ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

October 20, 1994

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

SUBJECT: PROPOSED CONFIRMATORY SURVEY PLAN FOR THE REACTOR BUILDING, 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. Comments you may have will be incorporated into the final plan. Attachment A of the document contains the spending plan for this project. 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:rde

Enclosure

cc: R. Uleck, NRC/NMSS/TWFN 7F27
D. Tiktinsky, NRC/NMSS/TWFN 8A23
L. Pittiglio, NRC/NMSS 7F27
R. Nimitz, NRC/Region I
PMDA, NRC/NMSS/TWFN 8A23
J. Beck, ORISE/ESSAP
E. Abelquist, ORISE/ESSAP
File/273

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PDR ADOCK 05000322
W PDR

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

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PROPOSED
CONFIRMATORY SURVEY PLAN
FOR THE REACTOR BUILDING
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. Phase 1 included the termination survey of the internal components of the main turbine, the Turbine Building, site grounds, and exterior site structures. Phases 2 and 3, included the Reactor Building Suppression Pool, Phase 2 systems and the Radwaste Building. Phase 4 addresses the remaining portions of the Reactor Building.

The NRC Headquarters' Division of Waste Management 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, exterior site structures, Radwaste Building, Suppression Pool, and Phase 2 systems. The results of which are the subject of separate final or in process 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 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 the Reactor Building is predominately structural steel and concrete. Total floor space of the building is approximately 7,800 m^2 (84,000 ft^2) divided among 8 levels at elevations 8'-0", 40'-0", 63'-0", 78'-0", 112'-0", 128'-9", 150'-0", and 175'-0". The Reactor Building

housed the nuclear steam supply system which included the Reactor Pressure Vessel and its associated auxiliary and safety systems. Major structural components included the primary containment system, spent fuel storage pool, dryer/separator pool, polar crane and building sumps. The major auxiliary and safety systems included the reactor core isolation cooling, high pressure coolant injection, core spray, stand by liquid control, reactor water cleanup, fuel pool cooling and clean-up, and primary containment atmospheric control systems.

LIPA has classified plant systems and building surfaces 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 those 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. 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.

OBJECTIVES

The objectives of this confirmatory survey are to provide independent document reviews 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 plan with the approval of the NRC site representative. Deviations to this survey plan will be documented in the site log book.

DOCUMENT REVIEW

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 Reactor Building. Table 1 lists the survey units selected for confirmatory surveys. Of the total, 11 were selected randomly and 19 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. Specific procedures are listed on pages 8 and 9 of this plan. 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 was dependent upon the classification of the 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 structural 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 each accessible floor direct measurement location. 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]

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 mean for a survey unit
$\overline{X_E}$	Is the ESSAP surface activity mean for the same survey unit
n_L	Is the number of LIPA direct measurement data points
n_E	Is the number of ESSAP direct measurement 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 1 m^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 NRC has approved site-specific allowable surface contamination guidelines for H-3 and Fe-55, particularly in activated concrete and steel.[5] These guidelines are:

Total Activity

200,000 dpm/100 cm^2, averaged over 1 m^2

600,000 dpm/100 cm^2, maximum in a 100 cm^2 area

Removable Activity

1,000 dpm/100 cm^2

The exposure rate guideline currently being used by the NRC is 5 μR/hr above background, measured at 1 m above the surface.[6]

TENTATIVE CONFIRMATORY SCHEDULE

Phase III:	Reactor Building Surveys	
	Document Review	October 1994
	Confirmatory Survey	October 31 through November 11, 1994
	Sample Analysis	November 1994
	Draft Report	January 31, 1995

