ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

ENERGY/ENVIRONMENT SYSTEMS DIVISION

July 29, 1994

Mr. David Fauver
Division of Low-Level Waste Management - NMSS
U.S. Nuclear Regulatory Commission
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

SUBJECT: CONFIRMATORY SURVEY PLAN FOR THE RADWASTE BUILDING AND SUPPRESSION POOL, SHOREHAM NUCLEAR POWER STATION, BROOKHAVEN, NEW YORK [DOCKET FILE NO. 50-322]

Dear Mr. Fauver:

Enclosed is the subject document for your review and comment. To enable us to meet the proposed August 22, 1994 survey start date, we will need to receive the Survey Plan Approval Form by August 17, 1994. Please do not hesitate to contact me at (615) 576-5073 should you have any questions.

Sincerely,

Timothy J. Vitkus
Environmental Project Leader
Environmental Survey and
Site Assessment Program

TJV:dac

Enclosure

cc: T. Mo, NRC/NMSS/TWFN/8A33
D. Tiktinsky, NRC/NMSS/TWFN/8A23
L. Pattiglio, NRC/NMSS/7F27
R. Nimitz, NRC/Region I
PMDA, NRC/NMSS/TWFN/8A23
J. Beck, ORISE/ESSAP
File/258

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PDR ADOCK 05000322
P PDR

P. O. BOX 117, OAK RIDGE, TENNESSEE 37831-0117

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CONFIRMATORY SURVEY PLAN
FOR THE RADWASTE BUILDING AND SUPPRESSION POOL
SHOREHAM NUCLEAR POWER STATION
BROOKHAVEN, NEW YORK

INTRODUCTION

The Long Island Lighting Company (LILCO) constructed a boiling water reactor known as the Shoreham Nuclear Power Station (SNPS). The plant was designed to provide a gross electrical output of 849 Megawatts and achieved initial criticality in February 1985. The U.S. Nuclear Regulatory Commission (NRC) License No. NPF-82 (NRC Docket File No. 50-322) issued for the facility allowed reactor operations at power levels not to exceed 5% of full power. Low power testing in accordance with the license then commenced in July 1985 and continued intermittently until January 1989, at which time power generating operations were terminated. The total reactor operating history was equivalent to 2.03 effective full power days of fuel exposure. The irradiated fuel, which was a standard low enrichment (2 to 3% uranium-235) uranium fuel, was subsequently removed from the reactor vessel and placed into the spent fuel pool in August 1989.

Various reactor components, piping systems, and other equipment became radiologically contaminated as a result of reactor operation. The primary contaminants which have been identified during characterization studies include iron-55, cobalt-60, nickel-63, and smaller quantities of tritium, carbon-14, nickel-59, manganese-54, zinc-65, and europium-152.[1]

The Long Island Power Authority (LIPA) was established to decommission the facility and release the site for unrestricted use. The LIPA Decommissioning Plan was approved for implementation by the NRC in June 1992 and will include decontamination or removal of

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contaminated portions of the reactor and other plant systems and equipment. A major consideration of the decommissioning plan is to maintain the integrity when possible, of plant structures and systems. The decommissioning and termination surveys are being conducted in phases, terminating in the removal of the spent fuel from the site and completion of the final surveys in October 1994. Phase 1 included the termination survey of the internal components of the main turbine, the Turbine Building, site grounds, and exterior site structures. The current phases, Phase 2 and 3, include the Reactor Building Suppression Pool and the Radwaste Building.

It is the policy of the NRC to perform confirmatory surveys of facilities that have undergone decommissioning and have requested NRC license termination. The NRC Headquarters' Division of Low-Level Waste Management and Decommissioning has requested that the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) conduct confirmatory radiological surveys of the SNPS decommissioning project. ESSAP has completed the confirmatory survey of the Turbine Internal components, the Turbine Building, site grounds, and exterior site structures. The results of which are the subject of separate final and draft reports.[2,3]

SITE DESCRIPTION

The SNPS is located in the Town of Brookhaven, New York, on the north shore of Long Island, approximately 80 km (50 mi) east of La Guardia Airport and the confluence of the East River and Long Island Sound (Figure 1). The SNPS is located on a 32.4 ha (80 ac) portion of a larger 202 ha parcel of land owned by the LILCO. The site is bounded on the north by Long Island Sound, on the east by the Wading River Marshland, on the west by other LILCO property, and on the south by Route 25A. A cyclone fence encloses the 8 ha site secured area. Within this boundary are the buildings and grounds classified as the Restricted Area, also known as the power block, where radiological controls were necessary (Figure 2). Each of the buildings that which have been or will be addressed during the confirmatory process are located here and are shown on Figure 2 as the Turbine Building, the Reactor Building, and the Rad Waste Building. Construction of these buildings is predominately structural steel and concrete. Total floor space

of the three buildings is approximately 45,600 m^2 (490,000 ft). The building interiors contain a multitude of process specific and environmental control equipment and piping.

