ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

September 29, 2005

Mr. Theodore Smith
MailStop: T-7F27
Division of Waste Management
U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852

**SUBJECT: IN-PROCESS INSPECTION SURVEY RESULTS FOR THE WEST END EXCAVATION AND SERVICE BUILDING AT THE CONNECTICUT YANKEE HADDAM NECK PLANT, HADDAM, CONNECTICUT [DOCKET NO. 50-0213; RFTA NO. 03-008]**

Dear Mr. Smith:

The Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) performed in-process inspection survey activities within the West End Excavation at the Connecticut Yankee Haddam Neck Plant in Haddam, Connecticut, on April 12 and 13, 2005. These survey activities were requested and approved by the U.S. Nuclear Regulatory Commission (NRC). The survey activities included beta and gamma surface scans, direct measurements for beta activity, tritium smear sampling and soil sampling. ESSAP also requested that Connecticut Yankee provide several additional soil samples for analyses. While on-site, the NRC site representative also requested that ESSAP perform a cursory survey of the Service Building. Survey activities in the Service Building included alpha plus beta and gamma surface scans on portions of the floor and lower walls. Enclosed are the in-process survey results documenting those survey activities.

If you have any questions or comments, please direct them to me at (865) 576-0065 or Scott Kirk at (865) 574-0685.

Sincerely,

Wade C. Adams

Wade C. Adams
Health Physicist/Project Leader
Environmental Survey and
Site Assessment Program

WCA:ar

Enclosure

cc: T. McLaughlin, NRC/NMSS/TWFN T-7E18
E. Knox-Davin, NRC/NMSS/TWFN 8A23
L. Kauffman, NRC/Region I
J. Kottan, NRC/Region I
E. Abelquist, ORISE/ESSAP
S. Kirk, ORISE/ESSAP
M. Miller, NRC/Region I
File/0857

| Distribution approval and concurrence: | Initials |
|---|---|
| Technical Management Team Member | SJK |
| Laboratory Manager | RDC |
| Quality Manager | CTP |

# IN-PROCESS INSPECTION SURVEY RESULTS FOR THE WEST END EXCAVATION AND SERVICE BUILDING AT THE CONNECTICUT YANKEE HADDAM NECK PLANT HADDAM, CONNECTICUT

## INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) requested that the Oak Ridge Institute for Science and Education's (ORISE) Environmental Survey and Site Assessment Program (ESSAP) perform an in-process inspection survey of the West End Excavation at the Connecticut Yankee (CY) Haddam Neck Plant (HNP). While on site, the NRC site representative also requested that ESSAP perform a cursory survey of portions of the Service Building. The in-process inspection surveys were performed on April 12 and 13, 2005. The areas that were surveyed are provided in Figure 1.

## PROCEDURES

The in-process inspection surveys were performed in accordance with a site-specific survey plan that was submitted to and approved by the NRC (ORISE 2005a). The ORISE/ESSAP Survey Procedures and Quality Assurance Manuals were also followed (ORISE 2004a and 2005b).

### West End Excavation

Beta surface scans were performed using gas proportional detectors coupled to ratemeter-scalers with audible indicators. Surface scans were performed on up to 50% of the lower wall (up to 2 meters) structural surfaces and on approximately 50% of the exposed bedrock surfaces. Particular attention was given to cracks and joints in the evaluated structural and bedrock surfaces where material may have accumulated. All locations where elevated radiation was detected were marked for further investigation which included additional surface scans and direct measurements. Direct measurements for beta activity were performed at ten locations on the lower concrete wall structural surfaces and a tritium (H-3) smear was collected at each direct measurement location. Three direct measurements were performed on the bedrock surfaces at elevated activity locations as determined by the surface scans. Locations where direct measurements were taken are indicated on Figure 2.

Gamma surface scans were performed over 90% of accessible portions of the West End Excavation area to include soil and bedrock using sodium iodide (NaI) scintillation detectors coupled to ratemeters with audible indicators. However, access to some areas was restricted due to safety concerns.

Soil samples were collected from five locations (Figure 2) and CY personnel provided nine additional soil samples from the West End Excavation to ESSAP for sample analyses.

