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October 9, 2000

Docket No. 50-116

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Subject: Final Status Survey Report for the Iowa State University UTR-10 Reactor

Dear Sir or Madam:

Please find enclosed two copies of the Final Status Survey report prepared after the completion of the decommissioning the ISU UTR-10 reactor.

If you have any questions regarding this request, please contact me at (515) 294-0539.

Sincerely,

Scott E. Wendt

Scott E. Wendt
Reactor Manager

Enclosures

c: (without enclosures)
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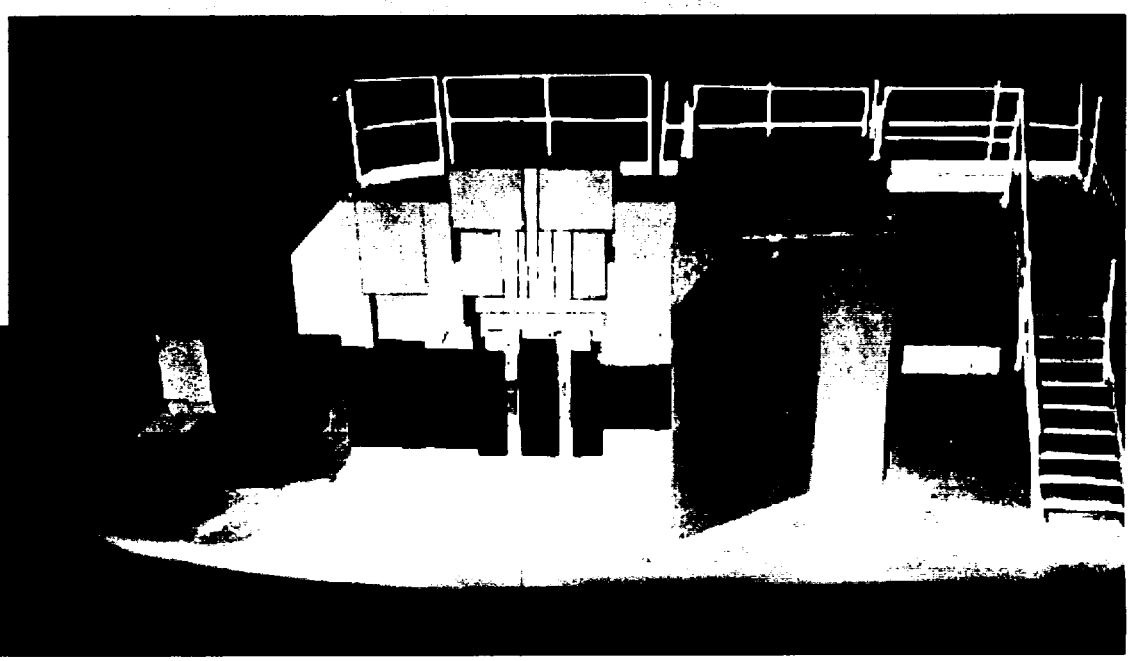
Iowa State University
UTR-10 Reactor
Final Status Survey Report



September 2000

Prepared by:
Duke Engineering & Services
400 Donald Lynch Boulevard
Marlborough, MA 01752

Duke Engineering & Services
A Duke Energy Company

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IOWA STATE UNIVERSITY
UTR-10 REACTOR
FINAL STATUS SURVEY REPORT

September 2000

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1.0 INTRODUCTION

This document describes the results of the final status survey performed by Duke Engineering & Services (DE&S) to demonstrate that radiation and radioactive contamination levels at the Iowa State University (ISU) UTR-10 Reactor have been reduced to levels below criteria established for unrestricted use.

The final status survey was conducted in accordance with a plan and implementing procedures derived from regulatory guidance, specifically NUREG-1575 "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM). DE&S employed a graded approach in designing the final status survey. This type of approach to data collection placed the greatest survey efforts on areas that have, or had, the highest potential for residual radioactivity and demonstrates that all radiological parameters do not exceed the established release criteria

The plan provided specific instructions for the performance of the final status survey including the survey measurement type, frequency and location within each survey unit. Survey/Sampling Work Plans (SSWP) were provided as Appendix A of the plan. Each SSWP contained a FSS General Instructions Form (DD-FS-300-1), a FSS Survey Location Designation, Results and Comment Form (DD-FS-300-2) and all necessary Final Status Survey Maps (DD-FS-300-3).

2.0 BACKGROUND INFORMATION ON REACTOR FACILITY

The UTR-10 was housed in the Nuclear Engineering Laboratory (NEL) building located on the west edge of the main campus of ISU, in Ames, Iowa. The facility is a two-story, three-level building of brick construction built in 1934 by the U.S. Department of Agriculture. It was deeded to the University in 1946. A map indicating the location of the University with respect to Ames and major highways is shown in Figure 2.1. The location of the NEL building within the ISU campus is shown in Figure 2.2.

The building floor space is divided into four levels: the basement (west side only), the ground floor (which includes the central bay), the first floor (west side only) and the second floor which surrounds the central bay. The central bay is approximately 34 feet high and has a floor area of 37 feet by 56 feet, of which a space approximately 37 feet by 38 feet is allocated to the reactor room. The reactor room houses the reactor, which is enclosed in a concrete biological shield, the process pit, the fuel storage pit, and a five-ton bridge crane. The facility layout is shown in Figure 1.3.

The UTR-10 was an Argonaut type reactor which used uranium enriched to 19.75% in ^{235}U in a graphite reflected, water moderated core. The reactor was installed in 1959 on the ground floor level, central bay area, of the NEL. In 1991 the reactor fuel was changed from its original high-enrichment uranium to low-enrichment uranium. The reactor was controlled with four window-shade type Boral control rods. Heat from fission was removed from the primary coolant by a 34,000 BTU/hr shell-and-tube heat exchanger that utilized city water as a heat sink. The reactor was designed to be inherently safe. It would automatically shut down if there was a loss of AC power or if parameters important to safety were exceeded.