LIPA has classified plant systems, building surfaces, and outside areas into two categories which are based on the potential for residual contamination. The two area categories referred to as affected or unaffected are defined as follows: affected areas are areas of the SNPS that are potentially contaminated or have known contamination, or a system which circulated, stored or processed radioactive materials such that they could become contaminated, or experience, neutron activation, or where records indicated spills or other occurrences may have resulted in contamination; unaffected areas are those portions of the SNPS that are not expected to contain residual radioactivity. Area classification was determined by radiological use history, environmental monitoring activities, and the results of a previous characterization survey. Affected and unaffected areas are further subdivided into survey units (SU). Survey units are categorized as structures (floors, walls, ceilings, and exterior surfaces of piping and equipment), plant systems (equipment and piping internals), and outdoor areas (grounds and building exteriors). In addition, affected survey units also have sub-classifications as suspect or non-suspect, and may also be classified as alpha affected if involved with fuel handling or storage. Table 1 provides a summary of the facilities addressed by this plan and the number and type of survey units associated with each.

OBJECTIVES

The objectives of this confirmatory survey are to provide independent document reviews, review and field observations of the LIPA procedures for embedded piping surveys, and radiological data for use by the NRC in evaluating the adequacy and accuracy of the licensee's procedures and termination survey results.

RESPONSIBILITY

Work described in this survey plan will be performed under the direction of Jack Beck, Acting Program Director and Tim Vitkus, Project Leader of ESSAP. The cognizant site supervisor has

the authority to make appropriate changes to the survey with the approval of the NRC site representative. Deviations to this survey plan will be documented in the site log book.

DOCUMENT REVIEW AND LIPA PROCEDURE SURVEILLANCE

ESSAP will review LIPA's release records for those survey units selected for confirmatory survey. Review of additional release records will be dependent upon findings as the surveys progress. Documents will be reviewed for adequacy, accuracy, completeness, and consistency. Data will be reviewed for appropriateness of calculations and interpretations relative to the guidelines.

PROCEDURES

A survey team from ESSAP will perform independent visual inspections, measurements, and sampling of survey units associated with the Radwaste Building and the Reactor Building Suppression Pool. Table 2 lists the survey units selected for confirmatory surveys. Of the total, 9 were selected randomly and 5 were selected by the NRC site representative. Field survey activities will be conducted in accordance with the applicable sections of the ESSAP Survey Procedures and Quality Assurance Manuals. The following procedures apply to survey units selected for independent confirmatory surveys. Additional information regarding selection of confirmatory survey units and the implementation of this plan may be found in the general site confirmatory survey plan.[4]

SURVEY PROCEDURES

Reference System

The reference systems established by LIPA will be used by ESSAP for referencing measurement and sampling locations. The grid size or reference interval established by LIPA for a given survey unit will be dependent upon the classification survey unit (affected vs. unaffected) and surface (floor, lower wall, upper wall, ceiling, or equipment).

Surface Scans

Surface scans for alpha, beta, and gamma activity, will be performed over 100% of floor, and lower wall surfaces and up to 50% of equipment surfaces, within each structural survey unit. Additional scans will be performed over portions of upper wall, ceiling, and system surfaces as well as locations, such as drains, where material may have settled or accumulated. Locations of elevated direct radiation detected by scans will be marked for further investigation. Scans will be performed using gas proportional, GM, ZnS, and/or NaI detectors coupled to ratemeters or ratemeter-scalers with audible indicators.

Surface Activity Measurements

For each survey unit, ESSAP will perform a minimum of thirty direct measurements for total beta surface activity. ESSAP will also perform additional direct measurements at locations of elevated direct radiation detected by surface scans. At measurement locations, where the average NRC surface contamination guideline is exceeded, the size of the contaminated area and the average activity in the contiguous 1 m^2 area will also be determined. Total alpha surface activity measurements will also be performed at each direct measurement location when a selected survey unit is classified as alpha affected or if alpha contamination is identified by surface scans. Measurements will be performed using GM, gas proportional, and/or ZnS detectors coupled to ratemeter-scalers. A smear sample for determining removable activity level will be collected from each direct measurement location.

