If required as a result of the soil boring and sampling activities during the field investigation, site restoration will be performed in accordance with procedures provided in Section 2.1.2 of the Master FSP.

3.3 SOIL BORINGS

At Site 1, soil borings will be advanced using a direct push drill rig. Information regarding the direct push technique is located in Master FSP Section 2.2.3 and Facility SOP SA-2.5.

3.4 DECONTAMINATION

Equipment will be surveyed prior to decontamination. If equipment survey results indicate levels less than those in USAEC Regulatory Guide 1.86 (USAEC, 1974) and reproduced in SOP HP-5 in Appendix D.2, the equipment will be decontaminated and the rinsate collected in a container dedicated to non-radioactive liquids. If equipment survey results indicate levels exceeding those in Regulatory Guide 1.86, the equipment will be decontaminated and the rinsate collected in a container dedicated to potentially radioactive liquids. Containers holding potentially radioactive liquids will be labeled as radioactive material (see SOP HP-5 in Appendix D.2), and sampled for gross alpha and beta analysis by a fixed-base off-site laboratory. The analytical results will be used to determine the disposition the rinsate waste. Equipment decontamination will be conducted in accordance with procedures provided in Section 2.11.2 of the Master FSP.

3.5 INVESTIGATION-DERIVED WASTE HANDLING

The investigation derived waste (IDW) produced during this investigation includes borehole cuttings, decontamination fluids, personal protective equipment (PPE), disposable sampling equipment, and miscellaneous trash.

Soil IDW resulting from unused borehole cuttings will be returned to the borehole.

Fluids generated during the decontamination of sampling equipment will be collected, segregated as described in Section 3.4, and containerized in Department of Transportation (DOT) approved drums dedicated to the containment of either non-radioactive or potentially radioactive (see Section 3.4) liquid IDW. Upon completion of field activities, the potentially radioactive liquid IDW will be analyzed for gross alpha/beta activity. If the analytical results indicate a concentration of 5 pCi/liter or less for radium-228 (Ra-228), then the liquid IDW will be disposed as non-radioactive material. If the analytical results indicate results greater than 5 pCi/liter, the liquid IDW will be considered a radioactive waste.

The MARSSIM provides a method for calculating the minimum count rate, above background, that is detectable by scanning with a given level of performance. This minimum detectable count rate (MDCR), is calculated as shown below:

$$MDCR = d'\sqrt{b_i} \quad \times \quad \left(60/i\right)$$

where d' is the index of sensitivity that represents the distance between the means of the background and background plus signal, and bi is the number of average background counts during the observation interval (i). Values of d' are obtained from Table 6.5 of MARSSIM. For a level of performance of 95% true positives and 20% false positives, d' is 2.48. For typical survey speeds it is assumed that the observation interval is one second, however MDCR values can be lowered by increasing the observation interval.

When detection depends on the ability of the surveyor to recognize events above the minimum count rate then a surveyor efficiency must be taken into consideration and the $MDCR_{surveyor}$ is calculated as follows:

$$MDCR_{surveyor} = \frac{MDCR}{\sqrt{p}}$$

where p is the surveyor efficiency. Typically a value for p of 0.5 is selected.

For surveys using a Ludlum Model 2224-1 scaler with a Ludlum Model 43-89 dual scintillator probe, MDCR and $MDCR_{surveyor}$ can be calculated for given background and count intervals. Table 3.5-1 lists MDCR and $MDCR_{surveyor}$ for a range of alpha background and count interval values.

Table 3.5-1

" Background (cpm)	Count Interval (sec)	MDCR (cpm)	MDCR (dpm/100 cm^2)	$MDCR_{surveyor}$ (cpm)	$MDCR_{surveyor}$ (dpm/100 cm^2)
1	1	19	593	27	838
2	1	27	838	38	1186
3	1	33	1027	47	1452
1	2	14	419	19	593
2	2	19	593	27	838
3	2	24	726	33	1027
1	5	9	265	12	375
2	5	12	375	17	530
3	5	15	459	21	649

MDCR and $MDCR_{surveyor}$ values were converted to dpm/100 cm2 values using the following conversion factors:

Instrument Efficiency - 0.15
Source Efficiency - 0.216 (From Table 5.4 of NUREG-1507, distributed source on carbon steel)
Total Efficiency – Instrument Efficiency X Source Efficiency = 0.0324

The primary items that will require direct surveys are the sampling head for the DPT unit, used PPE in the form of disposable gloves, and disposable sampling equipment. The carbon steel source efficiency was selected because it is the most conservative listing and should be sufficient to approximate these materials (smooth, even surface).

Regulatory Guide 1.86 values for average contamination levels for natural thorium are 1000 dpm/100cm^2 (**"**). Depending on background levels determined at the worksite, counting intervals will be adjusted to ensure that $MDCR_{surveyor}$ values are sufficiently below this release limit.

Miscellaneous trash, used PPE, and disposable sampling equipment will be surveyed in accordance with SOPs HP-2 and HP-5 (see Appendices D.1 and D.2 respectively) prior to release as normal trash. If any surveyed materials display readings approaching 1000 dpm/100 cm^2 (**"**), the materials will be containerized in a DOT approved drum dedicated to the storage of radioactive material. Solid IDW not determined to be radioactive will be disposed of as normal trash.

IDW determined to be radioactive waste will be disposed by the Navy through the Navy Low Level Radioactive Waste Program managed by NAVSEADET RASO in accordance with Section 7.13.1.2 of the Department of the Navy IR Manual (DON, 2001).

An inventory of all the radioactive waste will be maintained during the field activities.

3.6 SURVEYING

In accordance with Facility SOP 2.10, sample locations will be surveyed by a subcontractor licensed in the state of Maryland. Existing survey monuments within the Facility will be utilized as reference points. Horizontal locations will be surveyed to Maryland State Plan Coordinate System, North Zone, North American Datum, 1983 (NAD83). Vertical elevations will be referenced to National Geodetic Vertical Datum, 1929 (NGVD29). All surveying will be conducted by a registered land surveyor licensed to practice in the state of Maryland.

4.0 FIELD SAMPLING PROCEDURES

This section describes the procedures for sampling and sample handling.

4.1 SAMPLING PROCEDURES

This section describes the field sampling procedures for the SSP investigation for Site 1. General field sampling procedures are described in the Master FSP and Facility SOPs.

4.1.1 Radiological Soil Sampling, Field Screening, and Laboratory Analysis

Sections 2.3.6 and 2.3.7 discuss the approach to planning the quantity and location of Site 1 samples. All samples submitted to the fixed-base laboratory will be analyzed as described in Section 2.3.3.

In general, operating and field procedures for conducting radiological surveys, controlling radioactive material, and operating radiological instrumentation are discussed in SOPs HP-2, HP-5, and HP-10 contained in Appendices D.1, D.2, and D.3 attached to this document.

The reference area samples will be collected prior to collecting the Site 1 samples. At each reference area sample location, a direct push drill rig will be used to create a 3-inch-diameter borehole down to approximately 36 inches bgs (see work plan Section 3.3, Master FSP Section 2.2.3, and Facility SOP SA-2.5). As soil is extracted from the borehole, the soil from the 18- to 24-inch bgs interval, the 24- to 30-inch bgs interval, and the 30- to 36-inch bgs interval will be placed in separate piles on a plastic sheet adjacent to the borehole. The soil from the middle interval (24- to 30-inches) in each reference area borehole will be packaged for shipment to the fixed-base laboratory for a determination of the thorium-232 concentration by gamma spectral analysis. A gamma probe scintillator will be lowered into the borehole to measure gross gamma radiation at each interval (18- to 24-inchs bgs, 24- to 30-inchs bgs, and 30- to 36-inchs bgs). If a comparison of the radiation level for the middle (24- to 30-inch) interval with the radiation levels for the remaining two intervals indicates a difference greater than 1,000 counts per minute (cpm), then the soil from the interval indicating the greatest difference from the 24- to 30-inch interval will also be shipped to the fixed-base laboratory.

Site 1 samples will be collected using the same technique with the exception of the following. At each Site 1 borehole, only the soil from the boring interval exhibiting the highest radiation level will be shipped to the fixed-base laboratory for analysis. If none of the three sample intervals in a borehole exhibits an apparently high reading, one of the three samples from that borehole will be selected randomly for shipment to the fixed-base laboratory.

4.1.2 Quality Assurance/Quality Control Samples

To assure that data obtained during the investigation are accurate, various quality assurance/quality control (QA/QC) requirements have been established for fieldwork, laboratory analysis of collected samples, and validation of analytical results obtained from the laboratory. Detailed information regarding this subject is presented in the Master QAPP. Information relevant to this work is presented in the site-specific QAPP in Appendix B.

The field QC samples consist of field duplicates, field blanks, and equipment rinsate blanks. Each of these types of field QC samples will undergo the same preservation, analysis, and reporting procedures as the related environmental samples. A detailed description of each type of sample is presented in the Master QAPP in Section 3.5.3. The frequencies and types of field QA/QC samples to be collected for these investigations are as follows:

Type of Sample	Collection Frequency
Field Duplicate	1 per 10 samples per medium
Field Blank	1 per source per sampling event
Equipment Rinsate Blank	1 per 20 per sampling equipment

The QC measures that the laboratory needs to follow are outlined in detail during the procurement process.

Validation of the analytical results is discussed in detail in Section 9.0 of the Master QAPP. One hundred percent of the data for the SSP investigation activities will be validated in a limited fashion. The validation will be formulated to address only gross non-compliances resulting in the rejection of data and the elimination of false positives in accordance with the Environmental Protection Agency (EPA) National Functional Guidelines for Organic and Inorganic Data Review (EPA, 1993 and 1994) as described in Section 9.2 in the Master QAPP.

4.2 SAMPLE HANDLING

This section details sample-handling procedures including field-related considerations concerning sample containers, preservatives, and allowable holding times for requested analyses. In addition, sample identification, packaging, and shipping are addressed in this section.