The enclosure surrounding the reactor room included the central section of the building defined by the interior walls of offices, laboratories, and corridors.

The reactor was provided with multiple experiment features including beam ports, thermal column, shield tank, internal reflector, rabbit tube, and radiation cavity.

2.1 Operational History

The UTR-10 was designed and built in 1959 by the Advanced Technology Laboratories division of the American Radiator and Standard Sanitary Corporation. Initial reactor criticality was on December 31, 1959. Final reactor criticality was on May 8, 1998 and reactor operations officially ceased on May 15, 1998.

Radiological characterization surveys and sampling efforts began in July 1998 and finished in September 1998. Results of the characterization survey are found in DE&S' Document No. 00752.F02.A01, Characterization Report for the Iowa State University UTR-10 Reactor. This report was submitted with the Decommissioning Plan in January of 1999 and was approved by the NRC on July 8, 2000.

2.1.1 Site Conditions at Time of Final Status Survey

At the time of the final status survey, the structure was largely intact. All contaminated systems and components had been removed from the site. Potentially contaminated structural surfaces identified during characterization surveys were remediated or removed. Section 2 of the Decommissioning Plan provides additional information on demolition and construction activities including the methodologies used to implement them.

During remediation, engineering and health physics controls were in place to ensure and later confirm that the integrity of survey area classifications was maintained.