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 Techniqres

7.1 Surface Scanning

7.2 Alpha Radiation Measurement

7.3 Beta Radiation Measurement

7.4 Gamma Radiation (Exposure Rate) Measurement

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

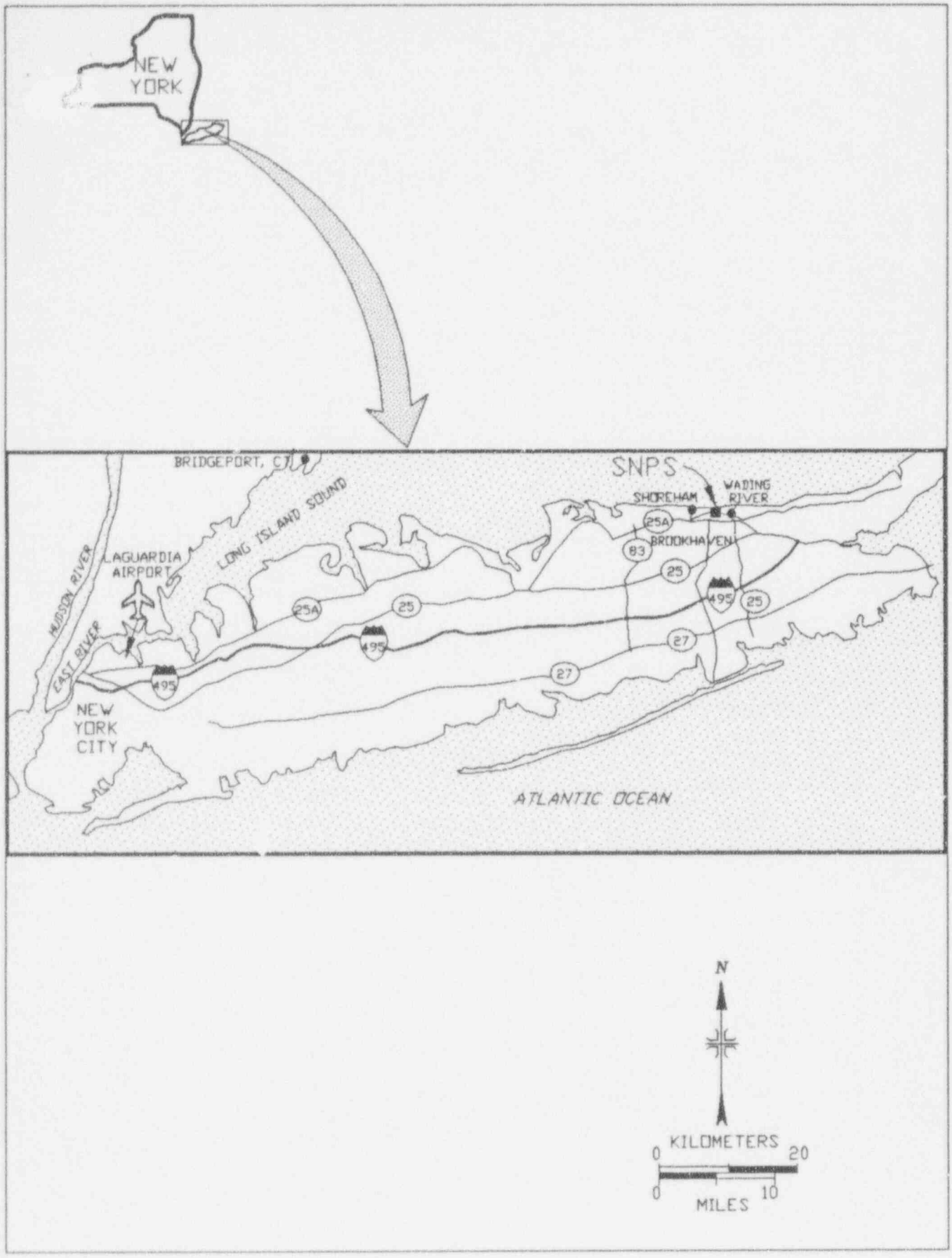

FIGURE 1: Location of the Shoreham Nuclear Power Station

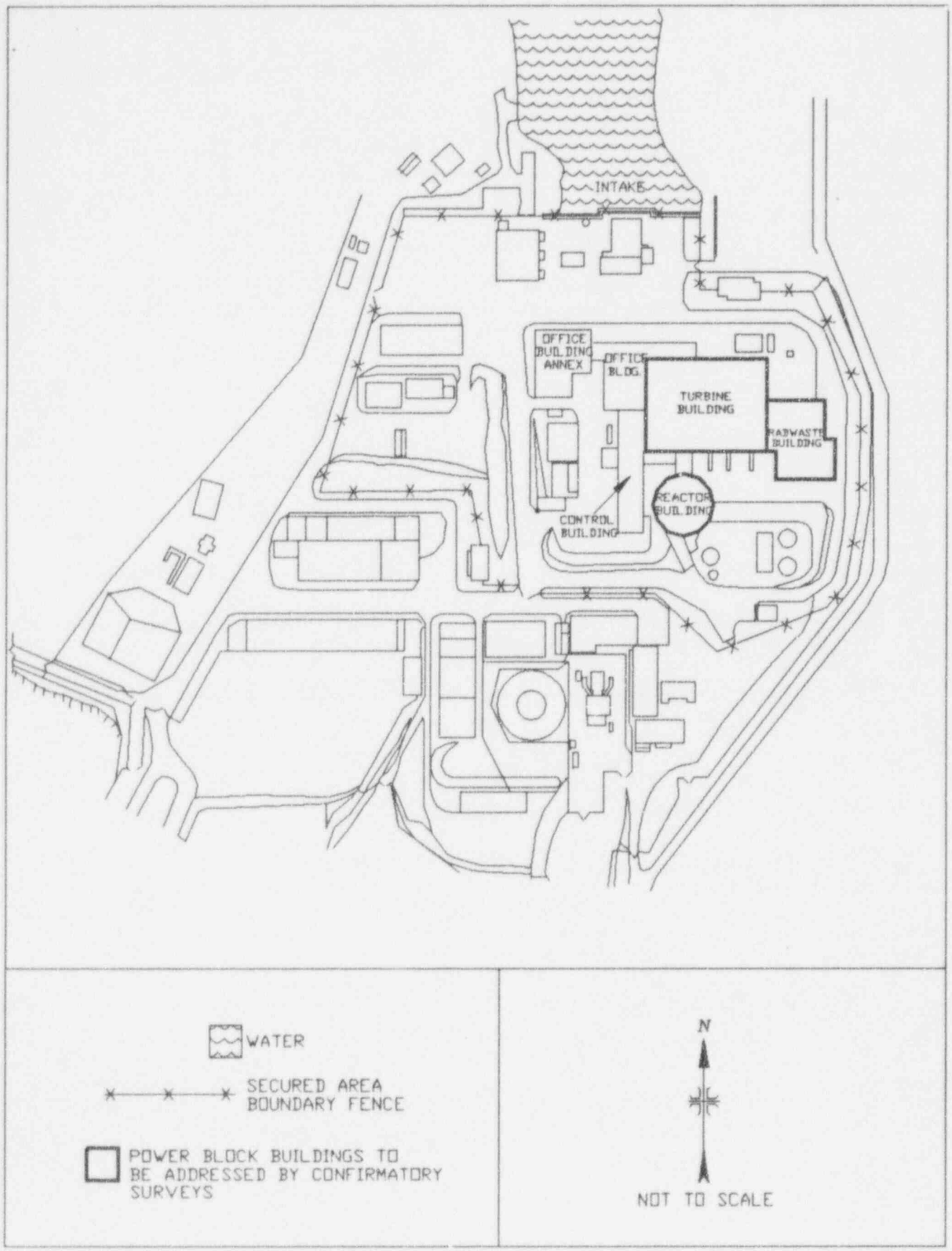

FIGURE 2: Plot Plan of the Shoreham Nuclear Power Station

TABLE 1

REACTOR BUILDING SURVEY UNITS SELECTED FOR CONFIRMATORY SURVEY SHOREHAM NUCLEAR POWER STATION BROOKHAVEN, NEW YORK

Survey Unit/Component	Survey Unit Name	Affected (A)/ Unaffected (U)	Structure/ System
PC004	Primary Containment - 63' NW	A	structure
PC005	Sub-Pile Room	A	structure
PC007	Primary Containment - 78' NE	A	structure
PC008	Primary Containment - 78' SE	A	structure
PC011	Primary Containment - 109' NE	A	structure
RB004	Reactor Building - 8' SE	A	structure
RB006	Reactor Building - 8' SW	A	structure
RB014	Reactor Building - 40' SW	A	structure
RB037	Reactor Building - 78' SW	A	structure
RB038	West Accumulator Aisle	A	structure
RB057	Fuel Pool Clean-up Pumps Room	A	structure