4.2.1 Field Documentation

Field documentation will be conducted as described in the Master FSP, Section 3.2.1. Completed chain-of-custody forms will be faxed to the TtNUS project manager on a daily basis.

4.2.2 Sample Nomenclature

Each sample collected will be assigned a unique sample tracking number consisting of a 12-digit alphanumeric code conforming to Facility SOP CT-04. Any other pertinent information regarding sample identification will be recorded in the field logbooks and on the sample log sheets.

The alphanumeric code to be used in the sample identification system is as follows:

Character Type:

A	=	Alpha
N	=	Numeric
E	=	Either alpha or numeric

(ANN)	(AA)	(EEE)	(NN)	(NN)
[Site]	[Sample Type]	[Location]	[Depth]	[Round]

No dashes are to be used in the sample number.

Site: S01 = Samples collected from Site 1
R01 = Samples collected from the reference area for the Site 1 investigation.

Sample Type:

SB = Subsurface soil sample

This field may also be used for QA/QC designation:

FB	=	Field blank
RB	=	Rinsate blank
FD	=	Field duplicate

Sample location:

EEE = Assigned number for each sample location of a particular medium; QA/QC samples will be numbered sequentially in the order of collection beginning with 001.

The fourth rinsate blank collected during the first field effort at Site 1 would be labeled as follows:

S01RB0040001

Sample Depth:

NN = Numbered sequentially in the order the sample is collected from a single location and representing a unique sampling depth at that location starting with 01. The depth will be shown as "00" for QA/QC samples.

For Site 1 and reference area samples, the sampling intervals will be assigned the following sample depth numbers.

01 = Sampling interval 18- to 24-inches bgs
02 = Sampling interval 24- to 30-inches bgs
03 = Sampling interval 30- to 36-inches bgs

Sampling round:

NN = The sampling round can range from 01 to 99.

For this field investigation, the sampling round will be designated as 01.

Field duplicate samples will be reported blind to the laboratory. The three-digit sample location identifier field will be assigned the designation DUP. The number of the duplicate collected for that specific matrix will be entered into the depth sample field. The time designated on the sample label and chain-of-custody form will be 0000 hours. The location at which the duplicate is collected will be noted on the sample log sheet and in the field notebook.

For example, the third surface soil duplicate sample collected during the first field effort at Site 1 would be labeled as follows:

S01SSDUP0301

Additional guidance is provided in Facility SOP CT-04.

4.2.3 Sample Containers, Preservatives, and Holding Times

The EPA Contract Laboratory Program Guidance for Field Samplers (EPA, 2004) addresses the topics of containers and sample preservations. Table 4-1 provides a summary of the analyses, methodologies, bottle requirements, preservation requirements, and holding times for the samples to be submitted for fixed-base laboratory analysis.

4.2.4 Sample Packaging and Shipping

Samples will be packaged in accordance with the Master FSP, Section 3.2.4, and Facility SOP SA-6.1. Once the samples are containerized, they will be delivered to a local Federal Express office. Sample containers provided by the laboratory are pre-preserved. The FOL will be responsible for completion of the following forms:

- Sample labels
- Chain-of-custody forms
- Chain-of-custody labels

4.3 SAMPLE CUSTODY

Custody of samples must be maintained and documented at all times. Chain of custody begins with the collection of the samples in the field. The Master FSP, Section 3.3, and the Facility SOP SA-6.3 provide additional guidance for sample custody procedures.

TABLE 4-1

SUMMARY OF FIXED-BASE LABORATORY ANALYSES, METHODOLOGIES, BOTTLE REQUIREMENTS, PRESERVATION REQUIREMENTS, AND HOLDING TIMES
NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND

Analysis	Analytical Method	Quantity of Samples[1]	Quantity of Containers per Sample	Container Type	Preservation Requirements	Holding Times[2]
SOIL						
Gross gamma spectrometry analysis	Laboratory SOP	54	1	8-oz. wide-mouth glass	Cool to 4°C	6 months

SOP Standard Operating Procedures.
1 Number does not include QA/QC samples to be analyzed.
2 All holding times are determined from date of collection.

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APPENDIX A

CHRONOLOGY, SITE 1 – THORIUM SPILL

CHRONOLOGY

SITE 1 - THORIUM SPILL
NAVAL DISTRICT WASHINGTON, INDIAN HEAD
INDIAN HEAD, MARYLAND

1. 1962

   1.1. Reference: January 31, 1972 memorandum from HM1 G. D. Schile and HM1 H. M. Mercer to Officer in Charge, Subject: Removal of Thorite Ore Deposits, Naval Ordnance Station, Indian Head, Maryland.

      1.1.1. The memorandum indicates, "In conversation with Lt. Thompson, it was learned that in 1962 the thorium was first placed in the area. Approximately five drums of 30 to 55 gallons capacity were spread over the site. Early in 1967, some thorite ore had been removed from the site, placed in barrels and transferred from EOD to an unknown destination. The earth at the site was then plowed, disced and harrowed many times in order to uniformly spread the thorite ore in the soil. The depth of the turnover is assumed to be about 8 to 12 inches. These comments were verified by conversation with Senior Chief Billingsly and CWO Colbath, who were stationed there at the time. No correspondence was found to verify this."

      1.1.2. The memorandum further indicated that, "Because of the new information, we dug to depths of 12 inches, and discovered thorite ore, verified by Beta-Gamma readings."

   1.2. Reference: December 7, 1970, communication from Commanding Officer, Naval Ordnance Station, to Commandant, Naval District Washington, Washington Navy Yard, requesting advice regarding acceptable method for deactivation of the radiation site.

      1.2.1. The communication indicates that the ore was purchased in 1962, and no AEC license was issued at the time of purchase. There is no record of any assay value of the ore (as of December 7, 1970).

      1.2.2. The area in question is approximately 20 feet by 30 feet.

2. December 7, 1970

   2.1. Reference: December 7, 1970 communication from Commanding Officer, Naval Ordnance Station, to Commandant, Naval District Washington, Washington Navy Yard, requesting advice regarding acceptable method for deactivation of the radiation site.

   2.2. Area was seeded with thorite ore.

   2.3. The seeded area is 30 feet from Strauss Avenue.

   2.4. The ore was purchased in 1962, and no AEC license was issued at the time of purchase. There is no record of any assay value of the ore (as of December 7, 1970).

3. April 22, 1971

   3.1. Reference: April 23, 1971 minutes of a meeting, Subject: Disposal of Rad Material at Indian Head, Maryland.

      3.1.1. The meeting was held on April 22, 1971 to develop a work plan for removing contaminated material from the site.

      3.1.2. Generally, the plan called for a sequence of radiological surveying and soil excavation. Contaminated soil was to be placed in drums for disposal through NCS Norfolk.

4. December 15, 1971

4.1. Reference: January 31, 1972 memorandum from HM1 G. D. Schile and HM1 H. M. Mercer to Officer in Charge, Subject: Removal of Thorite Ore Deposits, Naval Ordnance Station, Indian Head, Maryland.

4.1.1. The memorandum covers the results of a December 15, 1971 visit to the site by Radiological Affairs Support Office (RASO) personnel to conduct a survey of the area.

5. December 22, 1971

5.1. Reference: December 22, 1971 memorandum from the Engineering Division, United States Army Engineer Power Group, Fort Belvoir, Virginia, to OIC United States Naval Nuclear Power Unit, Fort Belvoir, VA, Subject: "Radiochemical Assay of Thorium Ore."

5.1.1. The memorandum indicated, "A sample of ore, delivered by NNPU personnel to Engineering Division, was assayed for thorium content with the following result: Thorium content 2.5 w/o thorium with a specific activity of 100 disintegrations per second (dps) per gram."

6. February 7, 1972

6.1. Reference: February 7, 1972 memorandum from Officer in Charge (RASO) to Commanding Officer, Naval Ordnance Station, Indian Head, Maryland 20640 (Code PW2), Subject: Removal of Thorite Ore Deposits from Radiation Training Area.

6.1.1. The memorandum delays the remediation of the site pending a more thorough radiological survey of the affected area.

7. March 28, 1972

7.1. Reference: April 5, 1972 memorandum from HM1 G. D. Schile and HM1 J. L. Baker to "10", Subject: Removal of Thorite Ore Deposits from Naval Ordnance Station, Indian Head, Maryland.

7.1.1. A radiological survey of the site was conducted on March 28, 1972. The survey determined that the affected site area covered a total of approximately 600 square feet in seven locations where thorite ore had been deposited. Depths ranged from 12 inches to 18 inches.

8. July 7 through 19, 1972

8.1. Reference: September 25, 1972 memorandum from Officer in Charge (RASO), to Commending Officer, Naval Ordnance Station Indian Head, Maryland

8.1.1. The memorandum indicated that, "Initial operations for removal of the subject radioactive thorite ore were conducted during the period 7-19 July 1972 under the supervision of this Unit's Radiological Affairs support Office (RASO) personnel. During the removal operations, fifty 55-gallon drums of low specific activity thorite ore waste were accumulated at the NOS, Indian Head Radiation Training Area."

9. October 18, 1972

9.1. Reference: Shipping document, DD Form 1149, dated October 18, 1972.

9.2. Reference: Government Bill of Lading No. 2160505, dated October 18, 1972. Shipper: Tri State Motor Transit Company. Shipper: Supply Officer, Naval Ordnance Station, Indian Head, Maryland 20640. Consignee: Nuclear Engineering Company, Inc., P.O. Box 147, Morehead, KY.

9.3. Reference: Material Requisition No. 11-0196-73, dated November 9, 1972. Contractor: Nuclear Engineering Company, Inc. Signed by: Wayne J. Bode.

9.4. Fifty drums of thorite ore deposits (Low Specific Activity ore, 40,000 pounds) were shipped from Naval Ordnance Station, Indian Head, Maryland, to Nuclear Engineering Company, Inc., P.O. Box 146, Morehead, Kentucky on October 18, 1972.