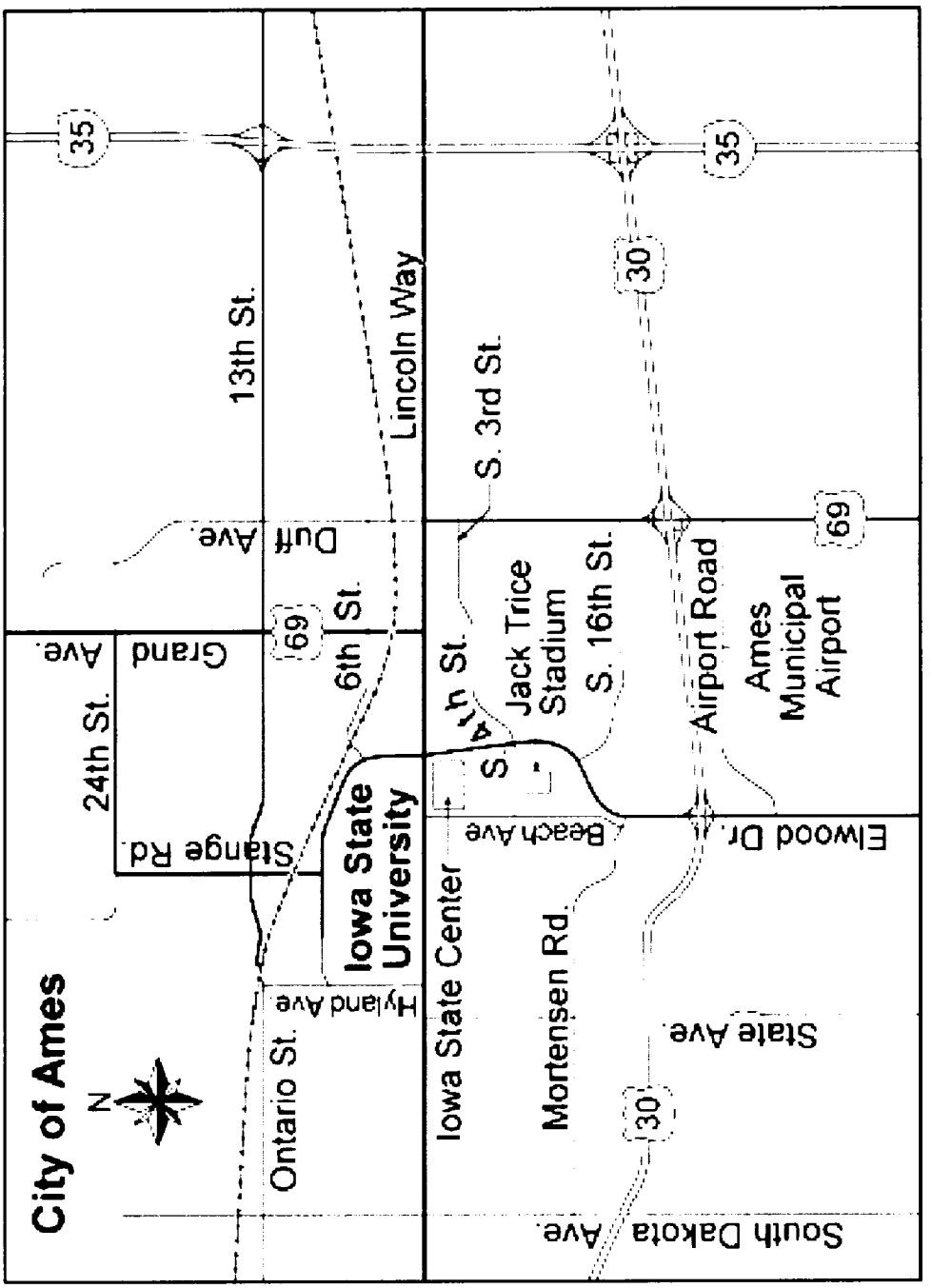


FIGURE 2.1: Location of ISU

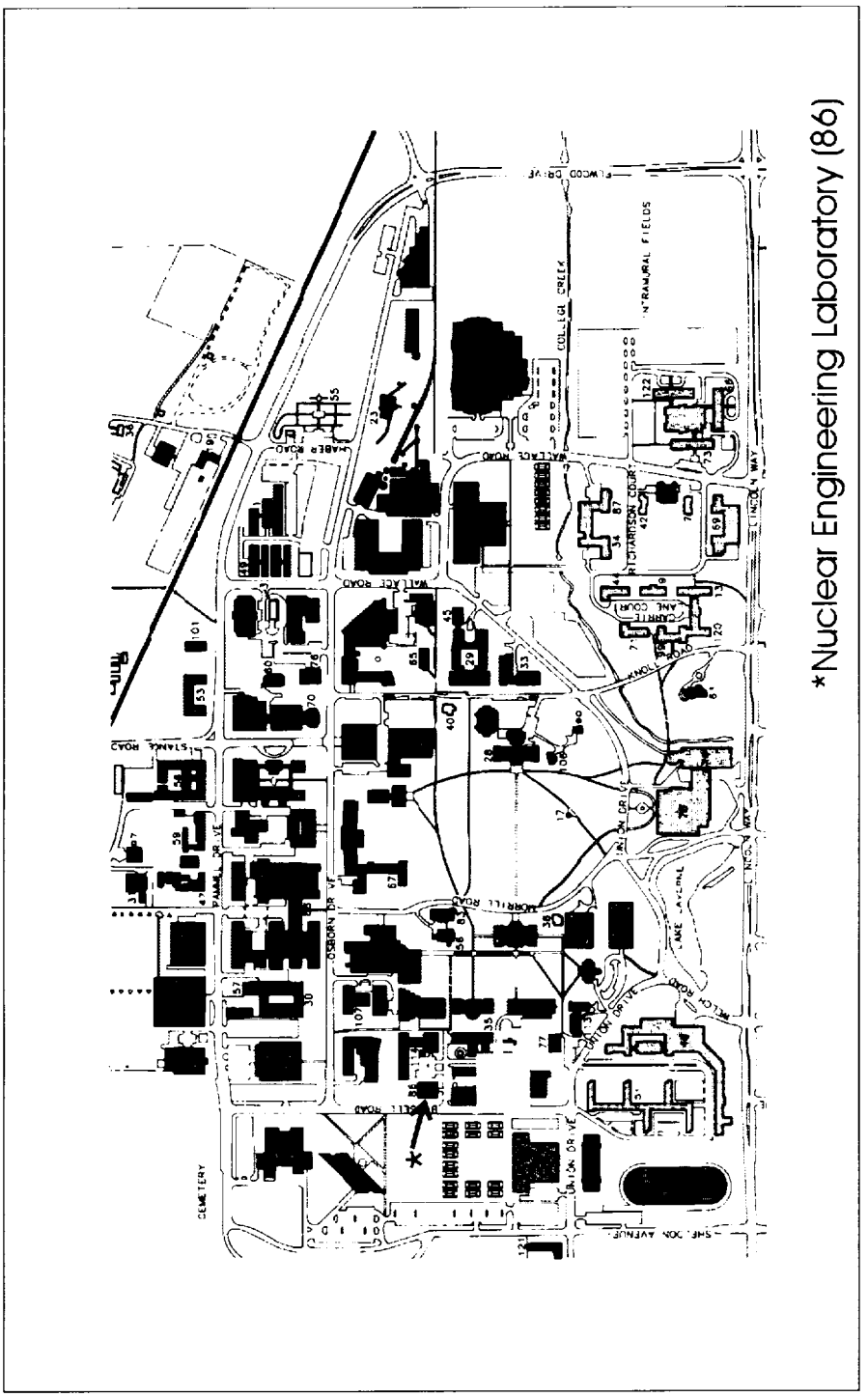


FIGURE 2.2: Location of NEL on ISU Campus

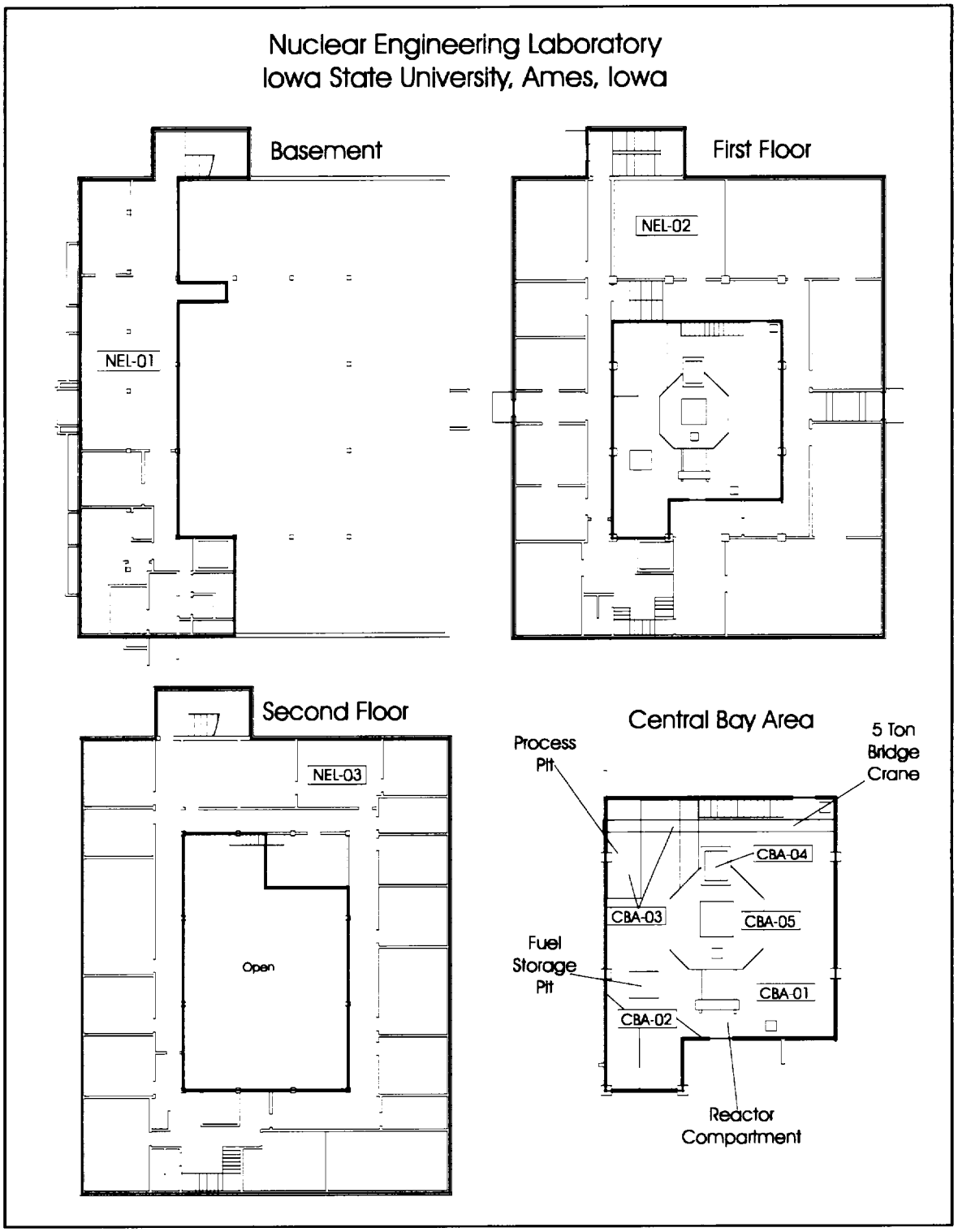


FIGURE 2.3: Facility Layout

3.0 DECOMMISSIONING ACTIVITIES

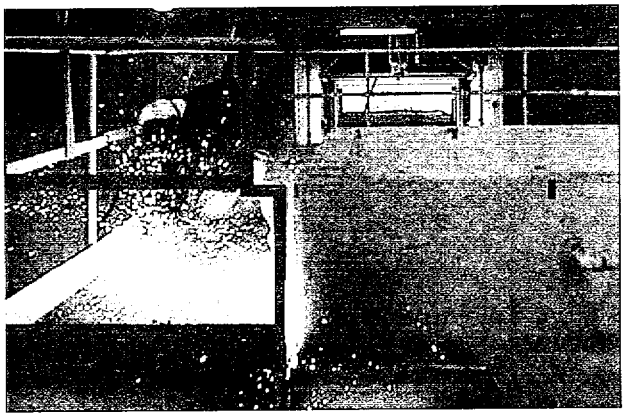
The following sections summarize the activities performed prior to the performance of the final status survey.

Decommissioning of the UTR-10 began in June 2000 and was concluded on August 4, 2000.

3.1 Decommissioning Tasks

3.1.1 Facility Modifications

The first stage of the decommissioning involved several facility modifications that would create a larger workspace in the reactor area and facilitate removal of the reactor components. These modifications included removal and relocation of the double doors (south end), demolition of the cinder-block wall, and removal and sealing of the second floor door openings at the north end. In addition, the following items were relocated: steam heater, crane power boxes and the emergency lighting conduit.



The north stairs, platform and stairs to the reactor top were removed using flame torches. None of these items were contaminated. As pieces were sectioned, they were surveyed, unconditionally released in accordance with procedure and removed for disposal as demolition waste or scrap metal for recycling. Access to the top of the reactor during the balance of the project was provided using temporary ladders.

3.1.2 Miscellaneous Equipment Removal

Attached conduit, miscellaneous equipment and non-operational systems attached to the walls were removed, unconditionally released and disposed as demolition waste.

3.1.3 Closure Removal, Remediation and Disposition

