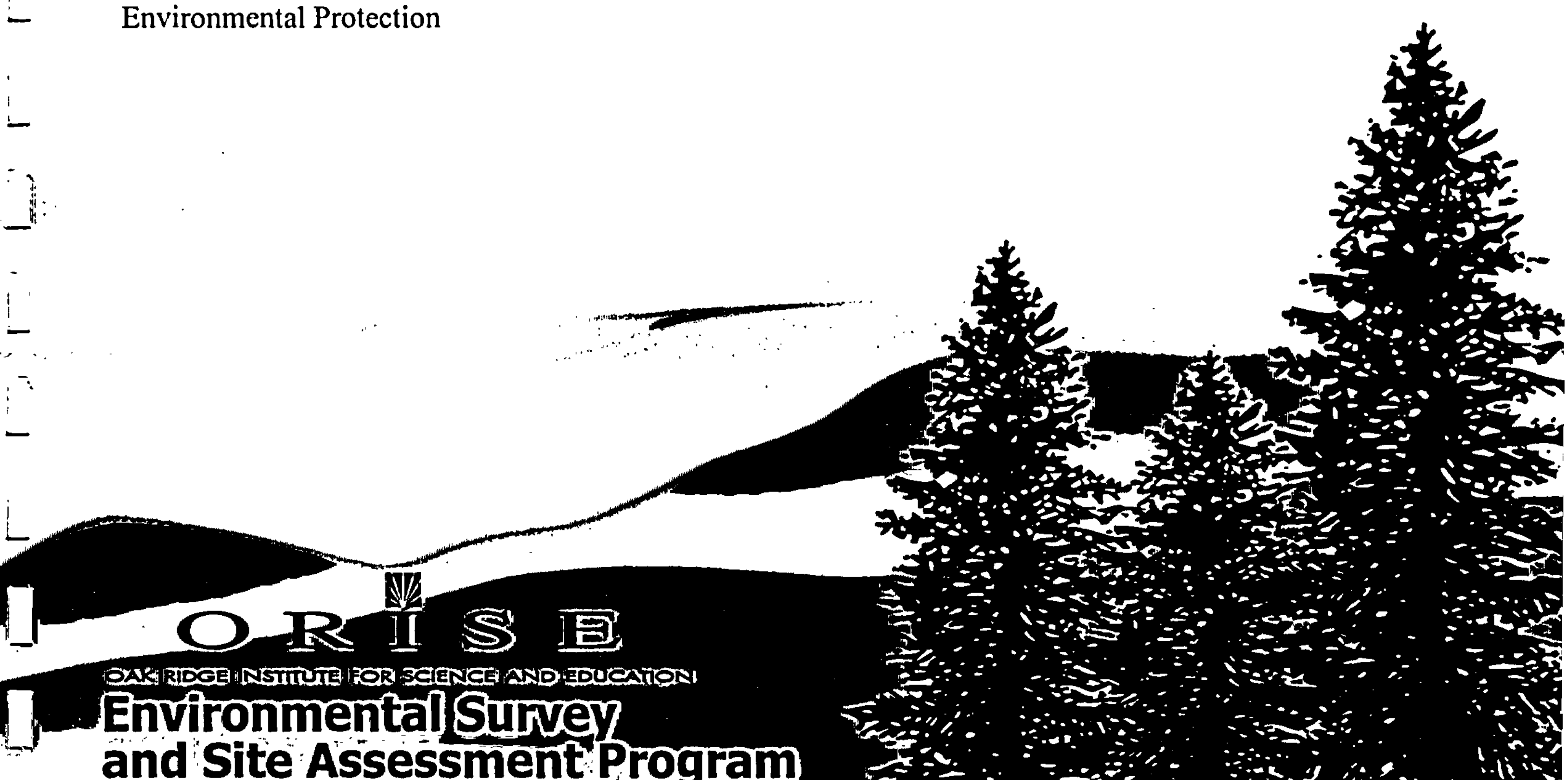
CONFIRMATORY SURVEY OF THE ADMINISTRATION BUILDING AT THE CONNECTICUT YANKEE HADDAM NECK PLANT HADDAM, CONNECTICUT [DOCKET NO. 50-0213, RFTA NO. 03-008]

W. C. ADAMS

Prepared for the
U.S. Nuclear Regulatory Commission
Division of Waste Management and
Environmental Protection



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Division of Waste Management
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FINAL REPORT

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CONFIRMATORY SURVEY OF THE ADMINISTRATION BUILDING AT THE CONNECTICUT YANKEE HADDAM NECK PLANT HADDAM, CONNECTICUT

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ABBREVIATIONS AND ACRONYMS

β-γ	beta-gamma
d_i	index of sensitivity
ε_{total}	total efficiency
ε_i	instrument efficiency
ε_s	surface efficiency
BKG	background
cm	centimeter
Co-60	cobalt-60
cpm	counts per minute
Cs-137	cesium-137
CYAPCO	Connecticut Yankee Atomic Power Company
DOE	Department of Energy
dpm	disintegrations per minute per 100 square centimeters
ESSAP	Environmental Survey and Site Assessment Program
ft	feet
HNP	Haddam Neck Plant
ISM	integrated safety management
ITP	Intercomparison Testing Program
JHA	job hazard analysis
MAPEP	Mixed Analyte Performance Evaluation Program
MDC	minimum detectable concentration
MDCR	minimum detectable count rate
min	minute
mm	millimeter
msl	mean sea level
MW	megawatts
NaI	sodium iodide
NIST	National Institute of Standards and Technology
NRC	Nuclear Regulatory Commission
NRIP	NIST Radiochemistry Intercomparison Program
ORISE	Oak Ridge Institute for Science and Education
PSDAR	Post Shutdown Decommissioning Activities Report
RCA	radiologically controlled area
sec	second
SU	survey unit
Tc-99	technetium-99
URS	unconditional release survey

CONFIRMATORY SURVEY
OF THE ADMINISTRATION BUILDING
AT THE CONNECTICUT YANKEE HADDAM NECK PLANT
HADDAM, CONNECTICUT

INTRODUCTION AND SITE HISTORY

The Connecticut Yankee Haddam Neck Plant (HNP), owned by the Connecticut Yankee Atomic Power Company (CYAPCO), began commercial operation in January 1968 under Atomic Energy Commission Docket Number 50-213, License Number DPR-61. The plant incorporated a 4-loop, closed-cycle, pressurized water type nuclear steam supply system; a turbine generator and electrical systems; engineered safety features; radioactive waste systems; fuel handling systems; instrumentation and control systems; and the necessary auxiliaries and structures to house plant systems and other onsite facilities. HNP was designed to produce 1,825 megawatts (MW) of thermal power and 590 MW of gross electrical power.