## Service Building

Alpha plus beta surface scans were performed on 25% of the accessible lower walls from the floor surfaces to a height of 2 meters and 15% of the floors. Areas of elevated activity were marked for further investigation. Additionally, NRC and CY personnel were subsequently notified of these findings. Direct measurements were not performed since this activity was considered a cursory inspection survey.

### SAMPLE ANALYSIS AND DATA INTERPRETATION

Radiological data and sample media were returned to ESSAP's laboratory in Oak Ridge, TN for analysis and interpretation. Radioassays were performed in accordance with the ESSAP Laboratory Procedures Manual (ORISE 2005c). Soil samples were analyzed by gamma spectroscopy for the primary radionuclides of interest (i.e., Co-60 and Cs-137). However, spectra were also reviewed for other gamma-emitting fission and activation products associated with the HNP and other identifiable total absorption peaks. The NRC requested additional Sr-90 and H-3 analyses for the CY-provided soil samples. Soil sample results were reported in units of picocuries per gram (pCi/g). Smear samples were analyzed for tritium activity using a liquid scintillation counter. Direct measurement data and smear data were converted to units of disintegrations per minute per 100 square centimeters (dpm/100 $cm^2$).

### FINDINGS AND RESULTS

## West End Excavation

Beta surface scans identified two areas of elevated activity on the lower wall concrete structures which were marked for further investigation. Total beta activity measurement results for the concrete structures ranged from -327 to 1,710 dpm/100 $cm^2$. Removable H-3 activity ranged from -2.4 to 19.2 dpm/100 $cm^2$.

A concrete core sample was removed from direct measurement location #6. The pre-remediation direct measurement result of this coring was 1,270 dpm/100 $cm^2$ and the post-remediation direct measurement result next to the removed concrete bore location was 790 dpm/100 $cm^2$. The licensee was to collect an additional core sample from elevated beta activity direct measurement location #9 and provide the sample results from both locations to ESSAP. The licensee's results are provided in the summary.

Beta surface scans identified four areas of elevated activity on the bedrock surfaces which were marked for further investigation. Direct measurements were performed at three of these locations depicted in Figure 1 that exhibited the highest beta activity. The results from these measurements ranged from 1,700 to 10,080 dpm/100 $cm^2$.

Gamma surface scans identified several locations of elevated direct gamma radiation on the bedrock surfaces and no elevated gamma activity on the soil surfaces. The areas of elevated gamma activity identified on the bedrock surfaces were believed to be attributable to natural background radioactivity within the bedrock. Further investigations by the licensee, as stated in the summary below, indicated that ESSAP's assumptions were correct.

The range of radionuclide concentrations for the five soil samples collected by ESSAP and the nine soil samples collected by the licensee are as follows:

| Radionuclides | Radionuclide Concentrations in Soil Samples (pCi/g) | |
|---|---|---|
| | ESSAP-Collected Samples | Licensee (CY)-Collected Samples |
| Co-60 | 0.01 – 0.28 pCi/g | 0.00 – 0.06 pCi/g |
| Cs-137 | 0.02 – 1.21 pCi/g | -0.02 – 0.05 pCi/g |
| Eu-152 | -0.03 – 0.01 pCi/g | -0.02 – 0.03 pCi/g |
| Eu-154 | -0.05 – 0.02 pCi/g | -0.22 – 0.10 pCi/g |
| H-3 | ---[a] | -0.7 – 6.6 pCi/g |
| Sr-90 | --- | -0.23 – 3.88 pCi/g |

[a]Analyses not performed.

A completing listing of surface activity and soil samples results are presented in Tables 1 and 2, respectively.

## Service Building

Two areas of elevated beta activity on the floor were identified during the alpha plus beta surface scans. One of these two areas had been previously identified by the licensee and the other was in a pipe drain which was not a part of the unrestricted release surveys and was to be disposed of as radiological waste. Apart from these two findings, gamma surface scans did not identify any areas of elevated gamma activity.

## SUMMARY

ESSAP identified four areas of elevated beta activity and requested additional information from the licensee to determine if those locations met the release criteria. These included the two areas on the lower wall concrete structural surfaces and two areas of elevated beta activity on the bedrock surfaces.