Each closure from the reactor was removed and staged for survey and remediation as required. The radioactive portions of each closure were removed using chipping hammers, drilling/splitting, and torch cutting in preparation for unconditional release criteria. Upon removing the activated portions, the closures were moved or oriented to a low background area for final survey. Following unconditional release, each closure was loaded for disposal as demolition waste. The disposition of each closure is discussed in the following sections.

3.1.3.1 Thermal Column Door

The thermal column door contained no activated material. As its total weight exceeded the capacity of the crane, it was rigged on one side, lifted and cribbing placed under one end and then the other. Rollers were placed at the south end of the door and, using the crane, the door was tilted onto the rollers. The door was then pulled out of the reactor area and loaded on a trailer for disposal as demolition waste.

3.1.3.2 Shutdown Closure

The shutdown closure was removed using the crane. The closure did not contain activated material. The closure was unconditionally released and disposed of as demolition waste.

3.1.3.3 Operating Closure

The operating closure was removed and surveyed. Radioactive material in the form of activation products was detected through approximately the lower twelve inches of the closure. The experiment plugs, an integral part of the closure, were found similarly contaminated. The experiment plugs were packaged as radioactive waste. The larger activated section of the closure was removed inside an HEPA ventilated containment. The remaining portion of the closure was then unconditionally released as demolition waste.

3.1.3.4 Experiment Closure

The experiment closure was removed and surveyed. Radioactive material in the form of activation products was detected through approximately the lower twelve inches. The closure was packaged as radioactive waste.

3.1.3.5 Miscellaneous Plugs and Port Closures

Various small plugs and experiment port closures were removed and packaged as radioactive waste.