10. November 3, 1972

10.1. Reference: December 29, 1972 memorandum from Officer in Charge (RASO) to Commanding Officer, Naval School, Explosive Ordnance Disposal, Naval Ordnance Station, Indian Head, Maryland 20640. Subject: Thorite Ore Removal.

10.1.1. RASO was requested to perform a final radiation survey of the Radiation Training Area following the removal of fifty (50) drums of soil containing thorite ore deposits. The survey was performed on November 3, 1972. The survey found additional contaminated soil totaling one and one-half drums. A follow-up survey on November 9, 1972, identified one additional area having thorite ore contamination in excess of acceptable limits. The additional contaminated soil occupied a volume of approximately 1.5 cubic feet. No disposal record could be located for the 1.5 cubic feet of contaminated soil.

11. February 12, 1976

11.1. Reference: March 1, 1976 memorandum from Officer in Charge (RASO) to Commanding Officer, Naval School, Explosive Ordnance Disposal, Naval Ordnance Station, Indian Head, Maryland 20640. Subject: Radiation Training Area; release for unrestricted use.

11.1.1. The memorandum describes a final radiation survey of the site area conducted on February 12, 1976. The memorandum indicates that, "...the thorite ore and some underlying soil was removed and shipped to a licensed burial ground for disposal. The area was later overfilled with 18 to 24 inches of clean soil to bring it up to the surrounding land contour. A survey of the subject area was conducted on 12 February 1976 by RASO personnel utilizing an AN/PDR-27® and an Eberline E-140N meter with a thin-window DT-304 G. M. detector. Several spot checks for alpha activity were conducted using and AN/PDR-56B. In no case were any readings above backgrounds obtained."

11.1.2. The memorandum concluded with, "Based upon the above survey, the subject area has been returned to background and may be released for unrestricted use."

12. 1983

12.1. Reference: March 26, 2002 memorandum from 044HM and O44SJ to File via 044. Subject: Installation Restoration Site 1 – Thorium Spill

12.2. As described in a March 25, 2002 conversation with a former station employee, two buried drums containing thorium material, dirt, and gravel were discovered during the construction of the Air Ordnance Building, Building 1662 (construction completed in 1983). The drums were removed and sent to the Property Disposal Office for disposal.

13. February 27, 1985

13.1. Four 32-gallon drums (2,180 pounds, 38 cubic feet) containing "thorium, heavy metal sludge, waste contaminated w/ dirt" were shipped to the Naval Supply Center, Norfolk, Virginia for disposal. An additional 925 pounds of "thorium, heavy metal waste contaminated w/dirt and water" were shipped from the facility may have been part of the same shipment.

14. June 16, 1998

14.1. Reference: June 16, 1998 communication from Officer In Charge, Naval Sea Systems Command Detachment, Radiological Affairs Support Office (NAVSEADET RASO) to Commending Officer, Naval School, Explosive Ordnance Disposal. Subject: Free Release Survey of Building 900.

14.1.1. The memorandum stated, "Based on the results of the subject survey NAVSEADET RASO concludes that no further radiological investigations or surveys are warranted."

15. October 18, 2001

15.1. Reference: November 13, 2001 "Report Regarding the Soil Sampling Performed at the Proposed Site of the Joint Interoperability. Building #900 Expansion Project Located at the Naval Surface Warfare Center In Indian Head, Maryland" Ten samples of subsurface soil (0.5 to 2 feet deep) were collected on October 18, 2001, along the southeast side of Building 900 (the area of the then proposed addition to the building). The report concluded that, "Based on the laboratory results, no further actions regarding Thorium are required at this time. Soil remediation will not be required as part of Building #900 Joint Interoperability project."

16. November 1, 2004

16.1. Reference: November 1, 2004 email from William Morris of RASO to Jeffrey Morris of NAVFACWASH. Subject: Site 1 – Thorium Spill at Indian Head.

16.2. The email described the location of the training area as follows:

The training area abuts Strauss Ave and extends 65 feet from Strauss Ave east southeast. The near boundary of the training area is 100 to 125 feet from Building 900. The far boundary of the training area is perhaps 200 to 250 feet from the edge of Building 900. I judge that Building 1662 and its parking area sit over most of the old training area. The only accessible parts of the old training area, then, are in front of Building 1662.

17. November 18, 2004

17.1. Reference: November 18, 2004 email from William Morris of RAS) to Jeffrey Morris of NAVFACWASH. Subject: Site 1 – Thorium Spill at Indian Head.

17.2. The email suggests an investigation approach as follows:

Use random sampling points, per MARSSIM Section 5.5.2.2, because all known barrels were accounted for and the contamination was rather spread around. Number of survey points should be less than 30. Boreholes to 2 to 3 feet deep. Use gamma probe scintillator, take readings, and then take soil from the highest reading part of the hole or below 2 feet depth and send it to a lab for gamma spectral analysis.

APPENDIX B

PROJECT-SPECIFIC HEALTH AND SAFETY PLAN

TO BE PROVIDED

APPENDIX C

PROJECT-SPECIFIC QUALITY ASSURANCE PROJECT PLAN

Quality Assurance Project Plan
for
Site Screening Process Investigation
at
Site 1 - Thorium Spill

Naval Support Facility,
Indian Head
Indian Head, Maryland

Naval Facilities Engineering Command
Washington

Contract Number N62472-03-D-0057

Contract Task Order 005

October 2005

090505/P

QUALITY ASSURANCE PROJECT PLAN
FOR
SITE SCREENING PROCESS INVESTIGATION

AT
SITE 1 – THORIUM SPILL

NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Engineering Field Activity Chesapeake
1314 Harwood Street, SE
Washington Navy Yard, D.C. 20374-5018

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CONTRACT NUMBER N62472-03-D-0057
CONTRACT TASK ORDER 005

OCTOBER 2005

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1-1 Analytical Detection Limits

LIST OF ACRONYMS

CLEAN	Comprehensive Long-Term Environmental Action Navy
CTO	Contract Task Order
DOE	Department of Energy
DQO	Data Quality Objective
EML	Environmental Measurements Laboratory
EPA	United States Environmental Protection Agency
FOL	Field Operations Leader
LCS	laboratory control sample
MS	matrix spike
MSD	matrix spike duplicate
NSF-IH	Naval Support Facility, Indian Head
PARCC	precision, accuracy, representativeness, comparability, and completeness
pCi/g	pico Curie per gram
pCi/l	pico Curie per liter
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
%R	percent recovery
RPD	relative percent difference
RPM	Remedial Project Manager
SOP	Standard Operating Procedure
SSP	Site Screening Process
TtNUS	Tetra Tech NUS, Inc.

1.0 PROJECT DESCRIPTION

1.1 INTRODUCTION

This project-specific Quality Assurance Project Plan (QAPP) for a Site Screening Process (SSP) investigation at the Naval Support Facility, Indian Head (NSF-IH), Indian Head, Maryland, was prepared by Tetra Tech NUS, Inc. (TtNUS) in response to Contract Task Order (CTO) 005 under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62472-03-D-0057. NSF-IH is a Naval Support Activity, South Potomac Facility within the Naval District Washington Region.

This document is intended to be used in conjunction with the accompanying Work Plan for Site Screening Process Investigations (SSP Work Plan) and the Master QAPP (TtNUS, 2004) and is limited to the sections and information specific to Site 1 – Thorium Spill.

1.1.1 Overall Project Objectives

The Master QAPP provides general quality assurance (QA) guidelines common to multiple site investigations to be conducted at the facility. It outlines QA issues for what are expected to be the most common types of field efforts and analyses during environmental investigations. Specific project objectives are identified in the project-specific work plans. Additional QA issues are addressed in addenda to the Master QAPP as necessary and are to be provided as appendices to the project-specific work plans.

Important companion documents to the Master QAPP and the project-specific work plan include the Master Plans for Installation Restoration Program Environmental Investigations (TtNUS, 2004), which includes Standard Operating Procedures (SOPs).

1.1.2 QAPP Preparation Guidelines

The project-specific QAPP and accompanying SSP Work Plan have been prepared to be used in conjunction with the Master QAPP to fulfill the general requirements outlined in United States Environmental Protection Agency (EPA) Requirements for Quality Assurance Project Plans (EPA, 2001) and Guidance for Quality Assurance Project Plans (EPA, 2002).

1.2 FACILITY DESCRIPTION

A facility description, including the location and general description, history, land use, water sources and usage, population, physiography and topography, geology, soils, hydrogeology, hydrology, ecology, and meteorology, is provided in the Master Work Plan.

1.3 PROJECT TARGET PARAMETERS AND INTENDED DATA USES

This section discusses typical laboratory analytical information to be generated during the course of the SSP investigation at Site 1. The analytical parameters of interest are Radium-228 and Gross Alpha/ Beta for liquid samples and Thorium-232 for soil samples. For Radium-228 and Gross Alpha/Beta in liquid samples, a threshold of 5 pico Curie per liter (pCi/l) determines if the liquid is to be handled as a radioactive liquid or a non-radioactive liquid. For Thorium-232 in soil samples, a threshold of 1 pico Curie per gram (pCi/g) difference between reference area soil and site area soil will determine if additional investigation will be needed at Site 1.

1.4 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are discussed in the SSP Work Plan.

1.5 SAMPLE NETWORK DESIGN AND RATIONALE

Sample network design and rationale are provided in the SSP Work Plan.

1.6 PROJECT SCHEDULE

The project schedule has not been determined to date and will be provided as an addendum to the SSP Work Plan.