On December 4, 1996, the HNP permanently shut down after approximately 28 years of operation. On December 5, 1996, CYAPCO notified the U.S. Nuclear Regulatory Commission (NRC) of the permanent cessation of operations at the HNP and the permanent removal of all fuel assemblies from the Reactor Pressure Vessel and their placement in the Spent Fuel Pool. The CYAPCO board of directors voted to permanently cease further operation and decommission the plant and submitted the Post Shutdown Decommissioning Activities Report (PSDAR), in accordance with 10CFR50.82 (a)(4), on August 22, 1997. The PSDAR was accepted by the NRC. On January 26, 1998, CYAPCO transmitted an updated Final Safety Analysis Report to reflect the plant's permanent shutdown status, and on June 30, 1998, the NRC amended the HNP Facility Operating License to reflect this plant condition (CYAPCO 2002).

CYAPCO conducted decontamination efforts and performed surveys in the Administration Building using an unconditional release survey (URS) procedure (CYAPCO 2004a). The objective of the URS procedure is to provide guidance for preparing, performing, documenting, and approving pre-demolition surveys for offsite release of secondary side buildings and structures, which are intended to be unconditionally released from the site. The licensee provided the URS results for the Administration Building to the NRC for review. CYAPCO surveys encompassed the first and second floors of the interior of the building and the exterior surfaces of the building.

The NRC's Headquarters and Region I Offices requested that the Oak Ridge Institute for Science and Education's (ORISE), Environmental Survey and Site Assessment Program (ESSAP) perform confirmatory surveys of the Administration Building after CYAPCO completed URS reports for the survey units that are to be released.

SITE DESCRIPTION

The HNP is located at 362 Injun Hollow Road in the Town of Haddam, Middlesex County, Connecticut on the east bank of the Connecticut River at a point 21 miles south-southeast of Hartford, Connecticut, and 25 miles northeast of New Haven, Connecticut (Figure 1).

The HNP is a 525 acre site on a level, 600-foot (ft)-wide terrace at an elevation of 21 ft above mean sea level (msl). A parking lot occupies the area to the north of the industrial area. Adjacent to the parking lot is a small man-made pond. A 5,500 foot-long cooling water discharge canal return was constructed and used during plant operation to return heated circulating water from the secondary plant back to the Connecticut River and to process and discharge liquids containing radioactivity. The discharge canal is separated from the Connecticut River by a 200 to 1,000 ft wide peninsula flood plain that ranges in elevation from about 5 to 15 ft above msl. A steep, wooded hill rises immediately east of the industrial area to elevations over 300 ft above msl. The lowermost 30 to 40 ft of the hillside adjacent to the plant consists of nearly vertical rock cut.

The HNP design includes several structures engineered and constructed to contain radioactive material. These structures include the Containment Building, the Primary Auxiliary Building, the Service Building, the Waste Storage Building, Ion Exchange Structure, Spent Resin Facility, and structures containing tanks for storage of radioactive liquids. These structures and facilities are located within the Radiologically Controlled Area (RCA) boundaries. The site also includes ancillary facilities that were used to support normal plant operations. These facilities consist of warehouses, administrative office buildings, an information center and Emergency Operations

Facility. Most buildings and facilities are centrally located on a 15 acre plot adjacent to the Connecticut River (Figure 2).

For this report, confirmatory surveys were performed on the Administration Building (Figures 2 through 4). The Administration Building is a two-story, red brick structure with concrete floors and outer walls of concrete block and inner walls of white brick, ceramic tile, concrete, sheetrock, metal panels and glass. The building contains several offices for station management, conference rooms and restrooms. All areas of the Administration Building were outside the RCA.

OBJECTIVES

The objectives of the confirmatory survey were to provide independent contractor field data reviews and to generate independent radiological data for use by the NRC in evaluating the adequacy and accuracy of the licensee's procedures and URS results and conclusions.

SURVEY PROCEDURES

ESSAP performed confirmatory survey activities on the two judgmentally-selected survey units (SU) within the Administration Building at the Connecticut Yankee Haddam Neck Plant in Haddam, Connecticut on March 17, 2004. The selected SUs were the First Floor, Area 1 and the Second Floor, Area 4. These SUs were selected based on their proximity to the main traffic areas on each floor. Survey activities consisted of alpha plus beta and gamma surface scans, total beta surface activity measurements and removable alpha and beta surface activity measurements. These survey activities were conducted in accordance with a site-specific inspection plan, submitted to and approved by the NRC, and the ORISE/ESSAP Survey Procedures and Quality Assurance Manuals (ORISE 2004a , 2003, and 2004b).

DOCUMENT/DATA REVIEW/PERFORMANCE OBSERVATIONS

ESSAP reviewed CYAPCO's survey documentation to determine the appropriateness and adequacy of the URS radiological instrumentation and procedures (CYAPCO 2004b, c and d). The URS results for the Administration Building were provided prior to ESSAP's confirmatory survey activities. ESSAP personnel also observed a CYAPCO technician perform routine survey activities in the Administration Building.

Reference System

The reference grid system established by the licensee was used to reference measurement and sampling locations within the Administration Building.

Surface Scans

Alpha plus beta and gamma radiation surface scans were performed on up to 75% of the floor and lower wall surfaces and approximately 5% of the upper surfaces in the selected survey units. Scans were performed using gas proportional and NaI scintillation detectors coupled to ratemeters or ratemeter-scalers with audible indicators.

Surface Activity Measurements

Construction material specific backgrounds were performed on poured concrete and white brick in the Administration Building, which were the only locations available with these materials; other construction material specific backgrounds were performed in the Office Building. ESSAP personnel performed direct measurements for alpha and beta surface activity at 20 locations within the Administration Building (10 locations in each selected SU). Measurement locations were randomly selected to encompass a wide area within the selected SUs and included floors, lower walls and upper surfaces. Direct measurements were performed using gas proportional detectors coupled to ratemeter-scalers. Smear samples, for determining removable gross alpha and gross beta activity levels, were collected from each direct measurement location. Measurement locations are shown on Figures 3 and 4.

SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data were sent to the ORISE/ESSAP laboratory in Oak Ridge, Tennessee for analysis and interpretation. Sample analyses were performed in accordance with the ORISE/ESSAP Laboratory Procedures Manual (ORISE 2004c). Smears were analyzed for gross alpha and gross beta activity using a low-background gas proportional counter. Smear sample results and direct measurement data were reported in units of disintegrations per minute per 100 square centimeters (dpm/100 cm^2).

Survey data were then compared with the licensee's pre-demolition contamination limits documented in Table 2, Section 6.3 of their URS procedure (CYAPCO 2004a). The procedure incorporated the surface contamination control criteria of NRC IE Circular 81-07 and NRC Information Notice No. 85-92 (NRC 1981 and 1985). The primary contaminants of concern for the Administration Building were beta-gamma emitters—fission and activation products—resulting from reactor operation. Appendices A and B provide additional information concerning major instrumentation, sampling equipment, and analytical procedures discussed in this report, including minimum detectable concentrations for field and laboratory instruments.

FINDINGS AND RESULTS

DOCUMENT REVIEW AND PERFORMANCE OBSERVATION

ESSAP reviewed the licensee's URS documentation and observed a CYAPCO technician performing routine surveys within the Administration Building. The reviews, the performance observation, and the subsequent ESSAP surveys indicated that there were some basic issues concerning CYAPCO's radiological survey procedures.