3.1.4 Tank and Sump Equipment Removal

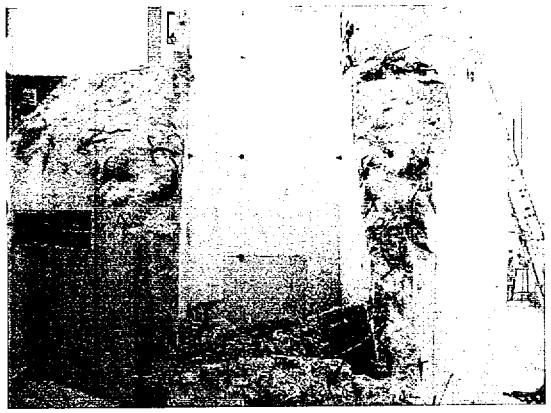
The tank and associated piping for the reactor water was removed to the point where it entered the concrete wall. Embedded piping was abandoned in place or removed as necessary. All reactor water equipment was surveyed, unconditionally released and disposed of as recyclable metals or demolition waste. The items in the sump and fuel pit were decommissioned in accordance with the established procedure requirements.

3.1.5 Graphite & Core Component Removal

Graphite was removed beginning at the south end of the bioshield. As each stringer was removed, it was numbered and segregated for survey. As the removal operations continued, each piece was surveyed in a low background area. Sections of graphite containing detectable radioactive material were sectioned and disposed of as radioactive waste. The remaining graphite was disposed of as demolition waste. Core mechanical components, activated support structures and internals were removed from the core, sectioned as necessary, and packaged as radioactive waste.

3.1.6 Water Tank Demolition

The water tank at the north end of the reactor was scored horizontally and vertically with a diamond blade concrete saw. It was then demolished using a hydraulic ram. As the tank walls were outside of the reactor activation zone, this material was surveyed, unconditionally released and disposed of as demolition waste.



3.1.7 Radiological Containment and Dust Control

The planned sequence of dismantlement was be to remove all reactor components first and the concrete bio-shield demolished last. Following the removal of the reactor components and graphite, a more definite activation profile was determined, by performing direct radiological surveys and analyses of concrete core samples.

The contamination levels inside the reactor cavity were not expected to warrant the use of contamination control containment during the removal of graphite and core components for packaging. As this was the case, and only non-transferable activated material was present, no containment or dust control measures were required. Continuous air samples were taken in the work area, at the south end of the reactor room and on the

roof, where large ventilation fans were placed to exhaust fumes for the heavy equipment and tools.

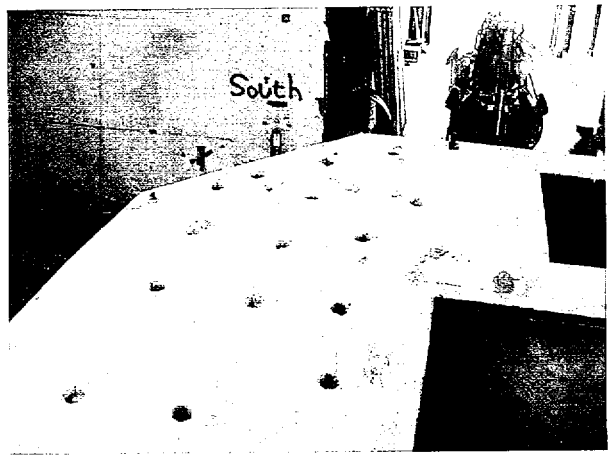
The primary means of dust control during concrete demolition was water, which was applied in a low volume mist at points where dust was produced. When necessary, additional HEPA ventilated containment was provided as an added dust control measure and to prevent cross contamination of office/occupied areas and non-contaminated areas of the reactor room. Excess water from misting activities was collected, re-used as necessary. Subsequently, remaining water was sampled and unconditionally released.

3.1.8 Bio-Shield Removal

The demolition of the bio-shield commenced after the preparations discussed above were completed and the area was staged to accommodate the dismantlement activities.

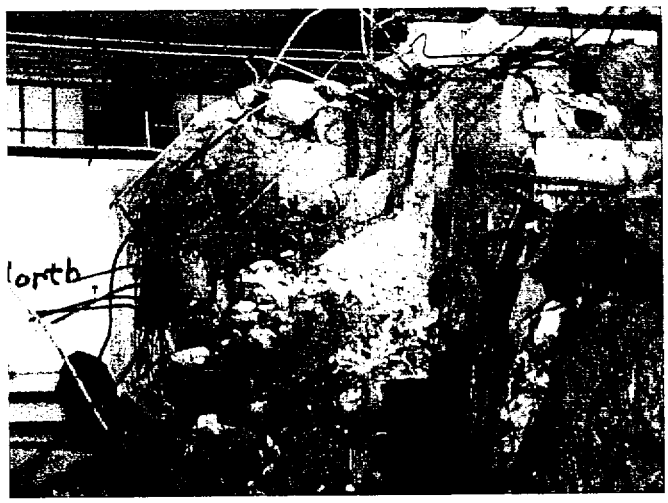
3.1.8.1 Hydraulic Splitting

Employing rock drills a pattern of vertical holes was placed throughout the bioshield. Drilling depths varied from four to eleven feet, with the intent of providing a clear demarcation of the interior activation zone. The holes were then filled with an expansive grout and allowed to cure for approximately twenty-four hours. The expansive grout created a series of fracture lines on the exterior surface as well as within the non-activated portions of the bioshield.