Exposure Rate Measurements

Exposure rate measurements will be performed within each survey unit, excluding system interiors, at the approximate location where LIPA performed measurements. All exposure rates will be measured at 1 m above surfaces using a pressurized ionization chamber (PIC). Background exposure rates were previously determined during the confirmatory survey of the Turbine Building.[3]

Embedded Piping

Confirmation of the radiological status of embedded piping will be accomplished primarily through data and records review including instrument calibrations and quality control factors. In addition, random independent measurements will be made at accessible openings and traps within the Radwaste Building.

Systems

LIPA intends to provide access points into the system components listed in Table 2. Beta and gamma surface scans will then be performed within the accessible portions of the system, followed by 5 to 30 direct measurements and smear samples (dependent upon component size). Scans and direct measurements will be performed using gas proportional, GM, ZnS, and/or NaI detectors coupled to ratemeters or ratemeter-scalers.

Confirmatory Analyses

Smear or miscellaneous samples, collected by LIPA, may be requested for confirmatory analyses.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data will be returned to ESSAP's Oak Ridge laboratory for analysis and interpretation. Smears will be analyzed for gross alpha and gross beta activity using a low background proportional counter. Smear and direct measurement data will be converted to units of dpm/100 cm^2 and exposure rates to μR/h. Data will then be compared to the LIPA results and NRC guidelines. Survey results will be presented in a draft report at the completion of this confirmatory phase and submitted to the NRC for review and comment.

DATA EVALUATIONS AND COMPARISONS

The results of each survey unit sampled will be statistically tested. The goal of the test is to determine, with a given confidence level, that the LIPA survey data is not biased low compared to ORISE. The null hypothesis will be that in a survey unit, surface activities as calculated by LIPA are greater than or equal to those determined by ESSAP, i.e., H_o: $\mu_{LIPA} \geq \mu_{ESSAP}$. This hypothesis will be tested at the 95% confidence level (0.05 level of significance). If the hypothesis is rejected at that confidence level, the alternative hypothesis will be accepted i.e., H_A: $\mu_{LIPA} < \mu_{ESSAP}$. The test statistic, t, will be calculated using the following equation:

$$t = \frac{\overline{X_E} - \overline{X_L}}{\sqrt{\frac{(n_E-1)S_E^2 + (n_L-1)S_L^2}{n_E + n_L - 2}\left(\frac{n_E + n_L}{n_E n_L}\right)}}$$

where:

$\overline{X_L}$	Is the LIPA surface activity or soil concentration mean for a survey unit
$\overline{X_E}$	Is the ESSAP surface activity or soil concentration mean for the same survey unit
n_L	Is the number of LIPA direct measurement or soil concentration data points
n_E	Is the number of ESSAP direct measurement or soil concentration data points
S_L, S_E	Are the standard deviations.

The calculated t is then compared to the critical value of Student's t-distribution (one-tailed) for the appropriate degrees of freedom at the 95% confidence level (0.05 level of significance). If the H_o: $\mu_{LIPA} \geq \mu_{ESSAP}$ is rejected, then ESSAP will evaluate additional options and alternatives and confer with the NRC as to the recommended approach.

GUIDELINES

The applicable Regulatory Guide 1.86 guidelines are those for beta-gamma emitters and the alpha contamination guidelines are those for uranium and associated decay products. The beta-gamma guidelines are:

Total Activity

5,000 ß-γ dpm/100 cm^2, averaged over 1m^2

15,000 ß-γ dpm/100 cm^2, maximum in a 100 cm^2 area

Removable Activity

1,000 ß-γ dpm/100 cm^2

The alpha guidelines are:

Total Activity

5,000 α dpm/100 cm^2, averaged over 1 m^2

15,000 α dpm/100 cm^2, maximum in a 100 cm^2 area

Removable Activity

1,000 α dpm/100 cm^2

The exposure rate guideline currently being used by the NRC is 5 μR/hr above background, measured at 1 m.[5] The site specific NRC criterion for soils is 8 pCi/g average concentration of Shoreham produced gamma-emitting radionuclides.