During the performance observation, a CYAPCO technician performed a background scan by placing a thin aluminum shield over the beta scintillator face and turned the instrument face away from the wall surface to collect the instrument "ambient" background scan range. The technician then took the shield off and placed the face of the instrument approximately 1 cm from the surface of the wall and performed a surface scan of the same area. Upon completion of the scan, the technician checked a box on a field survey record form that states that "No detectable activity identified during scan." The technician did not record the scan range or perform a direct measurement. This technique was used for areas with low potential for contamination.

ESSAP identified the absence of CYAPCO final scan data and/or direct measurement data documentation in the URS reports and discussed this observation with the NRC. ESSAP and NRC then discussed surface scanning procedures/techniques with CYAPCO personnel during the close-out meeting. ESSAP recommended that CYAPCO consider the appropriateness of not documenting scan results. The NRC documented the observations and conclusions in the NRC Inspection Report No. 05000213/2004001.

SURFACE SCANS

Alpha plus beta and gamma surface scans of the selected SUs floors, lower walls and upper surfaces did not identify any area of elevated direct radiation.

SURFACE ACTIVITY LEVELS

Results of total and removable surface activity for the Administration Building are provided in Table 1. Total beta surface activity for the First Floor, Area 1 ranged from -360 to 570 dpm/100 cm^2 and for the Second Floor, Area 4 ranged from -310 to 800 dpm/100 cm^2. Removable surface activity for both areas ranged from 0 to 1 dpm/100 cm^2 for gross alpha and -3 to 7 dpm/100 cm^2 for gross beta.

COMPARISON OF RESULTS WITH GUIDELINES

The primary contaminants of concern for the CYAPCO are beta-gamma emitters—fission and activation products—resulting from reactor operation. Cesium-137 (Cs-137) and cobalt-60 (Co-60) were identified during characterization as the predominant radionuclides present on surfaces. The minimum detection criteria from NRC IE Circular 81-07 (NRC 1981) are as follows:

<u>Total Activity</u>

5,000 β-γ dpm/100 cm^2, maximum in a 100 cm^2 area

<u>Removable Activity</u>

1,000 β-γ dpm/100 cm^2

The supplemental guidance to IE Circular 81-07, NRC Information Notice No. 85-92 states that "In practice, no radioactive (licensed) material means no detectable radioactive material." CYAPCO used "No detectable activity identified during scan" as a release limit for URS criteria.

No confirmatory direct measurements performed in the Administration Building exceeded the criteria and confirmatory surface scans did not indicate any direct radiation above surface material backgrounds.

SUMMARY

At the request of the Nuclear Regulatory Commission's Headquarters and Region I Offices, the Environmental Survey and Site Assessment Program of the Oak Ridge Institute for Science and Education conducted a confirmatory survey of the Administration Building at the Connecticut Yankee Atomic Power Company Haddam Neck Plant, in Haddam, Connecticut. Confirmatory activities were performed on March 17, 2004 and included reviews of unconditional release survey procedures and data, surface scans, direct surface activity measurements and performance observations. Overall, the results of the survey activities confirmed that the radiological conditions of the Administration Building met the licensee's pre-demolition contamination limits documented in Table 2, Section 6.3 of their unconditional release survey procedure (CYAPCO 2004a) and also included recommendations for enhancing survey documentation.

FIGURES

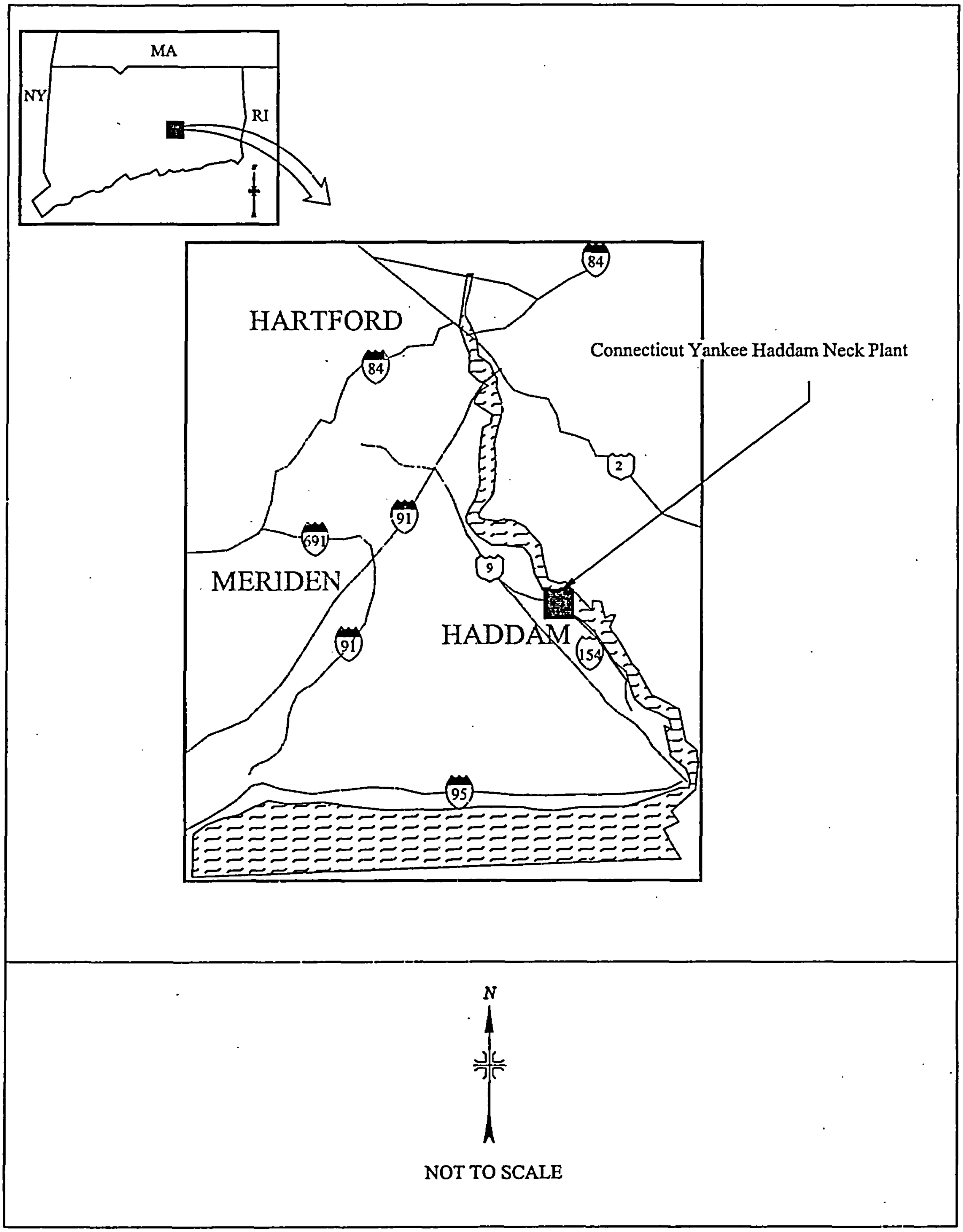

FIGURE 1: Location of the Connecticut Yankee Haddam Neck Plant - Haddam, Connecticut