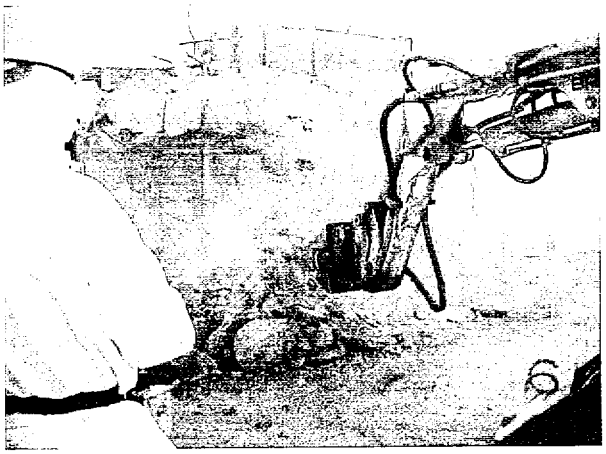


3.1.8.2 Demolition

The bioshield was demolished using a tethered hydraulic ram (BROKK). Care was taken to remove only the non-activated portions of the shield delineated by the expansive grout. During this portion of demolition, misting and ventilation was employed to control dust. Air samples and daily surveys of the work area were used to confirm that cross contamination did not occur. Non-radioactive portions of the bioshield were disposed of as demolition waste.

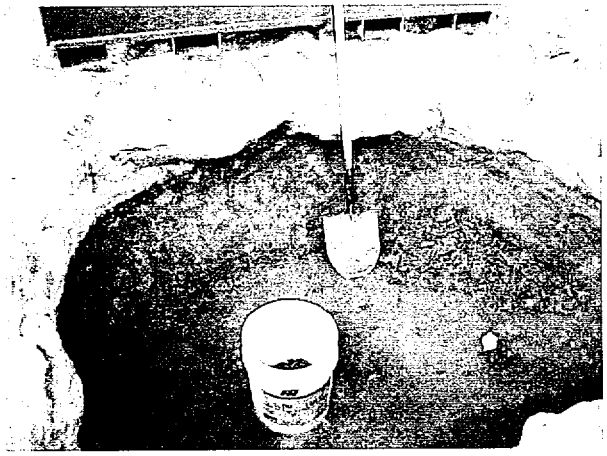


Upon approaching the activation zone, work was stopped and a HEPA ventilated containment constructed around the remaining portion of the bioshield. Demolition was then completed in the previous manner. After removal of the bioshield, portions of the underlying floor area that had been activated were removed and like the remaining bioshield material, disposed of as radioactive waste.



3.1.8.3 Pit Excavation

Directly underneath the reactor centerline a small pit consisting of activated soil was identified. This area was sampled, a screening DCGL determined and the area excavated until no detectable radioactivity remained. The removed material was disposed of as radioactive waste.



4.0 FINAL STATUS SURVEY OVERVIEW

4.1 Radiological Release Criteria

The NRC Final Rule on License Termination, 10 CFR 20.1402, provides radiological criteria for release of a site for unrestricted use. Acceptability criterion for unrestricted use is a maximum Total Effective Dose Equivalent (TEDE) of 25 mrem per year from residual radioactivity above background. Application of As Low As Reasonably Achievable (ALARA) is also a requirement.

4.2 Demonstrating Compliance with Release Criteria

DE&S employed an alternate method described in MARSSIM Section 2.6.1, which was to perform a direct comparison of each measurement result to the $DCGL_W$. Specifically, MARSSIM Section 2.6 states "At some sites a simple comparison of each measurement result to the $DCGL_W$, to demonstrate that all the measurement results are below the release criterion, may be more effective than statistical tests for the overall demonstration of compliance with the regulation provided an adequate number of measurements are performed," A degree of conservatism is built into this method, given that an elevated measurement criterion ($DCGL_{EMC}$) will not be utilized. DE&S believes that this type of conservatism is warranted, especially at a facility where a low potential for residual contamination exists. The overall result in implementing this As-Low-As-Reasonably-Achievable (ALARA) method is reduced risk to a building occupant following license termination.

4.3 Derived Concentration Guideline Levels (DCGLs)

4.3.1 DCGLs for Structural Materials

The DCGLs utilized to screen individual measurement values were based on the results of radioanalytical data as input into the NRC code DandD v.1. ISU site-specific DCGLs were established by adjusting the generic limits to account for Hard-to-Detect Radionuclides (HTDN) that cannot be measured with typical survey instrumentation.

Section 7.1 of the Characterization Report provides the equations utilized to calculate these site-specific DCGLs. Table 4.1 provides a summary of the bulk material sample Part 61 analysis results and the calculated HTDN ratios utilized to determine the DCGLs. The corresponding DCGLs for each material are shown in Table 4.2.

Table 4.1: Bulk Material Composite Sample 10 CFR Part 61 Analytical Results Summary

Sample Description	Identified Detectable Radionuclides	ISU Radionuclide-Specific D and D Limit (dpm/100 cm^2)	F_n/L_n (Fraction/ Limit)	Identified HTDNs	ISU Radionuclide-Specific D and D Limit (dpm/100 cm^2)	F_n/L_n (Fraction/ Limit)
Composite Smear Sample	None	N/A	N/A	None	N/A	N/A
Rx. Graphite	None	N/A	N/A	None	N/A	N/A
Rx. Concrete	Co-60	7,040	4.09E-05	H-3	1.23E+08	9.76E-10
	Eu-152	12,700	3.76E-05	Fe-55	1.10E+04	2.06E-07
	Fe-59	88,300	1.30E-06			
Rx. Steel	Co-60	7,040	4.36E-05	Zn-65	48,100	1.44E-05
Rx. Aluminum	None	N/A	N/A	None	N/A	N/A

Table 4.2: ISU Site-Specific DCGLs

Material	Total Surface Contamination DCGL (dpm/100 cm^2)
Structural Surfaces	5.3E03
Reactor Graphite	5.3E03
Reactor Steel	5.3E03
Reactor Aluminum	5.3E03
Reactor Concrete (Activated Portions)	1.1E04

4.3.2 DCGLs for Soil

A DCGL for soil was developed to address the contaminated soil that lay beneath the former location of the Reactor Housing (CBA06). D and D v.1 was used to develop screening values for each of the five nuclides identified in the analysis of soil samples taken during the remediation phase of the project. The samples were obtained from a localized area of activated soil at the core centerline. The only input to the D and

D code was the nuclide soil concentration (@ 1 pCi/g). All other input parameters were left at the default values. In addition, the resident farmer scenario was applied. Given the use of default parameter values and the application of the resident farmer scenario, DE&S believes the screening values to be conservative. Table 4.3 shows the radionuclides of concern along with their published NRC screening values.