Section 8.0 Sampling Procedures

8.7 Determinat

8.9 Sample Inv-

Section 9.0 Integrated Survey Procedu

9.2 General Scan

Section 10.0 Health and Safety and Co

Section 11.0 Quality Assurance and Qu

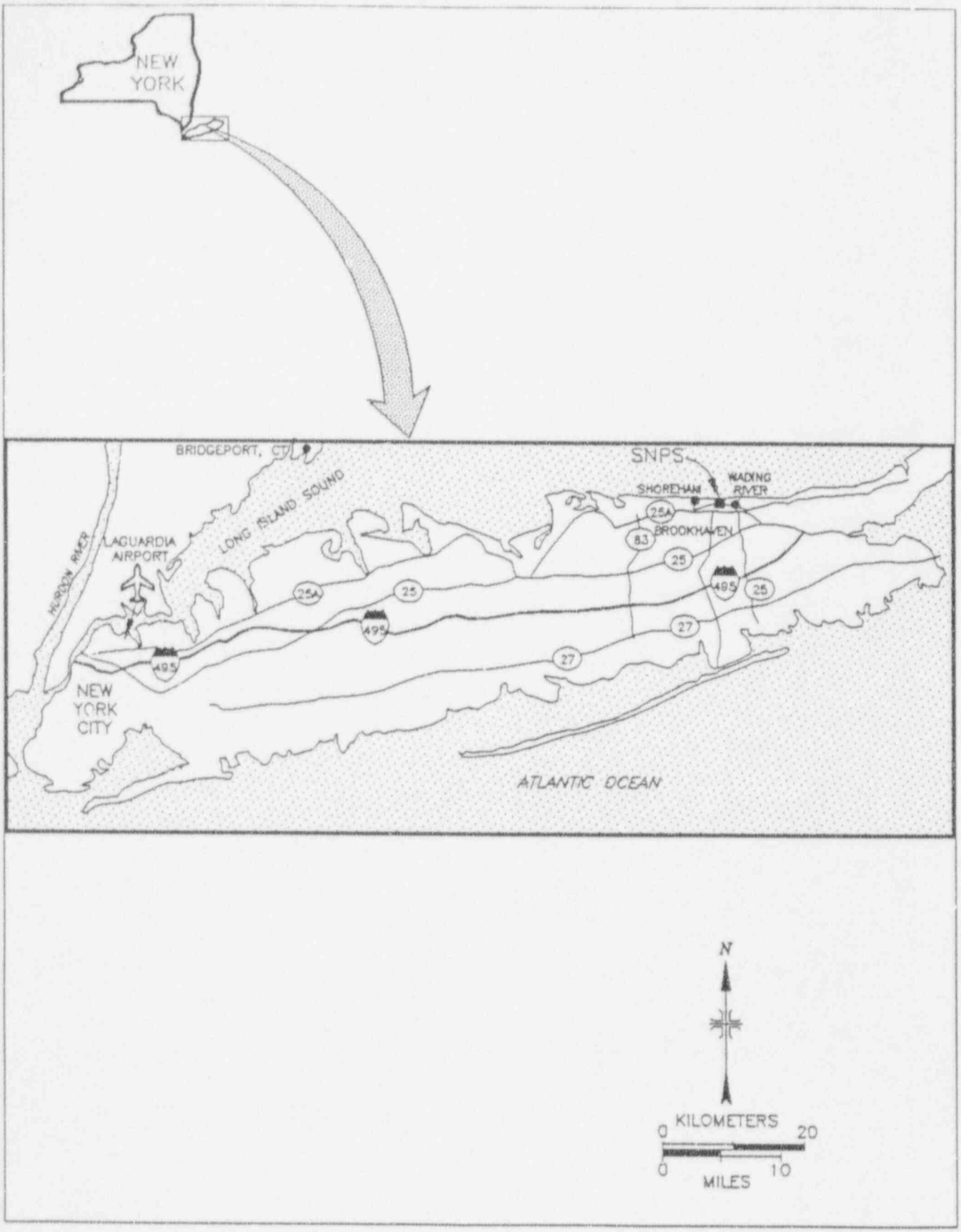

FIGURE 1: Location of the Shoreham Nuclear Power Station

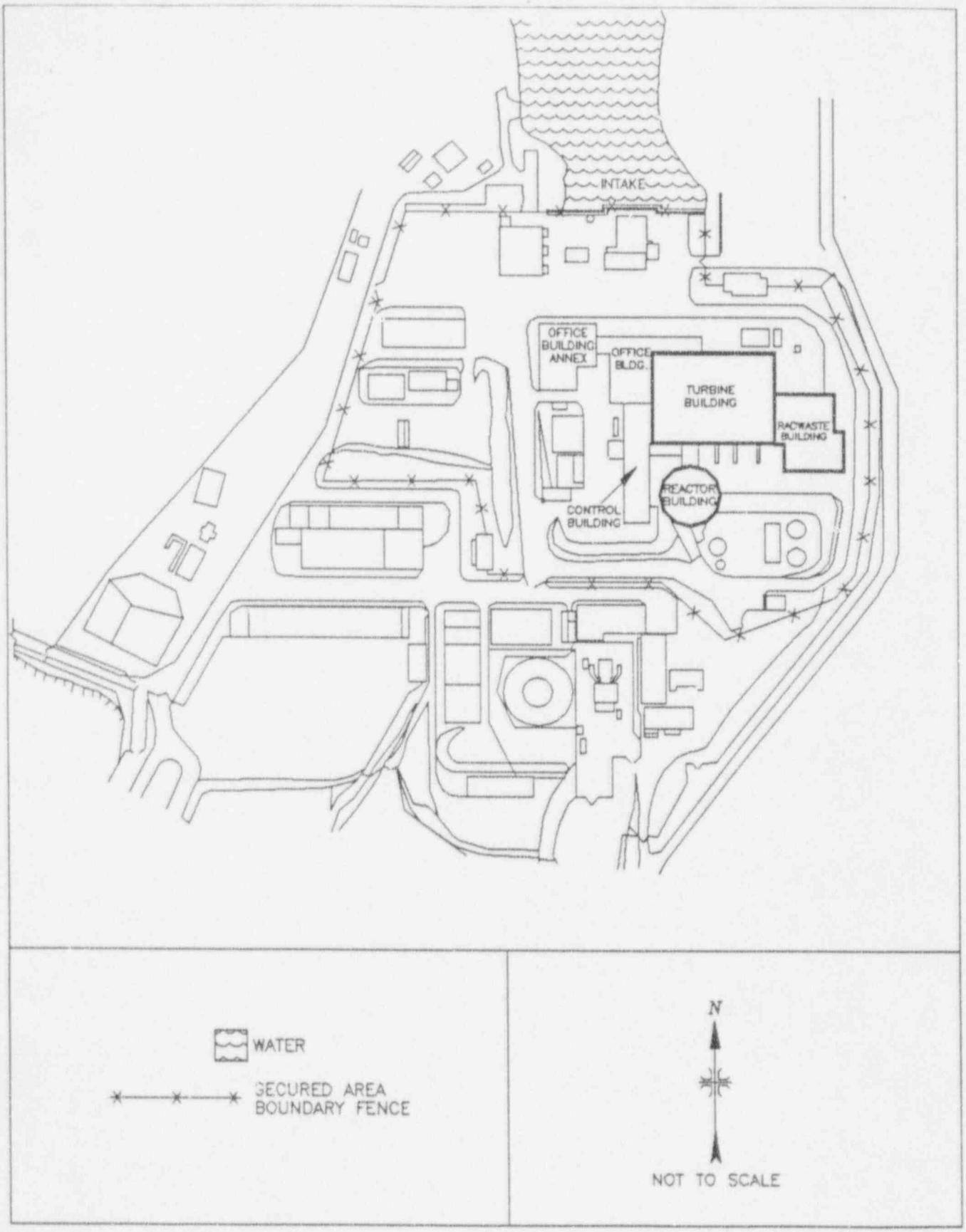

FIGURE 2: Plot Plan of the Shoreham Nuclear Power Station

Section 8.0 Sampling Procedures

8.7 Determination of Removable Activity

8.9 Sample Identification and Labeling

Section 9.0 Integrated Survey Procedures

9.2 General Survey Approaches and Strategies

Section 10.0 Health and Safety and Control of Cross Contamination

Section 11.0 Quality Assurance and Quality Control

Tentative Confirmatory Schedule

Phase III:	Radwaste Building Surveys	
	Document Review	August 1994
	Confirmatory Survey	August 22 through September 26, 1994
	Sample Analysis	September 1994
	Draft Report	October 28, 1994

LIST OF CURRENT PROCEDURES TO BE USED IN THE SURVEY

Applicable procedures from ORISE ESSAP Survey Procedures Manual (Revision 8; December 31, 1993) include:

Section 5.0 Instrument Calibration and Operational Check-Out

- 5.1 General Information
- 5.2 Electronic Calibration of Ratemeters
- 5.3 Gamma Scintillation Detector Check-Out and Cross Calibration
- 5.4 Alpha Scintillation Detector Calibration and Check-Out
- 5.5 GM Detector Calibration and Check-Out
- 5.6 Proportional Detector Calibration and Check-Out
- 5.7 Pressurized Ionization Chamber Calibration and Check-Out
- 5.8 Floor Monitor Check-Out
- 5.10 Field Measuring Tape Calibration

Section 7.0 Scanning and Measurement Techniques

- 7.1 Surface Scanning
- 7.2 Alpha Radiation Measurement
- 7.3 Beta Radiation Measurement
- 7.4 Gamma Radiation (Exposure Rate) Measurement

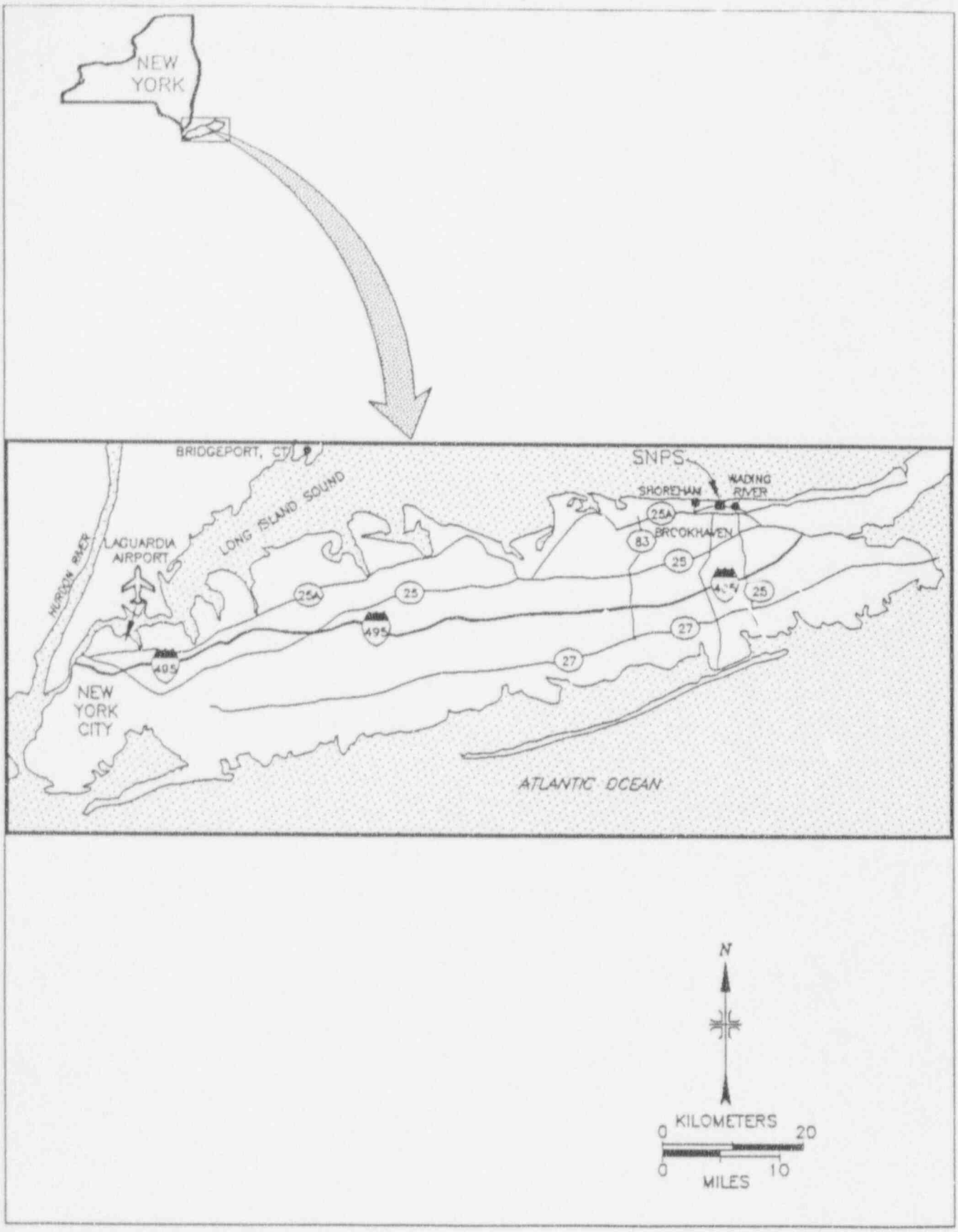

FIGURE 1: Location of the Shoreham Nuclear Power Station

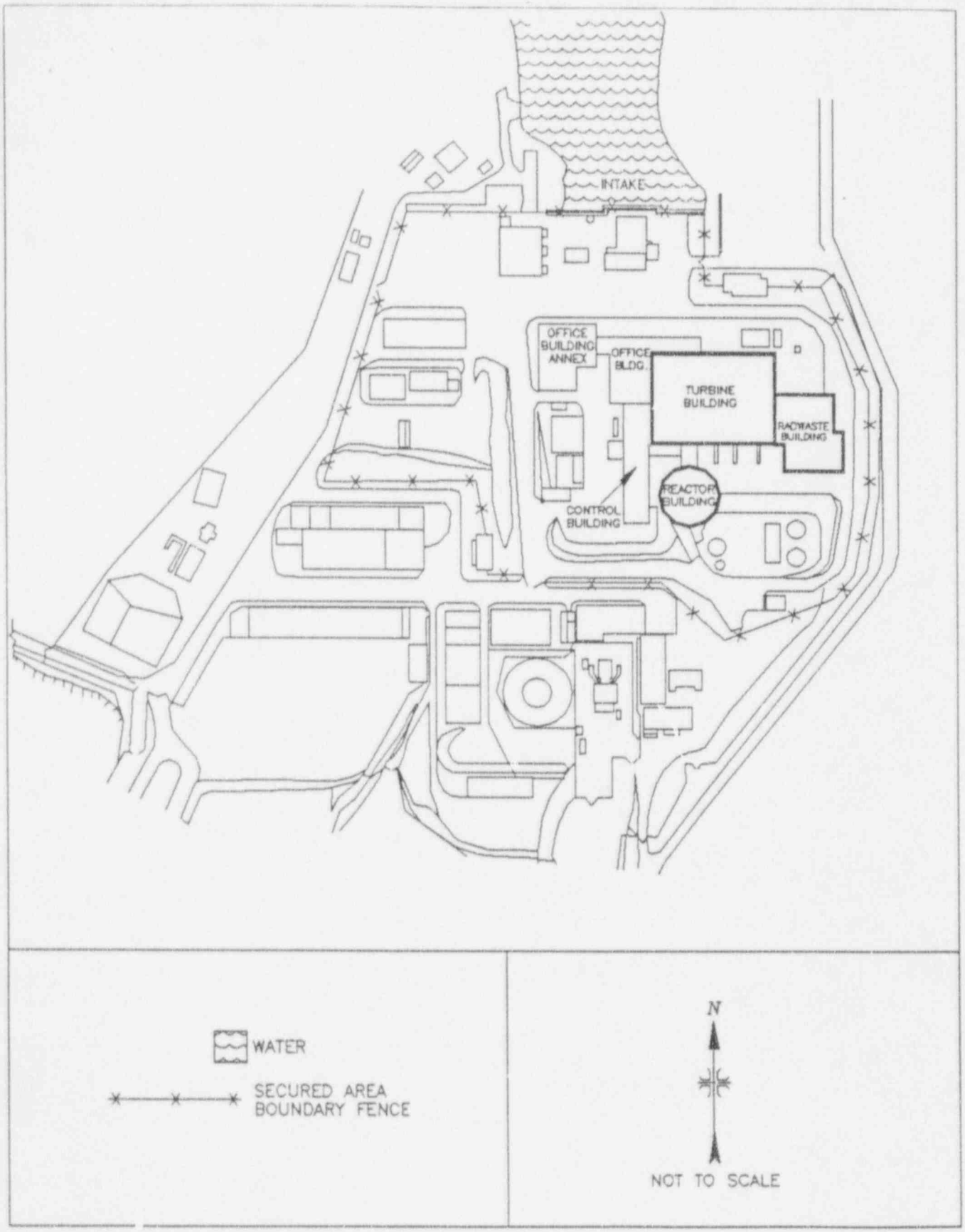

FIGURE 2: Plot Plan of the Shoreham Nuclear Power Station

TABLE 1

SUMMARY OF THE SNPS FACILITIES AND ASSOCIATED SURVEY UNITS

Description	No. of Affected Survey Units	No. of Unaffected Survey Units	Total No. of Survey Units
Turbine Building Structures	10	104	114
Reactor Building Structures	110	0	110
Rad Waste Building Structures	77	0	77
Drywell	22	0	22
Suppression Pool	13	0	13
Plant Systems	38	44	82
Site Grounds	0	10	10
Site Exteriors	0	32	32
Total	**270**	**190**	**460**