The licensee did not require beta surface activity release criteria for the West End Excavation area concrete structure surveys. Instead, the licensee performed beta scans and defined an elevated reading as twice the ambient background for the scan survey (CYAPCO 2005a). Therefore, the licensee collected core samples from the identified elevated areas and used a

volumetric guideline to determine if the elevated activity location met their volumetric release criteria.

To address the elevated beta activity determined by ESSAP on the concrete structure surfaces, the licensee collected a concrete core from ESSAP direct measurement location #6 and their radioassay of this core yielded a Sr-90 concentration of 3.39 pCi/g. As reported by the licensee, this coring had the highest reported Sr-90 activity for the Cable Vault Wall and was approximately twelve times the average for the data set. Based on the licensee's evaluation of the core sample from location #6, they did not collect a core sample from location #9 since they deemed it was not necessary because the "...higher elevated area was shown not to significantly impact future groundwater dose" (CYAPCO 2005b).

To address the elevated gamma activity identified by ESSAP on the bedrock surfaces and to determine if the activity was licensed material, the licensee conducted a geological study on the bedrock and this information is provided in their radiological assessment report for this area (CYAPCO 2005b). At two elevated areas on the bedrock identified by ESSAP (locations #2 and #15), the licensee performed *in situ* gamma measurements with an Exploranium miniSpec, Model GR-130 to quantify gamma-emitting radionuclides of concern. The licensee reported that there were no gamma energy peaks associated with Cs-137 or Co-60 in the energy spectrums that they measured. However, they did report distinct peaks of energy associated with K-40 and other naturally occurring radioactive materials (CYAPCO 2005b).

To address the beta activity identified by ESSAP at bedrock locations #2 and #15, the licensee performed attenuation measurements using a "...beta sensitive device and multiple shields of uniform absorber thickness..." to approximate the beta endpoint energy. The licensee's conclusion was that the ESSAP "elevated beta response was likely due to naturally occurring K-40 in the bedrock" (CYAPCO 2005b). ESSAP reviewed the process used by the licensee and is in agreement with their findings.