As the affected area was small, and continuation of activation products under the concrete slab was ruled out by survey, the remaining soil was removed and packaged as radioactive waste. In order that no licensed radioactive material remained in the soil, a composite sample from the perimeter of the excavation and a sample at the reactor centerline were taken and analyzed to the appropriate environmental LLDs. Analytical results of these samples indicated that no licensed radioactive material presence.

4.4 Data Quality Objectives

The Data Quality Objectives (DQO) process was implemented in the final status survey plan using a graded approach as recommended in MARSSIM. The DQOs for the NEL site are:

- Selecting and verifying survey unit classification.
- Collecting sufficient data of high quality to ensure that a comparison can be made with the release criteria for each survey unit to determine if residual radioactivity in each unit has been reduced to a level below the release criteria.
- Ensuring that the potential risk from the site as a whole is below the dose limit release criteria.

4.5 Final Area Classification and Survey Unit Designation

The final area classification of the ISU NEL facility was subdivided into Class 1, Class 2, and Class 3 areas, according to MARSSIM. These three categories are defined as follows:

- **Class 1 Areas:** Areas that had, prior to remediation, known contamination based on characterization survey in excess of the DCGL.
- **Class 2 Areas:** Areas that had, prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGL.
- **Class 3 Areas:** Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGL.

Table 4.3: ISU Screening Values for Soil

Radionuclide	Analytical Result uCi/g	fraction	D and D SV* pCi/g	uCi/g
Fe55	6.90E-06	3.56E-01	9470	9.47E-03
Co60	2.00E-06	1.03E-01	3.64	3.64E-06
Cs134	9.80E-08	5.06E-03	1.75	1.75E-06
Eu152	9.89E-06	5.10E-01	8.65	8.65E-06
Eu154	4.93E-07	2.54E-02	8.01	8.01E-06
TOTAL	1.94E-05	1.00E+00		
*SV = Screening Value; corresponds to 25 mrem/y				
Maximum total concentration in soil		1.07E-05 uCi/g	(10.7 pCi/g)	
Maximum detectable gamma concentration in soil		6.89E-06 uCi/g	(6.9 pCi/g)	

As the Characterization Report had shown that only Class 1 areas contained contamination that could be confirmed, these areas received the highest degree of survey efforts during the final survey.

The Characterization Report (section 8.0, Conclusions) provided guidance on the classification of survey areas for the final status survey. However, due to the demolition of the Reactor Housing, two survey areas (CBA04 and CBA05) were deleted from the scope of the final status survey. An additional survey area (CBA06) was defined, which addressed the Reactor Housing footprint. In addition, all miscellaneous equipment or components within the Reactor Room (CBA03) were included as part of CBA02. In the event that the soil beneath CBA06 could not be completely removed, a provisional survey area SS001 was also created. The final area classifications of the ISU NEL facility are shown in Table 4.4.

4.6 Survey Areas, Units, Locations and Points

A survey documentation package was prepared for each survey unit. Each documentation package included, at a minimum:

- General Work Instructions that define the measurements, instrumentation and instructions for conduct of the survey;
- Survey Location Designations, Results and Comments regarding conditions encountered
- A Map of the survey area.

Table 4.4: Final Status Survey Unit Designation and Classification

Nuclear Engineering Laboratory – Basement			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
NEL01	Floors and Lower Walls (including the basement sump)	556	3
Nuclear Engineering Laboratory – First Floor			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
NEL02	Floors and Lower Walls	1396	3
Nuclear Engineering Laboratory – Second Floor			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
NEL03	Floors and Lower Walls	1467	3
Central Bay Area – Reactor Room			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
CBA01	Floors and Lower Walls	240	2
CBA02	Upper Walls and Ceiling	770	3
Central Bay Area – Reactor Housing (Foundation)			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
CBA06	Reactor Housing Foundation	<100	1
Central Bay Area – Process Pit			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
PP001	Process Pit	52	1
Central Bay Area – Fuel Storage Pit			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
FP001	Fuel Storage Pit	<100m^2	1
Soil Beneath Reactor Housing			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
SS001	Subsurface Soil	<100m^2	1

4.6.1 Survey Areas and Survey Units

Survey areas with similar characteristics and contamination potential were identified and engineering judgement used to divide each survey area into survey units. This division was performed in to support reproducible confirmatory measurements. Definition of survey units was accomplished by selecting existing facility characteristics such as horizontal and vertical structural support beams, concrete pour seams or piping runs to define the unit boundaries. Distance measurements were documented, as necessary, to support reproducibility.

In addition, the use of photographs, drawings or maps was employed to support survey unit identification. This method for area designation also served to aid survey personnel to define areas of elevated activity that required further investigation and/or remediation.

4.6.2 Survey Locations and Survey Points

Survey locations were clearly identified to allow for reproducibility of measurements. Surface markings were employed in lieu of a physical grid layout. Survey locations were clearly identified to provide a method of referencing survey results to survey unit locations. Designated Class 1 and Class 2 survey units were subdivided uniformly for survey design, measurement control purposes, and to identify survey locations. Grids were not employed to divide Class 3 survey units.