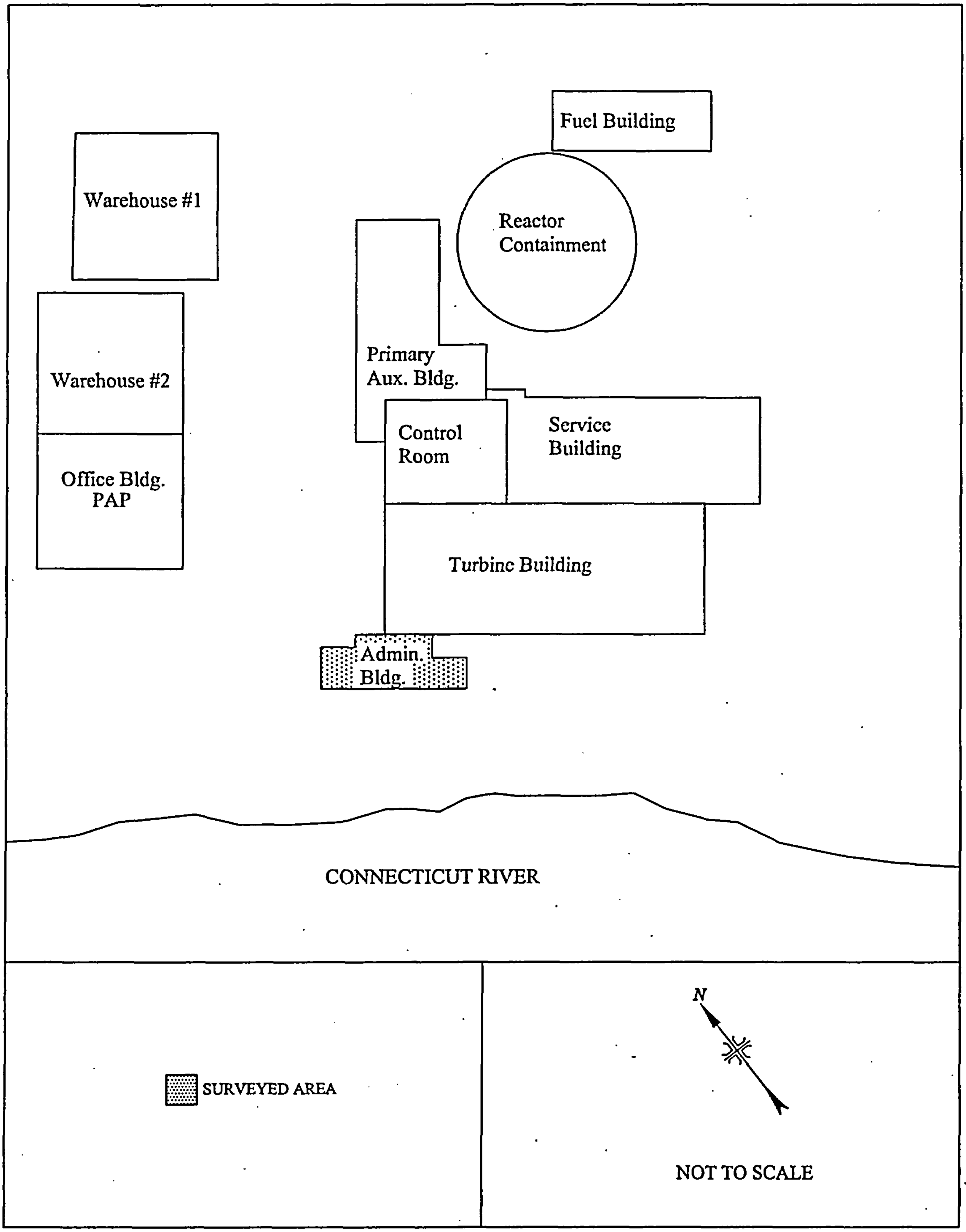

FIGURE 2: Plot Plan of Buildings at the Connecticut Yankee Haddam Neck Plant Indicating Location of the Administration Building