TABLE 1-1

ANALYTICAL DETECTION LIMITS
SITE 1 – THORIUM SPILL
NAVAL SUPPORT FACILITY, INDIAN HEAD
INDIAN HEAD, MARYLAND

Media/Analyte	Analytical Method (1)	Threshold	Laboratory Detection Limit
Aqueous/Gross Alpha/Beta	SW-846 9310	5 pCi/L	3 pCi/L / 4 pCi/L
Aqueous/Radium-228	SW-846 9320	5 pCi/L	1 pCi/L
Soil/Thorium-232	DOE A-01-R	1 pCi/G	0.2 pCi/G

pCi/l = pico Curie per liter
pCi/g = pico Curie per gram

1- SW-846 USEPA, 1986. Test Methods for Evaluating Solid Wastes, Volumes 1A through 1C: Laboratory Manuals Physical/Chemical Methods. SW-846, third edition with updates up to and including Update III. Office of Solid Waste and Emergency Response, Washington, DC. November.

DOE A-01-R DOE, 1997, Environmental Measurements Laboratory (EML) Procedures Manual HASL 28th edition, February.

2.0 PROJECT ORGANIZATION

The project organization for the investigation activities is project specific and is provided in the project-specific Work Plan in Section 1.3. Personnel expected to be involved with the investigation activities at a programmatic level for the foreseeable future include the Navy Remedial Project Manager (RPM), the Facility Point of Contact, and the TtNUS Program Manager and Quality Assurance Manager, as follows:

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3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective for this project is to develop and implement procedures for field sampling, chain of custody, laboratory analysis, and reporting that will provide results that will be evaluated in the SSP Report to determine what, if any, future actions may be needed for Site 1.

The precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters are qualitative and/or quantitative statements regarding the quality characteristics of the data used to support project objectives and ultimately, environmental decisions. These parameters are discussed in the remainder of this section. Specific routine procedures used to assess the quantitative parameters (precision, accuracy, and completeness) are provided in Section 12.0 of the Master QAPP.

3.1 PRECISION

3.1.1 Definition

Precision is a measure of the amount of variability and bias inherent in a data set. Precision describes the reproducibility of measurements of the same parameter for samples under similar conditions. The equation for determining precision is provided in Section 12.2 of the Master QAPP.

3.1.2 Field Precision Objectives

Field duplicate precision monitors the consistency with which environmental samples were obtained and analyzed. Field duplicate results for solid matrix samples are considered to be precise if the relative percent difference (RPD) is less than or equal to 50 percent. Field precision is assessed through the collection and measurement of field duplicates at a rate of one duplicate per 10 environmental samples or one duplicate per sampling day per matrix, whichever is greater.

3.1.3 Laboratory Precision Objectives

Laboratory precision QC samples are analyzed at a frequency of 5 percent (i.e., one QC sample per 20 environmental samples). Laboratory precision is measured via comparison of calculated RPD values and Precision Control Limits specified in the analytical method or by the laboratory's QA/QC Program.

The following analyses will be completed for environmental samples collected during the SSP investigation for Site 1:

- Analysis of soil samples for Thorium-232
- Analysis of aqueous samples for Radium-228 and Gross alpha/beta.

Precision for these analyses will be measured via the RPDs for matrix spike (MS)/matrix spike duplicate (MSD) samples. RPDs should be statistically derived at the analytical laboratory. These limits will be provided in each analytical data package.

3.2 ACCURACY

3.2.1 Definition

Accuracy is the degree of agreement between two results that include an observed value and an accepted reference value. The equation for determining accuracy is provided in Section 12.1 of the Master QAPP.

3.2.2 Field Accuracy Objectives

Accuracy in the field is assessed through the use of field and equipment blanks and is ensured through adherence to all sample handling, preservation, and holding time requirements.

3.2.3 Laboratory Accuracy Objectives

Accuracy in the laboratory is measured through the comparison of a spiked sample result against a known or calculated value expressed as a percent recovery (%R). Percent recoveries are derived from the analysis of known amounts of compounds spiked into deionized water [i.e., laboratory control sample (LCS) analysis], or into actual samples (i.e., surrogate or MS analysis). These analyses measure the accuracy of laboratory operations as affected by matrix. LCS and/or MS analyses are performed with a frequency of 1 per 20 associated samples of like matrix. Surrogate spike analysis is performed for all organic analyses. Laboratory accuracy is assessed via comparison of calculated %R values with Accuracy Control Limits specified in the analytical method or by the contracted laboratory QA/QC Program.

Accuracy for these radiological analyses will be measured via the %R values for MS/MSDs and LCSs. QC limits for matrix and surrogate spike recoveries are statistically derived by the analytical laboratory and will be provided in each analytical data package.

3.3 COMPLETENESS

3.3.1 Definition

Completeness is a measure of the amount of usable, valid, analytical data obtained compared to the amount expected to be obtained. Completeness is typically expressed as a percentage.

The ideal objective for completeness is 100 percent (i.e., every sample planned to be collected is collected, every sample submitted for analysis yields valid data). However, samples can be rendered unusable during shipping or preparation (e.g., bottles broken or extracts accidentally destroyed); errors can be introduced during analysis (e.g., loss of instrument sensitivity, introduction of ambient laboratory contamination), or strong matrix effects can become apparent (e.g., extremely low MS recovery). These instances result in data that do not meet QC criteria. Based on these considerations, 95 percent is considered an acceptable target for data completeness. If critical data points are lost, resampling and/or reanalysis may be required.

3.3.2 Field Completeness Objectives

Field completeness is a measure of the amount of valid field measurements obtained from all of the field measurements taken in the project. The equation for completeness is presented in Section 12.3 of the Master QAPP. Field data completeness for the SSP investigation activities for Site 1 is expected to be 95 percent.

3.3.3 Laboratory Completeness Objectives

Laboratory completeness is a measure of the amount of valid laboratory measurements obtained from all of the laboratory measurements made in support of a given project. The equation for completeness is presented in Section 12.3 of the Master QAPP. Laboratory completeness for the SSP investigation activities for Site 1 is expected to be at least 95 percent.

One hundred percent of the radiological will be validated in accordance with method-specific requirements. Data rejected as a result of the validation process will be treated as incomplete data.

3.4 REPRESENTATIVENESS

3.4.1 Definition

Representativeness is an expression of the degree to which the data accurately and precisely depict the actual characteristics of a population or environmental condition existing at an individual sampling point.

Use of standardized sampling, handling, analytical, and reporting procedures ensures that the final data accurately represent actual site conditions.

3.4.2 Measures to Ensure Representativeness of Field Data

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the SSP Work Plan is followed and that the sampling techniques detailed are used.

3.4.3 Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory is ensured by using the proper analytical procedures, meeting sample holding times, and analyzing field duplicate samples.

3.5 COMPARABILITY

3.5.1 Definition

Comparability is defined as the confidence with which one data set can be compared to another (e.g., between sampling points, between sampling events). Comparability is achieved by using standardized sampling and analysis methods and data reporting formats including use of consistent units of measure and reporting of solid matrix sample results on a dry-weight basis. Additionally, consideration is given to seasonal conditions and other environmental variations that could influence data results.

3.5.2 Measures to Ensure Comparability of Field Data

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the SSP Work Plan is followed and that proper sampling techniques are used.

3.5.3 Measures to Ensure Comparability of Laboratory Data

Analytical data will be comparable when similar sampling and analytical methods are used and documented. Results will be reported in units that ensure comparability with current State and federal standards and guidelines. Detection/reporting limits are discussed in Section 1.0 of this project-specific QAPP.

3.6 LEVEL OF QUALITY CONTROL EFFORT

Equipment blank, field blank, method blank, duplicate, and MS samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs.

External QC samples (i.e., field QC samples) consist of field duplicates, field blanks, and equipment (rinsate) blanks. Each of these types of field QC samples undergoes the same preservation, analysis, and reporting procedures as the related environmental samples. Each type of field QC is discussed below.

Field duplicates are either two samples collected independently at a sampling location or a single sample homogenized and split into two portions. Field duplicates are collected and analyzed for chemical constituents to measure the precision of the sampling and analysis methods employed. The general level of the QC effort will be one field duplicate for every 10 or fewer investigative samples or one duplicate per matrix per sampling day, whichever is greater.

Field blanks (ambient condition blanks) consisting of distilled water will be submitted to the laboratories to provide the means to assess the quality of the data resulting from the field sampling program. Field blank samples are analyzed to check for background contamination at the facility (e.g., vapors or exhaust fumes) that may cause sample contamination. Field blanks will be collected based on conditions at the time of sampling at the discretion of the Field Operations Leader (FOL), with a minimum of one field blank collected per site.

Equipment (rinsate) blanks are obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through sample collection equipment after decontamination and prior to use. One rinsate blank will be collected per each type of sampling equipment used (e.g., hand tools) per day that sampling is conducted at a minimum frequency of 10 percent. A sampling event is matrix specific; therefore, an equipment blank must be collected for each matrix sampled. If pre-cleaned, dedicated, or disposable sampling equipment is used, one rinsate blank must be collected as a "batch blank." Rinsate blanks are analyzed for the same chemical constituents as the associated environmental samples.

Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures. MS samples provide information about the effect of the sample matrix on the digestion and measurement methodology. All MSs will be performed in duplicate when enough sample volume is available. One MS/MSD will be analyzed for every 20 or fewer investigative samples. MS/MSD samples are investigative samples. Soil and sediment MS/MSD samples require no extra volume.

4.0 SAMPLING PROCEDURES

Field sampling procedures for NSF-IH environmental investigation activities are discussed in detail in the facility SOPs. Specific sampling information contained in the facility SOPs and provided in the project-specific Work Plan is as follows:

- Field sampling by matrix
- Field QC sample collection/preparation procedures
- Sample containers, preservatives, and volume requirements
- Decontamination procedures
- Sample packaging and shipping procedures
- Mobilization/demobilization
- Soil sampling procedures
- Surveying
- Waste handling
- QC sample procedures
- Field measurements/screening
- Preventive maintenance procedures/schedule
- Sample disposal

5.0 CUSTODY PROCEDURES

Refer to Section 5.0 of the Master QAPP (TtNUS, 2004).