TABLE 2

RADWASTE BUILDING AND SUPPRESSION POOL SURVEY UNITS SELECTED FOR CONFIRMATORY SURVEY

Survey Unit/Component	Survey Unit Name	Affected (A)/ Unaffected (U)	Structure/ System
RadWaste Building			
RW013	RadWaste - 15' North Hallway	A	Structure
RW017	Cation/Anion Reger and Resin Storage Tanks Area	A	Structure
RW023 (Cubicle A)	Liner Fill Stations/BW Storage Rooms	A	Structure
RW040	Waste Evaporator/Regen. Evap. Distil. Room	A	Structure
RW042	RadWaste - 37' North Hallway	A	Structure
RW069	"B" RW O/G HEPA after Filter Area	A	Structure
RW072	Off Gas Desiccant Dryers Area	A	Structure
SU012/Valves E4101V3049 and E4101V3050	Reactor Building Hi Pressure Coolant Injection System	A	System
SU015/Non Regenerative Heat Exchanger 1G33-E-014	Reactor Water Clean up	A	System
SU014/Valve 1G11-AOV-38	RadWaste Building Drain Piping System	A	System
SU-14/Flat Bed Floor Drain Filter 1G11-FL-012	RadWaste Building Drain Piping System	A	System

TABLE 2 (Continued)

RADWASTE BUILDING (Continued)
AND SUPPRESSION POOL SURVEY UNITS
SELECTED FOR CONFIRMATORY SURVEY

Survey Unit/Component	Survey Unit Name	Affected (A)/ Unaffected (U)	Structure/ System
SU014/RadWaste Equipment and Floor Drain Survey Sump 1G11-Tk-054	RadWaste Building Drain Piping System	A	System
SU043/Tank E	Condensate Demineralizes	A	System
IN52-DE-002E			
Reactor Building			
SP004	Suppression Pool - NW Quadrant	A	Structure
SP005	Suppression Pool Area Inside Vessel Pedestal	A	Structure

REFERENCES

1. Long Island Lighting Company, "Shoreham Nuclear Power Station Site Characterization Program Final Report," May 1990.

2. T. J. Vitkus, ORISE, "Confirmatory Survey of the Turbine Internal Components, Shoreham Nuclear Power Station, Brookhaven, New York," July 1993.

3. T. J. Vitkus, ORISE, Draft Report—"Confirmatory Survey of the Turbine Building, Site Grounds, and Site Exteriors, Shoreham Nuclear Power Station, Brookhaven, New York," February 1994.

4. Letter from T. J. Vitkus, ORISE to D. Fauver, U.S. Nuclear Regulatory Commission, "Final Confirmatory Survey Plan from the Shoreham Nuclear Power Station, Brookhaven, New York [Docket File No. 50-322]," November 4, 1993.

5. U.S. Nuclear Regulatory Commission, "Guidance and Discussion of Requirements for an Application to Terminate a Non-Power Reactor Facility Operating License," Revision 1, September 1984.

APPENDIX A

CONFIRMATORY SURVEY PLAN
FOR THE RADWASTE BUILDING AND SUPPRESSION POOL
SHOREHAM NUCLEAR POWER STATION
BROOKHAVEN, NEW YORK

Activity		RadWaste Building and Suppression Pool
Plan Preparation Total Cost:		$13,700
Document Review	% of Total Cost[a]	1%
Survey Preparation		8%
On-Site Activities Total Cost:		$98,500
Travel	% of Total Cost[a]	27%
Surface Scans		17%
Direct Measurements		23%
Sampling		<1%
Sample Analysis Total Cost:		$1,800
Smear Analysis	% of Total Cost[a]	1%
Report Preparation Total Cost:		$32,000
Data Tabulation	% of Total Cost[a]	8%
Illustration		7%
Draft and Final Report Text Preparation & Review		7%
Total Cost Estimate		$146,000

[a]Percentages are provided for estimating purposes only and may not be indicative of actual project cost distributions.