RB061	RWCU Regen/Non-Regen HTX's Room	A	structure
RB068	Spent Fuel Storage Pool	A	structure
RB071×01	Reactor Cavity - 150'	A	structure
RB072×01	Dryer/Separator Storage Pool	A	structure
RB073×02	Bioshield Wall Blocks (Concrete)	A	structure
RB073×03	Bioshield Wall Blocks (Steel)	A	structure
RB103	Reactor Building - 175'	A	structure
RB106	Reactor Building - 175'	A	structure
RB109	Polar Crane	A	structure
SU001	Reactor Assembly Lower Bowl	A	system
SU002	Nuclear Boiler Main Steam Relief Valve 1B21-RV-095G	A	system

TABLE 1 (Continued)

REACTOR BUILDING SURVEY UNITS
SELECTED FOR CONFIRMATORY SURVEY
SHOREHAM NUCLEAR POWER STATION
BROOKHAVEN, NEW YORK

Survey Unit/Component	Survey Unit Name	Affected (A)/ Unaffected (U)	Structure/ System
SU004	CRD Hydraulic Control	A	system
SU014×05	#953 Misc. Embedded Drain Piping 1G11-TK-190	A	system
SU014×12	RB Porous Concrete Sump #19 or 20	A	system
SU023	Misc. Building Storm Drains	A	system
SU058	Reactor Primary Containment	A	system
SU060×09	Fuel Pool Cooling Room	A	system
SU060×13	RWCU Valve Chambers Room	A	system
SU060×23	Reactor Building Air from Drywell IT46-ADV-039A	A	system
SU060×24	Reactor Building Vent Dump	A	system