6.0 CALIBRATION PROCEDURES AND FREQUENCIES

Calibrations for the laboratory analyses detailed in the accompanying SSP Work Plan will be performed in accordance with laboratory SOPs.

7.0 ANALYTICAL AND MEASUREMENT PROCEDURES

Radium-228 will be analyzed via SW-846 9320 at a detection limit of 1 pCi/L, Thorium-232 will be analyzed via Department of Energy (DOE) A-01-R at a detection limit of 0.2 pCi/L. Gross Alpha/Beta will be analyzed via SW-846 9310 with detection limits of 3 pCi/L and 4 pCi/L, respectively

In addition to the field QC samples (duplicates, rinsate blanks, etc.) discussed in Section 3.0 of the Master QAPP, laboratory QC samples including LCS samples, MS/MSD samples, and method blanks, will be analyzed as required by the analytical methods to be used. Laboratory QC samples are discussed in additional detail in Section 8.0 of the Master QAPP.

8.0 INTERNAL QUALITY CONTROL CHECKS

Refer to Section 8.0 of the Master QAPP (TtNUS, 2004).

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

Refer to Section 9.0 of the Master QAPP (TtNUS, 2004).

10.0 PERFORMANCE AND SYSTEM AUDITS

Refer to Section 10.0 of the Master QAPP (TtNUS, 2004).

11.0 PREVENTIVE MAINTENANCE PROCEDURES

Refer to Section 11.0 of the Master QAPP (TtNUS, 2004).

12.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

Refer to Section 12.0 of the Master QAPP (TtNUS, 2004).

13.0 CORRECTIVE ACTION

Refer to Section 13.0 of the Master QAPP (TtNUS, 2004).

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Refer to Section 14.0 of the Master QAPP (TtNUS, 2004).

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APPENDIX D

STANDARD OPERATING PROCEDURES

APPENDIX D.1

HEALTH PHYSICS SOP 2 (HP-2)

RADIOLOGICAL SURVEYS

RADIOLOGICAL SURVEYS

1.0 PURPOSE

To provide techniques for performing and documenting radiological surveys.

2.0 SCOPE

This procedure applies to all radiological surveys of areas, tools, equipment and materials. This procedure applies to all Radiation Control personnel performing and documenting radiological surveys.

3.0 DEFINITIONS

100 cm^2 smear survey - The use of a collection medium to determine smearable contamination levels. Normally this survey will cover a 100 cm^2 surface area.
Activity – The rate of disintegration or decay of radioactive material. The typical units of activity for the purposes of this procedure are disintegrations per minute (dpm) for smearable contamination and dpm or millrad per hour (mrad/hr) for fixed contamination.
Contamination – Deposition of radioactive material in any place it is not desired. Contamination may be due to the presence of alpha and/or beta/gamma contamination.
CW – Closed Window, portable ion chamber survey instrument measurement with shield closed.
Disintegration per Minute (dpm) – A radiological measurement determined by dividing instrument counts per minute (cpm) by the instrument efficiency.
Fixed Contamination – Radioactive contamination that is not readily removed from a surface by applying light to moderate pressure and wiping with a paper or cloth disk smear.
Large Area Smear Survey – The use of a collection medium to perform a smearable contamination survey over a surface area greater than 100 cm^2.
Lower Limit of Detection (LLD) - For the purpose of this procedure, LLD is the smallest sample activity that will produce a net count rate that will be detected as being positive 95 percent of the time.

$$LLD_{dpm} = \frac{\left(\frac{2.71}{t_s}\right) + 3.29\sqrt{\left(\frac{B}{t_s} + \frac{B}{t_b}\right)}}{E_c}$$

where:
t_s = Sample count time (min)
t_b = Background count time (min)
B = Total background counts
E_c = Counter efficiency

mrem/hr – Unit of dose equivalent rate. Dose equivalent rate in mrem/hr is numerically equal to the absorbed dose in mrad multiplied by a quality factor and any other necessary modifying factor.
mrad/hr – Open portable ion chamber survey instrument measurement used to identify beta-gamma contamination levels for sources greater than the capabilities of a GM survey instrument.
ND – Notation used to document that no detectable radiation, fixed contamination, or smearable contamination using large area smears was found using the most sensitive instrument scale.
OW – Open Window, portable ion chamber measurement with shield retracted or open.
Skin Dose – The dose to the skin/extremity that is a combination of the beta-corrected dose rate and gamma dose rate.
Smearable Contamination - Radioactive particulate matter that has been deposited on surfaces and which can be removed by wiping with light to moderate pressure with a paper or cloth disc media.

RADIOLOGICAL SURVEYS

4.0 PRECAUTIONS and LIMITATIONS

4.1 Instruments used to perform radiological surveys shall be operationally checked in accordance with procedure HP-10, *Radiological Instrumentation Routine Checks and Count Room Operations.*

4.2 Contact dose rates shall be performed at a distance of 1 inch or less from the source of radiation.

4.3 Whole body dose rates shall be taken at a distance of 30 centimeters for posting purposes.

4.4 Routine radiation and contamination surveys may be used to write RWPs, if the survey has been performed within 24 hours of RWP initiation or there is reasonable assurance that conditions have not changed.

4.5 When large area smears are used, results should be reported in dpm/probe area or mrad/hr above background. Do not attempt to quantify the survey area.

4.6 Disk smear surveys should be performed over approximately a 100 cm^2 area. For objects with a total surface area of less than 100 cm^2, survey results should be reported as dpm/smear.

4.7 HP personnel performing surveys should be aware of known or expected radiological conditions in the areas to be surveyed.

5.0 PROCEDURE

5.1 Radiation Surveys

5.1.1 General area surveys are normally performed to measure only gamma radiation levels. These will typically be performed using closed window (CW) portable ion chamber survey instruments. However, when suspected, general area beta levels can be measured using an open window (OW) portable ion chamber, correcting for gamma dose rates and applying correction factors. Beta survey results should be identified as such and reported in mrad/hr.

5.1.2 Environmental walkover surveys will typically be performed using a microR meter (Ludlum Model 19 or equivalent)

5.1.3 For general area surveys, hold the instrument detector at waist level, and obtain the highest reading observed while traversing the reference grid lines. Investigate high readings to identify radiation sources. Once discrete radiation sources have been identified, perform contact dose rates to quantify radiation levels. The same process is used when determining beta dose rates.

5.1.4 General area surveys for RWPs should include accessible areas and positions or levels where personnel will be performing work.

5.1.5 Special job-specific surveys may be performed during field operations. These activities are described in Attachment I.

5.1.6 Survey data should be documented in accordance with Section 5.7 of this procedure.

5.2 Smearable Contamination Surveys

5.2.1 Wipe a disc smear over an area of approximately 100 cm^2. 100 cm^2 is approximated by a four-inch square or an 18-inch "S".

5.2.2 Avoid cross-contaminating the samples.

5.2.3 Count the smears on the appropriate counting equipment. The following guidelines should be used when counting smears:

a. Portable survey instruments should be used to count smears over 1000 dpm/100 cm^2 β–γ and/or 200 dpm/100 cm^2 α and for smears taken in posted Contamination (CA), High Contamination (HCA) and Airborne Radioactivity Areas (ARA).

b. All smears taken for the purpose of determining if an item or area is below the posting or release requirements must be counted on an instrument capable of detecting below those limits.

5.2.4 Report results in units of dpm/100 cm^2. If reporting values less than the Lower Limit of Detection (LLD) of the counting instrument, state the LLD value for the counting situation.

RADIOLOGICAL SURVEYS

5.3 Large Area Smear Surveys

5.3.1 Large area smears are used to obtain a gross indication of contamination levels in large areas or on pieces of equipment. Large area smears may also be used to check normally clean areas or equipment for the presence of contamination.

5.3.2 Using masslin cloth (or equivalent), wipe the suspect surface. If there is a significant dust or dirt layer present on the suspect surface, smaller areas should be smeared to minimize the accumulation of large dust/dirt deposits on the smear.

5.3.3 Count the wipe using appropriate portable survey instruments.

5.3.4 Use the highest reading obtained for reporting the results. Results should be reported in units of dpm/probe area.

5.3.5 When using large area smears to check a clean area for contamination, any indication of contamination should be investigated using 100 cm^2 smear surveys.

5.3.6 Large area smears should not be used to document unconditional release surveys.

5.4 Fixed Contamination Surveys

5.4.1 Fixed contamination surveys should be performed by positioning the applicable portable survey instrument detector (α or β–γ) approximately ¼ inch above the surface to be surveyed, moving the detector slowly (1 to 2 inches per second), and observing closely for increases on the meter display or in the audible signal. If the beta-gamma background is greater than 300 cpm, shielding of the detector or shielding of the area if practical may be required to allow detection of the activity at the prescribed criteria.

5.4.2 If activity is detected, hold the probe stationary until the meter stabilizes to obtain a reading.

5.4.3 Record fixed contamination levels in units of dpm/probe area. Specify on survey records the location and approximate size of the fixed contamination area.

5.5 RAM Shipping and Receipt Surveys

5.5.1 All RAM Shipments and Receipts will be performed in accordance with applicable Department of Transportation regulations, as specified in 49 CFR.

5.5.2 Prior to shipment, all packages shall be surveyed by a qualified HP, and documented on a Radiological Survey Form.

5.5.3 The following types of radiation surveys may be performed on outgoing RAM shipments:

5.5.3.1 For Limited Quantity and Excepted Quantity shipments, dose rates on the external surfaces of the package(s) must be less than 0.5 mrem/hr.

5.5.3.2 For Exclusive Use shipments, dose rates on the external surfaces of the package (s) should typically be less than 200 mrem/hr.

5.5.3.3 If dose rates on the external surfaces of package (s) prepared for Exclusive Use shipments exceed 200 mrem/hr, notify the Corporate Health Physicist so that proper precautions are taken to insure compliance with 49 CFR requirements.