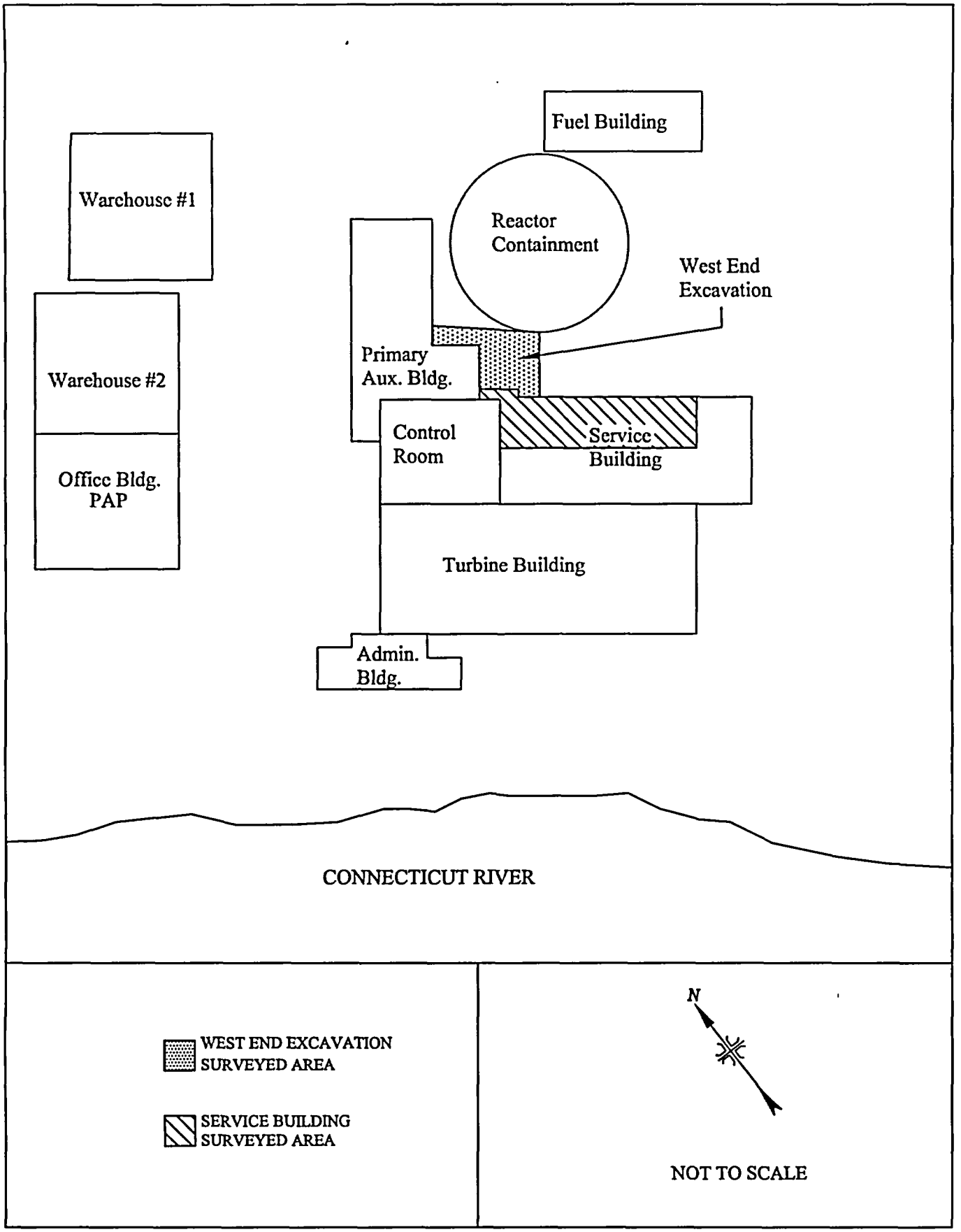
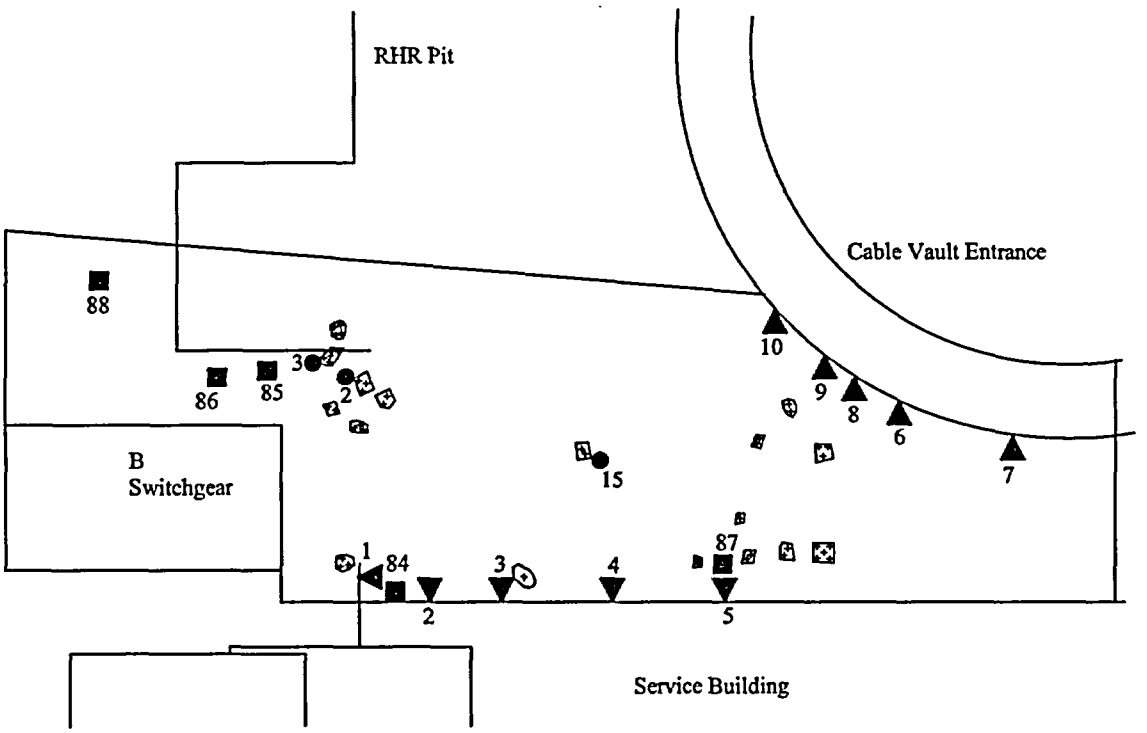