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, "Confirmatory Survey of the Turbine Building, Site Grounds, and Site Exteriors, Shoreham Nuclear Power Station, Brookhaven, New York," September 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. Letter from C.L. Pittiglio, U.S. Nuclear Regulatory Commission, to A.J. Bortz, Long Island Power Authority, subject "Approval of a Modification of Facility Release Criteria for Tritium and Iron-55 Surface Contamination at Shoreham Nuclear Power Station, Unit 1," June 7, 1994.

6. 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.

ATTACHMENT A

SPENDING PLAN

Name of Laboratory:
Oak Ridge Institute for Science and Education

Title of Project
Shoreham Reactor Building

PERFORMANCE PERIOD	
From	To
Oct-94	Mar-95
RFTA	**Est. Project Cost**
93-02	$176,150.00
NRC Fin Number	**ORISE Number**
A9076	1286.02

COST ELEMENTS	Oct-94	Nov-94	Dec-94	Jan-95	Mar-95
Direct Costs	$37,950.00	$83,250.00	$6,500.00	$700.00	$1,500.00
Indirect Costs- (G&A, DOE Factor)	$13,500.00	$29,650.00	$2,350.00	$250.00	$500.00
Total Estimate Costs	$51,450.00	$112,900.00	$8,850.00	$950.00	$2,000.00
Project Completion	27.53%	92.53%	98.21%	98.83%	100.00%