5.5.3.4 Contact and 30 cm dose rates shall be taken on all packages prepared for shipment.

5.5.3.5 Contact dose rates shall be taken on the outer surface (or in the case of a flat-bed style vehicle, on the vertical planes projected by the outer edges of the vehicle) of the transport vehicle, including the top and underside of the vehicle, and verified to be less than 200 mrem/hr.

5.5.3.6 General area dose rates shall be taken at points 2 meters (6.6 feet) from the outer lateral surfaces of the vehicle (or in the case of a flat-bed style vehicle, on the vertical planes projected by the outer edges of the vehicle) excluding the top and underside of the vehicle, and verified to be less than 10 mrem/hr.

5.5.3.7 General area dose rates shall be taken in any normally occupied space (cab and sleeper compartment) and verified to be less than 2 mrem/hr.

RADIOLOGICAL SURVEYS

5.5.4 The following types of contamination surveys may be performed on outgoing RAM shipments:

5.5.4.1 Contamination surveys are performed by wiping a 300 square centimeter area with a clean, dry smear. The results are reported as net dpm/100 cm^2.

5.5.4.2 All packages prepared for shipment must have transferable contamination levels less than 20 dpm/100 cm^2 α and less than 200 dpm/100 cm^2 β-γ.

5.5.4.3 Packages with transferable contamination above section 5.3.4.2 limits, but less than 220 dpm/100 cm^2 α and less than 2200 dpm/100 cm^2 β-γ may be shipped if approved by the Corporate Health Physicist and the HSO (or their designees).

5.5.4.4 Outer surfaces and normally occupied areas (cab and sleeper compartment) must have transferable contamination levels less than 20 dpm/100 cm^2 α and less than 200 dpm/100 cm^2 β-γ.

5.5.5 The following actions shall be performed on incoming RAM shipments:

5.5.5.1 Upon arrival of a shipment of RAM, HSO should be notified.

5.5.5.2 Receipt surveys of RAM shipments should be performed as soon as practicable after receipt of the package(s), but not later than 3 hours after the package is received during normal working hours, or not later than 3 hours from the beginning of the next normal working day if it is received after working hours. These surveys consist of contact and general area dose rates and transferable contamination surveys.

5.5.5.3 Receipt survey limits are the same as those detailed in sections 5.3.3 and 5.3.4.

5.5.5.4 Prior to releasing a transport vehicle after the receipt and unloading of RAM, transferable contamination levels on all vehicle surfaces must be verified to be less than 20 dpm/100 cm^2 α and less than 200 dpm/100 cm^2 β-γ and contact dose rates must be less than 0.5 mrem/hr.

5.5.6 The Corporate Health Physicist shall be notified if survey results indicate dose rates or contamination levels in excess of those described in sections 5.3.3, 5.3.4 and 5.3.5.4 for outgoing and incoming RAM shipments (as applicable).

5.5.7 RAM should be handled in accordance with procedure HP-5, *Control of Radioactive Material.*

5.6 SpecialSurveys

Special radiological surveys may be required to support field operations. Details of project specific radiological survey techniques are provided in Attachment I.

5.7 Survey Documentation

5.7.1 The results of required radiological surveys (i.e., RWP, unconditional release, routine monitoring and posting, and personnel contamination incidents that could result in assigned dose) shall be documented and maintained. Survey records should contain sufficient detail to allow for a reconstruction of events if the originator is no longer available. Survey documentation should support a chronological, historical record that clearly establishes the area conditions.

5.7.2 The following information should be included on the survey form:

a. Date, time and purpose of the survey.
b. Survey Number
c. Location of the survey
d. Printed name and signature or initials of the surveyor.
e. Instrument information (i.e., model numbers, serial numbers).
f. Pertinent information needed to interpret survey results (i.e., instrument efficiencies, minimum detectable activities, area background radiation levels, instrument background)
g. Results of the measurements of general area and contact dose rates.

RADIOLOGICAL SURVEYS

h. Smearable and fixed contamination levels, using appropriate units (e.g., dpm/100cm^2, mrad/hr/100 cm^2, dpm/probe area, etc.)

i. Where necessary to distinguish, list the types of contamination and/or radiation detected (e.g., α or β–γ).

j. As necessary, narrative comments should be included to discuss specifics such as job coverage chronology, area or equipment disposition, posting/deposting actions, etc.

k. Any supporting paperwork (e.g., counting equipment printouts) should be attached to the survey record.

l. Multiple page surveys should be numbered in the # of # format to insure all records are maintained.

5.7.3 The following conventions should be used to denote survey data:

a. General area dose rates should be written in number format.

b. Contact dose rates should be underlined.

c. Smear locations should be numbered, with the number circled.

d. Large area smears should be annotated with a squiggly line to denote the area smeared.

e. As appropriate, survey results for beta-gamma and/or alpha contamination should be annotated by using "α" or "β–γ".

f. Drawing(s) should be included as necessary to clearly explain survey location or area layout.

6.0 RECORDS

The following records are generated by this procedure:

6.1 Radiological Survey Forms similar to that shown below.

Radiological Survey Form

Date/Time: _____

Location: _____

Description: _____

Instrument			
Serial #			
Cal. Date			

1 _____
2 _____
3 _____
4 _____
5 _____
6 _____
7 _____
8 _____
9 _____
10 _____
11 _____
12 _____
13 _____
14 _____
15 _____

Performed By _____

Instrumentation

The following types of instruments may be used to perform radiological surveys for Indian Head field operations:

Ludlum Model 2241 w/ NaI Scintillation Detector (44-2 or 44-10)

- *Digital LED Display with Backlight*
- *Auto-Ranging*
- *Built-In Scaler*
- *Alert and Alarm*
- *Utilizes G-M, Proportional, and Scintillation Detectors*
- *RS-232 Data Dump*

PART NUMBER:48-2444

INDICATED USE: General purpose survey, gross counting
COMPATIBLE DETECTORS: G-M, proportional, scintillation
CONNECTOR: Series "C" (*others available on request*)
AUDIO: Built in unimorph speaker with ON/OFF switch (*greater than 60 dB at 2 feet*)
ALERT/ALARM: Indicated by enunciator on display and audible tone
DISPLAY: 4 digit LCD display with 0.5"(1.3cm) high digits, separate enunciators for display units, alert, alarm, low battery, detector overload, counting overflow, and scaler counting
BACKLIGHT: Push-button to activate
RATEMETER: Can display in R/hr, Sv/hr, cpm, or cps when control switch is in RATEMETER position
DISPLAY RANGE: Auto ranging from 0.0 microR/hr - 9999 R/hr; 0.000 microSv/hr - 9999 Sv/hr; 0 cpm - 999k cpm; or 0 cps - 100k cps
LINEARITY: Reading within plus or minus 10% of true value with detector connected
SCALER: Activated by push-button in handle (*count time adjustable from 1 - 9999 seconds in 1 second intervals*)
RESET: Push-button to zero display, acknowledge and/or reset alarm
POWER: 2 each "D" cell batteries (*housed in sealed compartment that is externally accessible*)
BATTERY LIFE: Typically 200 hours with alkaline batteries (*low battery indicated on display*)
CONSTRUCTION: Cast and drawn aluminum with beige polyurethane enamel paint
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)
May be certified for operation from -40° F(-40° C) to 150° F(65° C)
SIZE: 6.5"(16.5cm)H X 3.5"(8.9cm)W X 8.5"(21.6cm)L
WEIGHT: 3.5 lbs (1.6kg) including batteries

The Model 44-2 is a 1" X 1" NaI(Tl) Gamma Scintillator that can be used with several different instruments including survey meters, scalers, ratemeters, and alarm ratemeters

PART NUMBER:47-1532

INDICATED USE: High energy gamma detection
SCINTILLATOR: 1" (2.5 cm) diameter X 1" (2.5 cm) thick sodium iodide (NaI)Tl scintillator
SENSITIVITY: Typically 175 cpm/microR/hr (*Cs-137*)
COMPATIBLE INSTRUMENTS: General purpose survey meters, ratemeters, and scalers
TUBE: 1.5:(3.8cm) diameter magnetically shielded photomultiplier
OPERATING VOLTAGE: Typically 500 - 1200 volts
DYNODE STRING RESISTANCE: 100 megohm
CONNECTOR: Series "C" (*others available*)
CONSTRUCTION: Aluminum housing with beige polyurethane enamel paint
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)
May be certified for operation from -40° F(-40° C) to 150° F(65° C)
SIZE: 2" (5.1 cm) diameter X 7.3" (18.5 cm)L
WEIGHT: 1 lb (0.5kg)

PART NUMBER:47-1540

The Model 44-10 is a 2" X 2" NaI(Tl) Gamma Scintillator that can be used with several different instruments including survey meters, scalers, ratemeters, and alarm ratemeters

INDICATED USE: High energy gamma detection
SCINTILLATOR: 2" (5.1 cm) diameter X 2" (5.1 cm) thick sodium iodide (NaI)Tl scintillator
SENSITIVITY: Typically 900 cpm/microR/hr (*Cs-137*)
ENERGY RESPONSE: Energy dependent
COMPATIBLE INSTRUMENTS: General purpose survey meters, ratemeters, and scalers
TUBE: 2"(5.1cm) diameter magnetically shielded photomultiplier
OPERATING VOLTAGE: Typically 500 - 1200 volts
DYNODE STRING RESISTANCE: 60 megohm
CONNECTOR: Series "C" (*others available*)
CONSTRUCTION: Aluminum housing with beige polyurethane enamel paint
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)
May be certified to operate from -40° F(-40° C) to 150° F(65° C)
SIZE: 2.6" (6.6 cm) diameter X 11" (27.9 cm)L
WEIGHT: 2.3 lb (1.1kg)