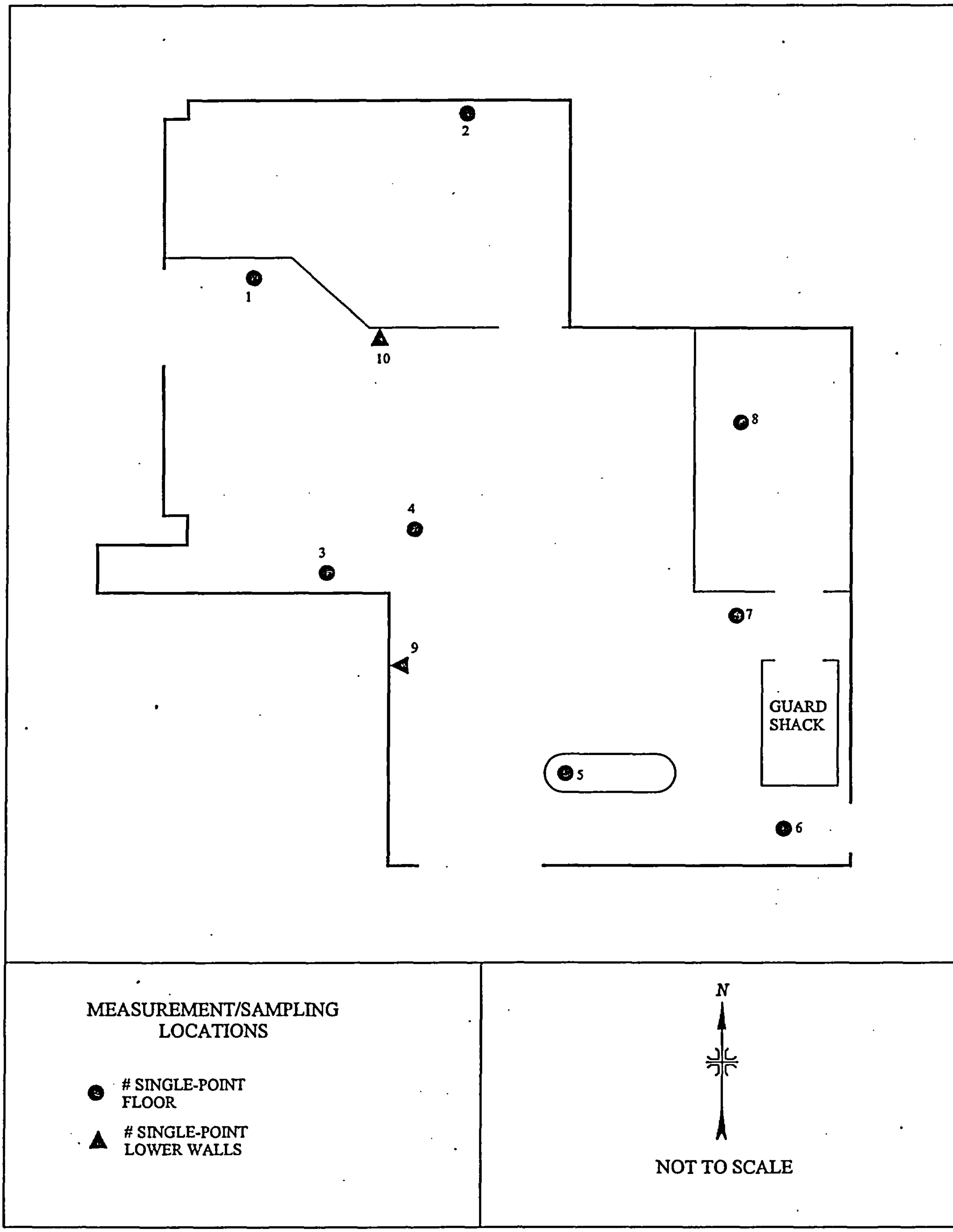

FIGURE 3: Administration Building, First Floor, Area 1 - Measurement and Sampling Locations

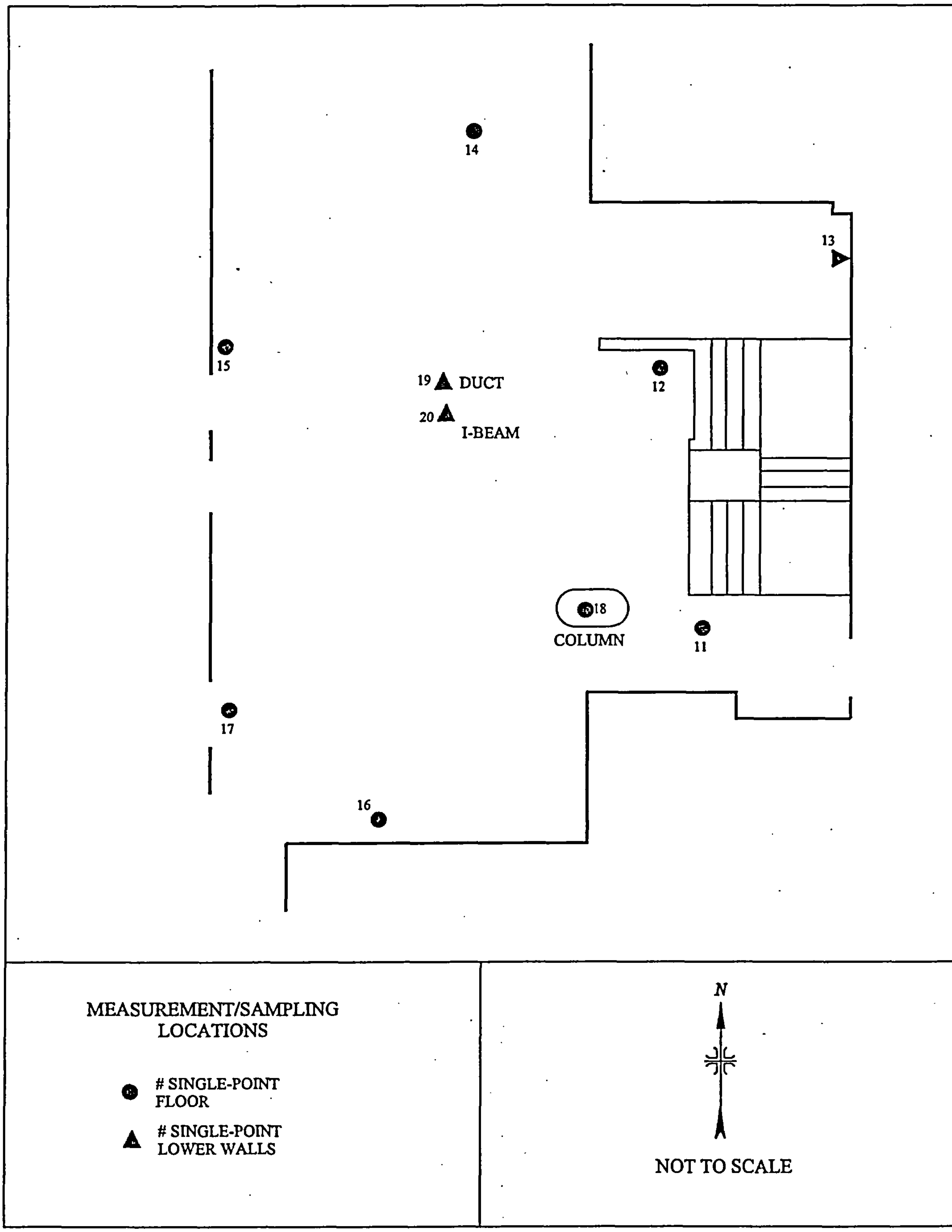

FIGURE 4: Administration Building, Second Floor, Area 4 - Measurement and Sampling Locations

TABLE

TABLE 1

SURFACE ACTIVITY LEVELS
ADMINISTRATION BUILDING
CONNECTICUT YANKEE HADDAM NECK PLANT
HADDAM, CONNECTICUT

Location[a]	Surface[b]	Surface Material	Total Beta Activity (dpm/100 cm^2)	Removable Activity (dpm/100 cm^2)	
				Alpha	Beta
First Floor, Area 1					
1	LW	Sheetrock	280	0	4
2	LW	White Brick	130	1	4
3	LW	White Brick	430	0	1
4	F	Tile	12	0	-2
5	LW	I-Beam	330	0	4
6	F	Tile	130	0	7
7	LW	Concrete Block	570	0	2
8	F	Concrete	160	0	-3
9	UW	White Brick	-360	0	-3
10	UW	Sheetrock	310	0	3
Second Floor, Area 4					
11	F	Concrete	-49	0	6
12	LW	White Brick	-90	0	4
13	UW	Plaster/Sheetrock	460	0	3
14	F	Concrete	-130	0	-2
15	LW	Plaster/Sheetrock	800	1	3
16	LW	Plaster/Sheetrock	380	0	-1
17	F	Concrete	-310	0	-2
18	LW	I-Beam	290	0	-1
19	US	Exhaust Duct	370	0	-2
20	US	I-Beam	-90	0	2

[a]Refer to Figures 3 and 4.
[b]F= floor, LW = lower wall and US = upper surface.

REFERENCES

Connecticut Yankee Atomic Power Company (CYAPCO). License Termination Plan, Connecticut Yankee Decommissioning Project, Haddam Neck Plant, Revision 1A. Haddam, Connecticut; October 2002.

Connecticut Yankee Atomic Power Company. Unconditional Release Surveys of Secondary Side Structures Prior to Demolition. CYAPCO Procedure No. GPP-GGGR-R2210-000 (RPM 2.2-28), Revision CY-000. Haddam, Connecticut; February 26, 2004a.