FIGURE 1: Plot Plan of Buildings at the Connecticut Yankee Haddam Neck Plant Indicating Surveyed Areas




MEASUREMENT/SAMPLING LOCATIONS

▲ # SINGLE-POINT LOWER WALLS

● # SINGLE-POINT BEDROCK

■ # SURFACE SOIL

ELEVATED DIRECT RADIATION

N

NOT TO SCALE

FIGURE 2: Connecticut Yankee Haddam Neck Plant West End Excavation - Measurement and Sampling Locations

## TABLE 1

## SURFACE ACTIVITY LEVELS
## CONCRETE STRUCTURES AND BEDROCK
## WEST END EXCAVATION
## NORTHEAST PROTECTED AREA GROUNDS
## CONNECTICUT YANKEE
## HADDAM, CONNECTICUT

| Location[a] | Total Beta Activity (dpm/100 $cm^2$) | Removable Tritium Activity (dpm/100 $cm^2$)[c] |
|---|---|---|
| **Concrete Structures Lower Walls** | | |
| 1 | 224 ± 93[b] | 4.6 ± 8.4[c] |
| 2 | 164 ± 90 | 19.2 ± 9.9 |
| 3 | -5 ± 81 | 2.2 ± 8.2 |
| 4 | 161 ± 90 | -0.3 ± 7.9 |
| 5 | 154 ± 90 | 4.9 ± 8.5 |
| 6 | 1,270 ± 130 | 6.0 ± 8.6 |
| Post-RA 6 | 790 ± 110 | ---[d] |
| 7 | -106 ± 75 | 3.8 ± 8.4 |
| 8 | -327 ± 59 | 0.2 ± 7.9 |
| 9 | 1,710 ± 150 | -2.4 ± 7.6 |
| 10 | 470 ± 110 | 5.6 ± 8.6 |
| **Bedrock** | | |
| 3 | 1,700 ± 210 | --- |
| 2 | 10,080 ± 340 | --- |
| 15 | 4,120 ± 230 | --- |

[a] Refer to Figure 2.
[b] Uncertainties represent the 95% confidence level, based on counting statistics only.
[c] Uncertainties represent the 95% confidence level, based on total propagated uncertainties.
[d] Measurement not performed.

## TABLE 2

## RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES WEST END EXCAVATION NORTHEAST PROTECTED AREA GROUNDS CONNECTICUT YANKEE HADDAM, CONNECTICUT

| Sample Identification | Radionuclide Concentrations (pCi/g) | | | | | |
|---|---|---|---|---|---|---|
| | Co-60 | Cs-137 | Eu-152 | Eu-154 | H-3 | Sr-90 |
| **Samples Collected by ESSAP[a]** | | | | | | |
| 0857S0084 | 0.02 ± 0.02[b] | 0.19 ± 0.03 | 0.00 ± 0.04 | 0.02 ± 0.07 | ---[c] | --- |
| 0857S0085 | 0.01 ± 0.02 | 0.19 ± 0.02 | -0.03 ± 0.04 | -0.05 ± 0.08 | --- | --- |
| 0857S0086 | 0.28 ± 0.05 | 1.21 ± 0.07 | -0.02 ± 0.06 | -0.01 ± 0.10 | --- | --- |
| 0857S0087 | 0.03 ± 0.03 | 0.02 ± 0.02 | 0.01 ± 0.04 | 0.00 ± 0.08 | --- | --- |
| 0857S0088 | 0.01 ± 0.02 | 0.04 ± 0.02 | 0.00 ± 0.04 | -0.02 ± 0.08 | --- | --- |
| **Samples Collected by Connecticut Yankee[d]** | | | | | | |
| 0857S0089/CY1 | 0.06 ± 0.05 | 0.00 ± 0.11 | 0.00 ± 0.10 | -0.13 ± 0.22 | 1.9 ± 1.5 | 0.3 ± 0.22 |
| 0857S0090/CY2 | 0.01 ± 0.02 | 0.02 ± 0.03 | -0.02 ± 0.03 | -0.03 ± 0.07 | 0.5 ± 1.4 | 0.1 ± 0.23 |
| 0857S0091/CY3 | 0.02 ± 0.03 | 0.04 ± 0.03 | 0.01 ± 0.06 | -0.02 ± 0.13 | 5.3 ± 1.6 | -0.04 ± 0.24 |
| 0857S0092/CY4 | 0.02 ± 0.05 | -0.02 ± 0.09 | 0.00 ± 0.10 | -0.22 ± 0.21 | 6.6 ± 1.6 | -0.04 ± 0.24 |
| 0857S0093/CY5 | 0.00 ± 0.04 | 0.05 ± 0.04 | -0.02 ± 0.09 | 0.10 ± 0.15 | 0.5 ± 1.4 | 3.88 ± 0.44 |