Ludlum Model 12 with 44-9 detector

- *4 Ranges*
- *Adjustable High Voltage*
- *Adjustable Threshold*
- *Utilizes G-M, Scintillation, or Proportional Detectors*
- *Built In Audio with ON/OFF Switch*
- *Total Range from 0 - 500,000 cpm*
- *Splash Proof*

PART NUMBER:48-1609

COMPATIBLE DETECTORS: G-M, proportional, scintillation
METER DIAL: 0 - 500 cpm, 0 - 2.5 kV, BAT TEST (*others available*)
MULTIPLIERS: X1, X10, X100, X1000
LINEARITY: Reading within plus or minus 10% of true value with detector connected
CONNECTOR: Series "C" (*others available*)
AUDIO: Built in unimorph speaker with ON/OFF switch (*greater than 60 dB at 2 feet*)
CALIBRATION CONTROLS: Accessible from front of instrument (*protective cover provided*)
HIGH VOLTAGE: Adjustable from 200 - 2500 volts (*can be read on meter*)
DISCRIMINATOR: Adjustable from 1 - 100 mV
RESPONSE: Toggle switch for FAST (4 seconds) or SLOW (22 seconds) from 10% to 90% of final reading
RESET: Push-button to zero meter
POWER: 2 each "D" cell batteries
BATTERY LIFE: Typically 2000 hours with alkaline batteries (*battery condition can be checked on meter*)
METER: 2.5" (6.4 cm) arc, 1 mA analog type
CONSTRUCTION: Cast and drawn aluminum with beige powdercoat
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)
May be certified for operation from -40° F(-40° C) to 150° F(65° C)
SIZE: 6.5" (16.5 cm)H X 3.5" (8.9 cm)W X 8.5" (21.6 cm)L
WEIGHT: 3.5 lbs (1.6 kg) including batteries

PART NUMBER:47-1539

The Model 44-9 is a pancake G-M that can be used with several different instruments including survey meters, scalers, ratemeters, and alarm ratemeters

INDICATED USE: Alpha beta gamma survey; Frisking
DETECTOR: Pancake type halogen quenched G-M
WINDOW: 1.7 plus or minus 0.3 mg/cm² mica
WINDOW AREA:
Active - 15 cm²
Open - 12 cm²
EFFICIENCY(4pi geometry): Typically 5%-C-14; 22%-Sr-90/Y-90; 19%-Tc-99; 32%-P-32; 15%-Pu-239
SENSITIVITY: Typically 3300 cpm/mR/hr (*Cs-137 gamma*)
ENERGY RESPONSE: Energy dependent
DEAD TIME: Typically 80 microseconds
COMPATIBLE INSTRUMENTS: General purpose survey meters, ratemeters, and scalers
OPERATING VOLTAGE: 900 volts
CONNECTOR: Series "C" (*others available*)
CONSTRUCTION: Aluminum housing with beige polyurethane enamel paint
TEMPERATURE RANGE: -4° F(-20° C) to 122° F(50° C)
May be certified for operation from -40° F(-40° C) to 150° F(65° C)
SIZE: 1.8" (4.6 cm)H X 2.7" (6.9 cm)W X 10.7" (27.2 cm)L
WEIGHT: 1 lb (0.5kg)

Techniques

Contamination Surveys

Contamination monitoring will be performed in accordance with Sections 5.2 – 5.4 of this procedure. Smears and large area wipes will be counted using the Ludlum Model 12 w/44-9 probe.

Radiation Surveys

Radiation surveys (general area, contact and walkover) will be performed using the techniques described in Section 5.1. Since a gamma scintillator detector is being used, beta dose rate surveys will not be performed.

Borehole readings will be obtained by lowering the detector into the borehole to the region of interest and obtaining a static count. Static counts may be obtained by performing a time 1-minute count using the scaler function of the 2241 or by allowing the meter to stabilize (approximately 20 – 30 seconds) and reading the meter face in the analog mode.

All instrument readings performed during sample screening and borehole logging activities will be recorded in the HP Field Logbook.

APPENDIX D.2

HEALTH PHYSICS SOP 5 (HP-5)

CONTROL OF RADIOACTIVE MATERIAL

CONTROL OF RADIOACTIVE MATERIAL

1.0 PURPOSE

To establish guidelines for the control of radioactive material (RAM) within the Radiologically Controlled Area (RCA) and for the unconditional release of materials from the RCA.

2.0 SCOPE

This procedure applies to all personnel working within the RCA.

3.0 DEFINITIONS

Conditional Release Survey – A survey performed on material to be removed from Contamination Areas (CAs) to determine the extent of external contamination and the suitability of storage and/or use within the boundaries of the RCA.
Leak Test – A test that is designed to verify the integrity of a sealed source by evaluating for smearable contamination in excess of 0.005 μCi.
Radioactive Material (RAM) – Material, equipment or system components determined to be contaminated or suspected of being contaminated. For the purposes of this procedure, RAM refers to material, tools and equipment used during the performance of routine facility activities. This procedure does not apply to product feed materials, product or stored inventory materials.
Radioactive Source – Any radioactive material acquired for in-laboratory use, instrument operation, functional testing, and/or calibration.
Sealed Source – Any radioactive material that is encased in or plated onto a container specifically designed to confine or prevent leakage of material from the container.
Unconditional Release Survey – A survey performed on potentially contaminated (internal and/or external) material to determine suitability for release and unrestricted use without license conditions or controls.

4.0 PRECAUTIONS and LIMITATIONS

4.1 Instruments used to perform radiological surveys shall be pre-checked in accordance with HP-10, *Radiological Instrumentation Routine Checks and Count Room Operations.*

4.2 Radiological release surveys should be performed in accordance with HP-2, *Radiological Surveys.*

4.3 Personnel should consult RadCon (Radiological Control) prior to bringing materials into the RCA. Special precautions may be required to protect equipment from internal contamination. Items with inaccessible surfaces (e.g., equipment with internal motors or fans) will not normally be unconditionally released.

5.0 PROCEDURE

5.1 Radioactive Material Labeling

5.1.1 Materials determined to be radioactive will be labeled in accordance with regulatory requirements.

5.1.2 Labels should contain sufficient information to allow personnel handling the material to take appropriate precautions to minimize exposure.

5.1.3 RAM stored within a CA does not require labeling, however identification of such materials is preferred.

5.1.4 RAM released from a CA should be stored in approved Radioactive Material Areas (RMAs).

5.1.5 Drums containing water such as decontamination rinse water shall be labeled with information similar to the following.

- The words: "Caution", "Radioactive Material", "Potentially Internally Contaminated"

- The words: "Description: Decontamination water"
- The words: :"Drum Exterior Dose Rate: xxxx milirem/hour"
- The words: "Survey Performed By: [name]"
- The words: "Date of Survey: [date]"
- The words: "Point of Contact: Mr. Shawn Jorgensen, Building 289, Phone (301) 744-2263"

5.1.6 Drums containing discarded personal protective equipment (PPE) and miscellaneous trash shall be labeled with information similar to the following.

- The words: "Caution", "Radioactive Material", "Internally Contaminated"
- The words: "Description: Personal Protective Equipment and miscellaneous trash""
- The words: "Dose Rate on Contained Material: xxxx milirem/hour
- The words: Removable Contamination on Contained Material: xxxx dpm/100 cm^2"
- The words: :"Drum Exterior dose rate: xxxx milirem/hour"
- The words: "Survey Performed By: [name]"
- The words: "Date of Survey: [date]"
- The words: "Point of Contact: Mr. Shawn Jorgensen, Building 289, Phone (301) 744-2263"

5.2 Conditional Release of Material From CAs and ARAs

5.2.1 All material must be surveyed by RadCon prior to removal from CAs or ARAs.

5.2.2 All accessible surfaces of the material should be surveyed.

5.2.3 Material with contamination levels < 1000 dpm/100cm^2 (α and β-γ), but with detectable dose rates should be removed from the CA or ARA, properly labeled and moved to an approved RMA for storage.

5.2.4 Material with contamination levels in ≥ 1000 dpm/100cm^2 (α or β-γ) should either be left in the CA or ARA, decontaminated and resurveyed, or bagged and removed to an RMA.

NOTE:

Decontamination of material is the responsibility of the individual requesting release of the material.

5.2.5 Packaged RAM should be labeled as specified in Section 5.1 of this procedure.

5.3 Unconditional Release of Material

5.3.1 Unconditional release surveys of materials other than personal items (e.g., notebooks, pens, etc.) should be performed by qualified RadCon personnel.

5.3.2 Personal items being removed by individuals exiting the RCA shall be surveyed using portable instruments located at the RCA entry/exit points. The following limits apply to these surveys:

NUCLIDE [a]	AVERAGE [b,c]	MAXIMUM [b,d]	REMOVABLE [b,e]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm²	15,000 dpm α/100 cm²	1,000 dpm α/100 cm²
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm /100 cm²	300 dpm /100 cm²	20 dpm /100 cm²
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm /100 cm²	3,000 dpm /100 cm²	200 dpm /100 cm²
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm β-γ/100 cm²	15,000 dpm β-γ/100 cm²	1,000 dpm β-γ/100 cm²

Reference: U.S. Atomic Energy Commission Directorate of Regulatory Standards, Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, June 1974.

[a]Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should be applied independently.
[b]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 by background, efficiency, and geometric factors associated with the instrumentation.
[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.
[d]The maximum contamination level applies to an area of not more than 100 cm .
[e]The amount of removable radioactive material per 100 cm 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 know efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

5.3.3 It is the responsibility of the individuals taking personal items into the RCA (with the intent of removing these items at a later time) to insure that adequate precautions are taken to prevent the contamination of these items (i.e., bagging, preventing direct contact with contaminated surfaces).

5.3.4 Materials (i.e., tools and equipment) surveyed by RadCon personnel for unconditional release shall have < 20 dpm/100cm² α, < 200 dpm/100cm² β-γ, and < 100ncpm/probe area by direct frisk.