Connecticut Yankee Atomic Power Company. Survey Plan 134-01, Admin Building, First Floor Interior. Haddam, Connecticut; March 2004b.

Connecticut Yankee Atomic Power Company. Survey Plan 134-02, Admin Building, Second Floor Interior. Haddam, Connecticut; March 2004c.

Connecticut Yankee Atomic Power Company. Survey Plan 134-03, Admin Building, Exterior Surfaces. Haddam, Connecticut; March 2004d.

Oak Ridge Institute for Science and Education (ORISE). Survey Procedures Manual for the Environmental Survey and Site Assessment Program. Oak Ridge, Tennessee; November 7, 2003.

Oak Ridge Institute for Science and Education. Revised Site-Specific Decommissioning Inspection Plan for the Connecticut Yankee Decommissioning Project, Haddam, Connecticut (Docket No. 50-0213; RFTA No. 03-008). Oak Ridge, Tennessee; March 9, 2004a.

Oak Ridge Institute for Science and Education. Quality Assurance Manual for the Environmental Survey and Site Assessment Program. Oak Ridge, Tennessee; January 7, 2004b.

Oak Ridge Institute for Science and Education. Laboratory Procedures Manual for the Environmental Survey and Site Assessment Program. Oak Ridge, Tennessee; March 16, 2004c.

U.S. Nuclear Regulatory Commission (NRC). IE Circular No. 81-07: Control of Radioactively Contaminated Material. Washington, DC; May 14, 1981.

U.S. Nuclear Regulatory Commission. Information Notice No. 85-92: Surveys of Wastes Before Disposal from Nuclear Reactor Facilities. Washington, DC; December 2, 1985.

APPENDIX A

MAJOR INSTRUMENTATION

APPENDIX A

MAJOR INSTRUMENTATION

The display of a specific product is not to be construed as an endorsement of the product or its manufacturer by the author or his employer.

SCANNING INSTRUMENT/DETECTOR COMBINATIONS

<u>Alpha plus Beta</u>

Ludlum Floor Monitor Model 239-1
combined with
Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-37, Physical Area: 550 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

<u>Gamma</u>

Eberline Pulse Ratemeter Model PRM-6
(Eberline, Santa Fe, NM)
coupled to
Victoreen NaI Scintillation Detector Model 489-55, Crystal: 3.2 cm x 3.8 cm
(Victoreen, Cleveland, OH)

DIRECT MEASUREMENT INSTRUMENT/DETECTOR COMBINATIONS

<u>Beta</u>

Ludlum Ratemeter-Scaler Model 2221
coupled to
Ludlum Gas Proportional Detector Model 43-68, Physical Area: 126 cm^2
(Ludlum Measurements, Inc., Sweetwater, TX)

LABORATORY ANALYTICAL INSTRUMENTATION

Low-Background Gas Proportional Counter
Model LB-5100-W
(Tennelec/Canberra, Meriden, CT)

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

APPENDIX B

SURVEY AND ANALYTICAL PROCEDURES

PROJECT HEALTH AND SAFETY

The proposed survey and sampling procedures were evaluated to ensure that any hazards inherent to the procedures themselves were addressed in current job hazard analyses (JHAs). All survey and laboratory activities were conducted in accordance with ORISE health and safety and radiation protection procedures.

Pre-survey activities included the evaluation and identification of potential health and safety issues. Of particular concern for the Administration Building were tripping hazards and cold weather conditions. Survey work was performed per the ORISE generic health and safety plans and a site-specific integrated safety management (ISM) pre-job hazard checklist. CYAPCO also provided site-specific safety awareness training.

CALIBRATION AND QUALITY ASSURANCE

Calibration of all laboratory instrumentation was based on standards/sources, traceable to NIST, when such standards/sources were available. In cases where they were not available, standards of an industry-recognized organization were used.

Analytical and field survey activities were conducted in accordance with procedures from the following Environmental Survey and Site Assessment Program documents:

- Survey Procedures Manual (November 2003)
- Laboratory Procedures Manual (March 2004)
- Quality Assurance Manual (January 2004)

The procedures contained in these manuals were developed to meet the requirements of Department of Energy (DOE) Order 414.1A and the U.S. Nuclear Regulatory Commission *Quality Assurance Manual for the Office of Nuclear Material Safety and Safeguards* and contain measures to assess processes during their performance.

Quality control procedures include:

- Daily instrument background and check-source measurements to confirm that equipment operation is within acceptable statistical fluctuations.
- Participation in MAPEP, NRIP and ITP Laboratory Quality Assurance Programs.
- Training and certification of all individuals performing procedures.
- Periodic internal and external audits.

Detectors used for assessing surface activity were calibrated in accordance with ISO-7503[1] recommendations. The total efficiency (ε_{total}) was determined for each instrument/detector combination and consisted of the product of the 2π instrument efficiency (ε_i) and surface efficiency (ε_s): $\varepsilon_{total} = \varepsilon_i \times \varepsilon_s$. The static ε_i was determined to be 0.39 during instrument calibration with Tc-99; the scanning ε_i was determined to be 0.30 for Tc-99 based on ESSAP experience.

Tc-99 was selected as the calibration source (maximum beta energy of 292 keV) as it provides a conservative representation of the radionuclide mixture. ISO-7503[1] recommends an ε_s of 0.25 for beta emitters with a maximum energy of less than 0.4 MeV (400 keV) and an ε_s of 0.5 for maximum beta energies greater than 0.4 MeV. Since the maximum beta energy for the CYAPCO primary contaminant of concern (Cs-137) is greater than 0.4 MeV, an ε_s of 0.5 was used to calculate ε_{total}.

SURVEY PROCEDURES

Surface Scans

Surface scans were performed by passing the detectors slowly over the surface; the distance between the detector and the surface was maintained at a minimum—nominally about 1 cm. A NaI scintillation detector was used to scan for elevated gamma radiation. Floor and wall surfaces and indentations were scanned using small area (126 cm^2) hand-held detectors. Identification of

[1] International Standard. ISO 7503-1, Evaluation of Surface Contamination - Part 1: Beta-emitters (maximum beta energy greater than 0.15 MeV) and alpha-emitters. August 1, 1988.

elevated levels was based on increases in the audible signal from the recording and/or indicating instrument.

Scan minimum detectable concentrations (MDCs) were estimated using the calculational approach described in NUREG-1507[2]. The scan MDC is a function of many variables, including the background level. The background count rates for the gas proportional detectors averaged 414 cpm for concrete, 189 cpm for metal, 806 cpm for white brick, 219 cpm for sheetrock, 489 cpm for floor tile, 675 cpm for glazed tile and 410 cpm for ambient air measurements. Additional parameters selected for the calculation of scan MDC included a two-second observation interval, a specified level of performance at the first scanning stage of 95% true positive rate and 25% false positive rate, which yields a d' value of 2.32 (NUREG-1507, Table 6.1), and a surveyor efficiency of 0.5. To illustrate an example for the hand-held gas proportional detectors, the minimum detectable count rate (MDCR) and scan MDC can be calculated as follows for concrete surfaces:

b_i = (414 cpm) (2 sec) (1 min/60 sec) = 13.8 counts

MDCR = (2.32) (13.8 counts)$^{1/2}$ [(60 sec/min) / (2 sec)] = 259 counts

$MDCR_{surveyor}$ = 259 / (0.5)$^{1/2}$ = 366 cpm

The scan MDC is calculated using the scanning ε_{total} of 0.15:

$$Scan\,MDC = \frac{MDCR_{surveyor}}{\varepsilon_{total}}\ \text{dpm}/100\ \text{cm}^2$$

The scan MDC for the gas proportional detectors used was approximately 2,400 dpm/100 cm^2 for concrete surfaces.