## TABLE 2 (continued)

## RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES WEST END EXCAVATION NORTHEAST PROTECTED AREA GROUNDS CONNECTICUT YANKEE HADDAM, CONNECTICUT

| Sample Identification | Radionuclide Concentrations (pCi/g) | | | | | |
|---|---|---|---|---|---|---|
| | Co-60 | Cs-137 | Eu-152 | Eu-154 | H-3 | Sr-90 |
| **Samples Collected by Connecticut Yankee** | | | | | | |
| 0857S0094/CY6 | 0.01 ± 0.02 | 0.01 ± 0.03 | 0.01 ± 0.04 | 0.05 ± 0.07 | 0.2 ± 1.4 | -0.03 ± 0.22 |
| 0857S0095/CY7 | 0.01 ± 0.02 | -0.01 ± 0.01 | 0.03 ± 0.03 | -0.06 ± 0.06 | 0.7 ± 1.4 | 0.01 ± 0.24 |
| 0857S0096/CY8 | 0.01 ± 0.01 | 0.00 ± 0.01 | 0.01 ± 0.02 | 0.00 ± 0.05 | -0.7 ± 1.4 | -0.23 ± 0.23 |
| 0857S0097/CY9 | 0.02 ± 0.02 | 0.00 ± 0.01 | 0.00 ± 0.03 | -0.03 ± 0.07 | -0.1 ± 1.4 | -0.16 ± 0.21 |

[a] Refer to Figure 2.
[b] Uncertainties represent the 95% confidence level, based on total propagated uncertainties.
[c] Analyses not performed.
[d] Sample identification contains ESSAP sample nomenclature/Connecticut Yankee nomenclature. These samples were provided by Connecticut Yankee and analyzed by ESSAP. Connecticut Yankee sample locations are not indicated on a figure.

## REFERENCES

Connecticut Yankee Atomic Power Company (CYAPCO). Characterization Report, West Section of the Excavations Associated with the Northeast Protected Area Grounds, Haddam Neck Plant, Haddam, Connecticut. Haddam, Connecticut; February 21, 2005a.

Connecticut Yankee Atomic Power Company. Radiological Assessment Report for the Western Section of the Excavation Associated with the Northeast Protected Area Grounds. Revision 0. Haddam, Connecticut; June 9, 2005b.

Oak Ridge Institute for Science and Education (ORISE). Survey Procedures Manual for the Environmental Survey and Site Assessment Program. Oak Ridge, Tennessee; September 2, 2004a.

Oak Ridge Institute for Science and Education. Revision 1—Site-Specific Decommissioning Inspection Plan for the Connecticut Yankee Decommissioning Project, Haddam, Connecticut [Docket No. 50-0213; RFTA No. 03-008]. Oak Ridge, Tennessee; April 8, 2005a.

Oak Ridge Institute for Science and Education. Quality Assurance Manual for the Environmental Survey and Site Assessment Program. Oak Ridge, Tennessee; July 29, 2005b.

Oak Ridge Institute for Science and Education. Laboratory Procedures Manual for the Environmental Survey and Site Assessment Program. Oak Ridge, Tennessee; June 20, 2005c.