5.3.5 Items with inaccessible surfaces should be disassembled as completely as possible to facilitate release surveys. Personnel requesting unconditional release surveys are responsible for the disassembly of equipment and, if determined to be contaminated, are also responsible for material disposition.

5.3.6 Items identified as RAM during the performance of an unconditional release survey should be handled in accordance with Section 5.2 of this procedure.

5.3.7 Unconditional release surveys should be documented on appropriate survey forms. A copy of the survey should be attached to the equipment.

5.3.8 Unconditionally released material will be placed in an approved holding location and the requestor notified of material status.

NOTE:
The requestor is responsible for the prompt and proper disposition of released material.

5.3.9 Unconditional release surveys are valid for 24 hours. If material is not removed during the 24 hour period, RadCon will void the release and the material will be returned to the RCA.

5.3.10 Unconditional Release Surveys should be documented on the Material Release Log, similar to Attachment 1.

5.4 Waste Minimization

The purpose of a radioactive waste minimization program is to reduce the generation of radioactive waste and the spread of contamination. The following practices should be implemented to support waste minimization:

5.4.1 Restrict material entering the RCA to those needed for the performance of work.

5.4.2 Restrict the quantity of hazardous materials, such as paints, solvents, chemicals, cleaners and fuels, entering the RCA and take measure to prevent inadvertent contamination of these materials

5.4.3 Reserve an assortment of tools primarily for use in Contamination, High Contamination and Airborne Radioactivity Areas. Tools should be maintained in a designated storage or distribution area.

5.4.4 Survey potentially contaminated material from RCAs to separate uncontaminated from contaminated materials.

5.4.5 Segregate known uncontaminated from potentially contaminated waste.

5.4.6 Limit the amount of materials taken into contaminated areas. All packaging should be removed, when possible, to prevent the unnecessary contamination of clean packing materials.

5.5 Radioactive Sources

5.5.1 All radioactive sources should be stored in a centralized location and recorded in the Radioactive Source Log, similar to Attachment 2.

5.5.2 Sources should be controlled in a manner that insures accountability and maintains doses as low as reasonably achievable (ALARA).

5.5.3 RadCon should be consulted prior to the purchase of new or replacement sources.

5.5.4 Upon receipt of a new source, RadCon should be notified so that the source may be entered into the Radioactive Source Log.

5.5.5 Sources shall be inventoried and leak tested every six months.

5.5.6 Source inventory should be performed as follows:

a. Verify the source presence by visual inspection. If source is inaccessible, verify presence using an appropriate survey instrument.

b. Verify source number and type by visual inspection.

c. Record these results on the Source Inventory/Leak Test Form (similar to Attachment 3).

5.5.7 If discrepancies in source inventory are discovered, notify the RadCon Team Leader.

5.5.8 Radioactive source leak test should be performed as follows:

a. When practical, remove the source from the container.
b. Dampen a smear with isopropyl alcohol or demineralized water.
c. Wipe the source, or container as applicable, with the dampened smear.
d. Allow the smear to air dry.
e. Count the smear using standard count room protocol to determine α and β-γ contamination levels.
f. Complete the Source Inventory/Leak Test Form and verify that the leak test results are less than 0.005 μCi.

5.5.8 If leak test results exceed 0.005 μCi, notify the RadCon Team Leader.

6.0 RECORDS

The following records are generated by this procedure:

6.1 RadCon Survey Forms
6.2 Material Release Log
6.3 Radioactive Source Log
6.4 Source Inventory/Leak Test Form

Material Release Log

Date Time	Material Description	Requestor	Survey Number	Dispostion	Notification Time	Comments	By
				Released Retained			
				Released Retained			
				Released Retained			
				Released Retained			
				Released Retained			
				Released Retained			
				Released Retained			
				Released Retained			
				Released Retained			
				Released Retained			
				Released Retained			
				Released Retained			
				Released Retained			
				Released Retained			
				Released Retained			

Reviewed:_____ Date:_____

Attachment 1

Radioactive Source Log

Source Number	Source Type	Isotope	Activity	Assay Date	Date Received	Location	Comments

Attachment 2

Source Inventory / Leak Test

Source Number:_____ **Activity:**_____ **Location:**_____

Isotope(s):_____ **Description:**_____ **Assay Date:**_____

Leak Test Date	Instrument	Total Counts(1)	Count Time (min)	Gross CPM	Bkgd. (cpm)	Net CPM(2) (NCPM)	Inst. Efficiency (eff.)	Activity (dpm)(3)	Activity (μCi)(4)	Initials

(1) – Report total counts for type of activity indicated by source type (α for Th-230, β-γ for Sr-90)
(2) – NCPM = Gross CPM – Bkgd. CPM
(3) – Activity (dpm) = NCPM/eff.
(4) – Activity (μCi) = Activity (dpm) X 2.22E+6

Custodian:_____

APPENDIX D.3

HEALTH PHYSICS SOP 10 (HP-10)

RADIOLOGICAL INSTRUMENTATION ROUTINE CHCKS AND COUNT ROOM OPERATIONS

RADIOLOGICAL INSTRUMENTATION ROUTINE CHECKS and COUNT ROOM OPERATIONS

1.0 PURPOSE

To establish guidelines for the routine operational checks performed on all radiological instruments used to evaluate radiological conditions.

2.0 SCOPE

This procedure applies to all personnel using radiological instruments for the assessment of facility radiological conditions.

3.0 DEFINITIONS

Check Source – A documented radioactive source, not necessarily NIST traceable, which is used to confirm the continuing satisfactory operation of an instrument.
Functional Check – A qualitative check of an instrument's physical capacity to respond to radiation.
Instrument – A complete system designed to quantify one or more particular ionizing radiation or radiations.
Response Check – A quantitative test performed between calibrations to give reasonable assurance that an instrument is still operating within calibrated parameters prior to use.

4.0 PRECAUTIONS AND LIMITATIONS

4.1 Personnel performing instrument checks are responsible for the control of check sources used to perform these checks.
4.2 Electrical systems should be de-energized prior to accessing internal components for repair or adjustment.
4.3 Instruments should only be issued to qualified individuals.
4.4 Portable survey instrumentation will be calibrated on a semi-annual frequency.
4.5 Laboratory counting instrumentation is calibrated in accordance with manufacturer's recommendations.

5.0 PROCEDURE

5.1 Portable Instrumentation

5.1.1 All portable instruments shall have the following operational checks performed daily or prior to issue if not used on a daily basis:
- a. Verify that a valid calibration sticker is affixed and that the calibration date has not expired.
- b. Verify battery integrity using appropriate meter response.
- c. Perform a background check.
- d. If applicable, verify instrument zero is established.
- e. Perform a response check using sources appropriate for the type(s) of radiation expected. Verify that meter deflection occurs.
- f. Perform a physical inspection of the instrument, noting any damage to case, detector or, if applicable, cables.

5.1.2 If the instrument fails to respond properly to any of these operational checks, tag the instrument "Out of Service" and notify the Health and safety Officer (HSO). Out of service instruments will be maintained separate from in-service equipment.

5.1.3 HP personnel may perform minor repairs (cord replacement, battery change). If maintenance is performed, repeat step 5.1.1 to verify instrument operability.

5.1.4 Record the results of all operational checks of portable instrumentation on the Instrument Check Logsheet, similar to Attachment 1.

5.2 Facility Use Instrumentation

5.2.1 Facility use instruments (e.g., PCM, portable friskers) shall be response checked daily or prior to use.

5.2.2 Prior to performing the response check, verify that a valid calibration sticker is affixed to each unit and that the calibration date has not expired.

5.2.3 Perform a background check.

5.2.4 Verify that instrument alarms are properly set.

5.2.5 Perform a response check and verify that the instrument alarms at the designated radiation level.

5.2.6 If the instrument fails to respond properly to any of these steps, tag the instrument "Out of Service" and notify the HSO. If the instrument is providing boundary contamination control functions (RCA boundary frisker or PCM), insure that a suitable replacement is provided.

5.2.7 Record results on the Fixed Instrument Logsheet, similar to Attachment 2.

5.3 Count Room Instrumentation

5.3.1 Daily operational checks (background counts, source checks, routine calibrations) of laboratory counting instruments (Tennelec counters, scalers) should be performed in accordance with the manufacturers recommended protocols. These checks should normally consist of the following:

a. Background Check
b. α and β-γ source checks
c. Efficiency calculations

5.3.2 Background checks > 10% of known average background levels should be investigated.

5.3.3 Sources checks falling outside of the $\pm 1\ \sigma$ range should be trended to determine instrument stability.

5.3.4 If source check results fall outside of the $\pm 2\ \sigma$ range, corrective actions should be taken in accordance with the manufacturer's recommendations.

5.3.5 Instrument calibrations and diagnostics should be performed in accordance with the manufacturer's recommendations.

5.3.6 Documentation generated during the performance of these checks should be reviewed by the individual performing the checks, and forwarded to the HSO for review.

6.0 RECORDS

The following records are generated by this procedure.

6.1 Instrument Check Logsheet
6.2 Fixed Instrumentation Logsheet
6.3 Laboratory Instrument generated reports

Portable Instrument Check Log Sheet

Instrument Type:_____ Instrument Number:_____ Cal.Date:_____

Radiation Detector Type: α β-γ γ Cal. Due:_____

Date/Time	Source Check	Battery Check	Condition	Zero	Bkgd.	Initials
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat.	Sat. Unsat.	Sat. Unsat. N/A		

Reviewed By:_____ Date:_____

Attachment 1

Fixed Instrument Check Log Sheet

Instrument Type:_____ Instrument Number:_____ Cal.Date:_____

Radiation Detector Type: α β-γ γ Cal. Due:_____

Date/Time	Source Check	Battery Check	Condition	Alarm Check	Bkgd.	Initials
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		
	Sat. Unsat.	Sat. Unsat. N/A	Sat. Unsat.	Sat. Unsat. N/A		

Reviewed By:_____ Date:_____

Attachment 2