Specific scan MDCs for the NaI scintillation detector for Cs-137 and Co-60 in concrete and tile floor surfaces were not determined as the instrument was used solely as a qualitative means to identify elevated gamma radiation for possible concrete sampling.

[2]NUREG-1507. Minimum Detectable Concentrations With Typical Radiation Survey Instruments for Various Contaminants and Field Conditions. U.S. Nuclear Regulatory Commission. Washington, DC; June 1998.

Surface Activity Measurements

Measurements of total beta surface activity levels were performed using a gas proportional detector with portable ratemeter-scalers. Count rates (cpm), which were integrated over one minute with the detector held in a static position, were converted to activity levels (dpm/100 cm^2) by dividing the net count rate by ε_{total} and correcting for the physical area of the detector.

Because different building materials (poured concrete, brick, wood, steel, etc.) may have different background levels, average background count rates were determined for each material encountered in the surveyed area at a location of similar construction and having no known radiological history.

The static beta MDCs—calculated using the average construction material background count rates for concrete, metal, white brick, sheetrock, floor tile, glazed tile, and ambient air within the building—for the single gas proportional detector (calibrated to Tc-99) used for direct measurements ranged from 272 to 550 dpm/100 cm^2. The physical surface area assessed by the gas proportional detector used was 126 cm^2.

Removable Activity Measurements

Removable gross alpha and gross beta activity levels were determined using numbered filter paper disks, 47 mm in diameter. Moderate pressure was applied to the smear and approximately 100 cm^2 of the surface was wiped. Smears were placed in labeled envelopes with the location and other pertinent information recorded.

RADIOLOGICAL ANALYSIS

Gross Alpha/Beta

Smears were counted for two minutes on a low-background gas proportional system for gross alpha and beta activity. The MDCs of the procedure were 8 dpm/100 cm^2 and 15 dpm/100 cm^2 for gross alpha and gross beta, respectively.

DETECTION LIMITS

Detection limits, referred to as minimum detectable concentration (MDC), were based on 3 plus 4.65 times the standard deviation of the background count [$3 + (4.65\sqrt{BKG})$]. Because of variations in background levels, measurement efficiencies, and contributions from other radionuclides in samples, the detection limits differ from sample to sample and instrument to instrument.

APPENDIX C

IE CIRCULAR NO. 81-07: CONTROL OF RADIOACTIVELY CONTAMINATED MATERIAL

AND

INFORMATION NOTICE NO. 85-92: SURVEYS OF WASTES BEFORE DISPOSAL FROM NUCLEAR REACTOR FACILITIES

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C. 20555

May 14, 1981

IE Circular No. 81-07: CONTROL OF RADIOACTIVELY CONTAMINATED MATERIAL

Description of Circumstances:

Information Notice No. 80-22 described events at nuclear power reactor facilities regarding the release of radioactive contamination to unrestricted areas by trash disposal and sale of scrap material. These releases to unrestricted areas were caused in each case by a breakdown of the contamination control program including inadequate survey techniques, untrained personnel performing surveys, and inappropriate material release limits.

The problems that were described in IE Information Notice No. 80-22 can be corrected by implementing an effective contamination control program through appropriate administrative controls and survey techniques. However, the recurring problems associated with minute levels of contamination have indicated that specific guidance is needed by NRC nuclear power reactor licensees for evaluating potential radioactive contamination and determining appropriate methods of control. This circular provides guidance on the control of radioactive contamination. Because of the limitations of the technical analysis supporting this guidance, this circular is applicable only to nuclear power reactor facilities.

Discussion:

During routine operations, items (e.g., tools and equipment) and materials (e.g., scrap material, paper products, and trash) have the potential of becoming slightly contaminated. Analytical capabilities are available to distinguish very low levels of radioactive contamination from the natural background levels of radioactivity. However, these capabilities are often very elaborate, costly, and time consuming making their use impractical (and unnecessary) for routine operations. Therefore, guidance is needed to establish operational detection levels below which the probability of any remaining, undetected contamination is negligible and can be disregarded when considering the practicality of detecting and controlling such potential contamination and the associated negligible radiation doses to the public. In other words, guidance is needed which will provide reasonable assurance that contaminated materials are properly controlled and disposed of while at the same time providing a practical method for the uncontrolled release of materials from the restricted area. These levels and detection capabilities must be set considering these factors: 1) the practicality of conducting a contamination survey, 2) the potential of leaving minute levels of contamination undetected; and, 3) the potential radiation doses to individuals of the public resulting from potential release of any undetected, uncontrolled contamination.

Studies performed by Sommers[1] have concluded that for discrete particle low-level contamination, about 5000 dpm of beta activity is the minimum level of activity that can be routinely detected under a surface contamination control program using direct survey methods. The indirect method of contamination monitoring (smear survey) provides a method of evaluating removable (loose, surface) contamination at levels below which can be detected by the direct survey method. For smears of a 100 cm^2 area (a de facto industry standard), the corresponding detection capability with a thin window detector and a fixed sample geometry is on the order of 1000 dpm (i.e., 1000 dpm/100 cm^2). Therefore, taking into consideration the practicality of conducting surface contamination surveys; contamination control limits should not be set below 5000 dpm/100 cm^2 total and 1000 dpm/100 cm^2 removable. The ability to detect minute, discrete particle contamination depends on the activity level, background, instrument time constant, and survey scan speed. A copy of Sommers studies is attached which provides useful guidance on establishing a contamination survey program.

Based on the studies of residual radioactivity limits for decommissioning (NUREG-0613[2] and NUREG-0707[3]), it can be concluded that surfaces uniformly contaminated at levels of 5000 dpm/100 cm^2 (beta-gamma activity from nuclear power reactors) would result in potential doses that total less than 5 mrem/yr. Therefore, it can be concluded that for the potentially undetected contamination of discrete items and materials at levels below 5000 dpm/100 cm^2, the potential dose to any individual will be significantly less than 5mrem/yr even if the accumulation of numerous items contaminated at this level is considered.

Guidance:

Items and material should not be removed from the restricted area until they have been surveyed or evaluated for potential radioactive contamination by a qualified* individual. Personal effects (e.g., notebooks and flash lights) which are hand carried need not be subjected to the qualified individual survey or evaluation, but these items should be subjected to the same survey requirements as the individual possessing the items. Contaminated or radioactive items and materials must be controlled, contained, handled, used, and transferred in accordance with applicable regulations.

The contamination monitoring using portable survey instruments or laboratory measurements should be performed with instrumentation and techniques (survey scanning speed, counting times, background radiation levels) necessary to detect 5000 dpm/100 cm^2 total and 1000 dpm/100 cm^2 removable beta/gamma contamination. Instruments should be calibrated with radiation sources having consistent energy spectrum and instrument response with the

*A qualified individual is defined as a person meeting the radiation protection technician qualifications of Regulatory Guide 1.8, Rev. 1, which endorses ANSI N18.1, 1971.

radionuclides being measured. If alpha contamination is suspected appropriate surveys and/or laboratory measurements capable of detecting 100 dpm/100 cm^2 fixed and 20 dpm/100 cm^2 removable alpha activity should be performed.

In evaluating the radioactivity on inaccessible surfaces (e.g., pipes, drain lines, and duct work), measurements at other appropriate access points may be used for evaluating contamination provided the contamination levels at the accessible locations can be demonstrated to be representative of the potential contamination at the inaccessible surfaces. Otherwise, the material should not be released for unrestricted use.

Draft ANSI Standard 13.12[4] provides useful guidance for evaluating radioactive contamination and should be considered when establishing a contamination control and radiation survey program.

No written response to this circular is required. If you have any questions regarding this matter, please contact this office.

REFERENCES

1 Sommers, J. F., "Sensitivity of Portable Beta-Gamma Survey Instruments," Nuclear Safety, Volume 16, No. 4, July-August 1975.

2 U.S. Nuclear Regulatory Commission, "Residual Radioactivity Limits for Decommissioning, Draft Report," Office of Standards Development, USNRC NUREG-0613, October 1979.

3 U.S. Nuclear Regulatory Commission, "A Methodology for Calculating Residual Radioactivity Levels Following Decommissioning," USNRC NUREG-0707, October 1980.

4 Draft ANSI Standard 13.12, "Control of Radioactive Surface Contamination on Materials, Equipment, and Facilities to be Released for Uncontrolled Use," American National Standards Institute, Inc., New York, NY, August 1978.

Attachments:
1. Reference 1 (Sommers Study)
2. Recently issued IE Circulars

SSINS No.: 6835
IN 85-92

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D.C. 20555

December 2, 1985

Information Notice No. 85-92: SURVEYS OF WASTES BEFORE DISPOSAL FROM NUCLEAR REACTOR FACILITIES

Addressees:

All production and utilization facilities, including nuclear power reactors and research and test reactors, holding an operating license (OL) or construction permit (CP).

Purpose:

The purpose of this information notice is to supplement the guidance of IE Circular 81-07 as it applies to surveys of solid waste materials before disposal from nuclear reactor facilities. It is expected that recipients will review the information for applicability to their facilities. However, this information notice does not constitute NRC requirements; therefore, no specific action or licensee response is required.

Description of Circumstance:

Some questions have arisen concerning appropriate methods of surveying solid waste materials for surface contamination before releasing them as nonradioactive (i.e., as wastes that do not contain NRC-licensed material).

Discussion:

The need to minimize the volume of radioactive waste generated and shipped to commercial waste burial sites is recognized by the NRC and industry. Some nuclear power plants have initiated programs to segregate waste generated in radiologically controlled areas. Such programs can contribute to the reduction in volume of radioactive waste; however, care should be taken to ensure that no licensed radioactive material is released contrary to the provisions of 10 CFR Section 20.301. In practice, no radioactive (licensed) material means no detectable radioactive material.

In 1981, IE Circular 81-07 was issued by the NRC. That circular provided guidance on the control of radioactively contaminated material and identified the extent to which licensees should survey for contamination. It did not establish release limits. The criteria in the circular that addressed surface contamination levels were based on the best information available at the time and were related to the detection capability of portable survey instruments equipped with thin-window "pancake" Geiger-Mueller (G.M.) probes, which respond primarily to beta radiation. Monitoring of aggregated, packaged material was not addressed. In 1981, there was no major emphasis on segregating waste from designated contamination areas. As a consequence, large volumes of monitored wastes were not being released for unrestricted disposal. However, because of recent emphasis on minimizing the volume of radioactive waste, current practices at many nuclear power facilities result in large volumes of segregated, monitored wastes, containing large total surface areas, being released as "clean" waste.

When scanning surfaces with a hand-held pancake probe, there is a chance that some contamination will not be detected. (See the papers by Sommers,[1] for example.) There is the chance also that the total surface area will not be scanned completely. Thus, when numerous items of "clean" material (e.g., paper and plastic items) are combined, the accumulation of small amounts of contamination that have escaped detection with the pancake probe may be detected using a detector that is sensitive to gamma radiation (e.g., by using a sensitive scintillation detector in a low-background area). Such measurements of packaged clean waste before disposal can reduce the likelihood that contaminated waste will be disposed of as clean waste, then found to be contaminated after disposal. (Some operators of sanitary landfills have begun to survey incoming waste for radioactivity using scintillation survey meters which in some cases are supplemented by portable gamma-ray spectrometers.[2])

In order to preclude the unintentional release of radioactive materials, a good monitoring program likely would include the following:

1. Careful surveys, using methods (equipment and techniques) for detecting very low levels of radioactivity, are made of materials that may be contaminated and that are to be disposed of as clean waste. These survey methods should provide licensees with reasonable assurance that licensed material is not being released from their control.

2. Surveys conducted with portable survey instruments using pancake G.M. probes are generally more appropriate for small items and small areas because of the loss of detection sensitivity created by moving the probe and the difficulties in completely scanning large areas. This does not preclude their use for larger items and areas, if supplemented by other survey equipment or techniques.

3. Final measurements of each package (e.g., bag or drum) of aggregated wastes are performed to ensure that there has hot been an accumulation of licensed material resulting from a buildup of multiple, nondetectable quantities (e.g., final measurements using sensitive scintillation detectors in low-background areas).

The foregoing does not constitute NRC requirements; therefore, no specific action or written response is required by this information notice. If you have any questions about this matter, please contact the Regional Administrator of the appropriate NRC regional office or this office.

Edward L. Jordan Director
Division of Emergency Preparedness
and Engineering Response
Office of Inspection and Enforcement

Technical Contact: John D. Buchanan, IE
(301) 492-9657

LeMoine J. Cunningham, IE
(301) 492-9664

Attachments:
1. References
2. List of Recently Issued IE Information Notices

Attachment 1
IN 85-92
December 2, 1985

REFERENCES

1 Sommers, J. F., (a) "Sensitivity of Portable Beta-Gamma Survey Instruments," Nuclear Safe 16 (No. 4), 452-457, July - August 1975, (b) "Sensitivity of GM and Ion-Chamber Beta Gamma Survey Instruments," Health Physics 28 (No. 6), pp. 775-761, June 1975.

2 Anonymous, "LA Nuclear Medicine Community Improves Radiation Monitoring at Landfills, " J. Nuclear Medicine 26 (#4), 336-337, April 1985.