A unique reference location ID code or number was assigned to identify each survey point. The numbering convention allowed the survey data to be easily referenced to survey points identified on maps or drawings. The survey point identification nomenclature is summarized in Table 4.5.

4.7 Turnover for Final Status Survey

Prior to acceptance of a survey area for the final status survey, several conditions were required to be met. These include:

- Decommissioning activities having the potential to contaminate the survey area must be completed.
- All tools and equipment not required to perform the survey must be removed, and housekeeping and area cleanup must be completed.
- Decontamination activities in the survey area must be completed.

Final operational radiological surveys must be completed in the survey area to ensure that no additional remediation is necessary and will consist of:

- Scan surveys to ensure that surface contamination is within the FSS total surface contamination limits.
- Smear surveys to ensure that the removable surface contamination is within the FSS removable surface contamination limits.

4.8 Access Control Measures

Upon commencement of the final status survey for survey areas where there is a potential for contamination, the following control measures were utilized:

- Installation of barriers to control access to surveyed areas,

- Installation of postings requiring personnel to perform contamination monitoring prior to surveyed area access,
- Locking of entrances to surveyed areas of the facility.

These measures will remain until the confirmatory survey is completed.

Table 4.5: Survey Location Code Index

1	2	3	4	5	6	9	10	11	7	8
x	n	n	n	x	x	n	n	n	x	x
Survey Unit I.D. (Per Survey Unit Classification and Description list				**Survey Type Code** C = Characterization F = Final Status I = Investigation Q = QC Replicate S = Special	**Survey Material Code** A = Asphalt B = Brick C = Concrete (bare) D = Concrete (painted) E = Cinder Block (paint) F = Cinder Block (bare) G = Generic O = Other P = Porcelain T = Ceramic Tile	**Survey Point** (Numbered Sequentially)			**Survey Unit Classification Code** A = Class 1 B = Class 2 C = Class 3	Survey Unit Code A = Upper Walls/Ceiling B = Floor/Lower Walls C = Ceiling D = Sub Floor E = Equipment F = Floors G = Grounds L = Lower Walls S = System U = Upper Walls X = Structural Exterior

4.9 Training Program

All personnel directly involved with the performance of the final status survey and data quality review were trained to a competency level commensurate with the activity being performed. The scope of the required training included, as necessary:

- MARSSIM
- Final Status Survey Procedures
- Equipment operation

In some cases, previous documentation of training, experience performing final survey and demonstration of proficiency was utilized as a means to demonstrate equivalency with the training requirements of FSS Plan.

4.10 Laboratory Services

Off-site laboratory sample analysis was provided by the Duke Engineering & Services Environmental Laboratory. The laboratory maintains an approved Quality Assurance Program.

4.11 Quality Assurance

Field surveys and collection of radiological data in the field requires additional quality provisions under MARSSIM. The DE&S Survey Quality Assurance Project Plan (QAPP) applies to these activities. The QAPP specifies the policies, organization, objectives, and Quality Assurance/Quality Control (QA/QC) procedures used by DE&S for site characterization and final survey activities. The primary goal of the QA/QC program was to identify and specify the implementation of surveying, sampling, and analytical methodologies, which limited the

introduction of errors into the analytical data. The specific purpose of the QAPP was to ensure that the samples were collected, analyzed and reported in a consistent manner and that the quality of the resulting data could be independently evaluated.

5.0 SAMPLING APPROACH

5.1 Instrumentation

To perform the final status survey, both field survey instrumentation and analytical laboratory equipment were selected based on: (1) the necessary Minimum Detectable Concentrations (MDC), and (2) stability and reliability under environmental conditions. DE&S utilized the appropriate instrumentation shown in Table 5.1 to perform the final status survey of the NEL site. All field survey instrumentation was calibrated, operated and controlled in accordance with applicable DE&S procedures.

Table 5.1: Final Survey Instrumentation

Instrument/Detector Type	Description	Measurement Types(s)
Eberline E-600	Data Logger	Electronic Storage of Data
Eberline SHP-100 Ludlum 43-37	100 cm^2 sealed-gas proportional detector 435 cm^2 sealed-gas proportional detector	Beta scan Beta surface contamination Alpha surface contamination
Eberline SHP-360	15.5 cm^2 GM detector	Beta-gamma scan Beta-gamma surface contamination
Eberline SHP-300	Energy Compensated GM	Gamma exposure rates
Eberline SPA-3 or Canberra Ge Detector	2" X 2" NaI or closed-end coaxial Ge detector	Gamma-scans
Low Background Gas Flow Proportional Detector	Alpha and beta activity on smear samples	Laboratory analysis
Liquid Scintillation	Low energy beta activity on smear samples	Laboratory analysis
Gamma Spectroscopy	Gamma-emitting radionuclide identification and activity quantification on smear & bulk material samples	Laboratory analysis

5.1.1 Minimum Detectable Concentration Calculation

Minimum Detectable Concentration (MDC) values for field and laboratory counting instrumentation were determined using the following equation, taken from Equation 3-10 in Draft NUREG-1507:

$$MDC = \frac{3 + 3.29\sqrt{R_b t_s \left(1 + \frac{t_s}{t_b}\right)}}{E\left(\frac{A}{100}\right) t_s}$$

where,

MDC	=	the minimum activity concentration on a surface or material volume that can be statistically detected above background with a 95% probability,
t_s	=	sample counting time interval,
R_b	=	background counting rate,
t_b	=	background counting time interval,
E	=	counting efficiency, and
A	=	area of the detector, or the area sampled for smear samples.

5.1.2 Detector Sensitivity

The detection sensitivity of some of the detectors selected for surface contamination measurements was estimated. These results are summarized in Table 5.2. The results are shown for the principal instruments that used for field and laboratory beta-gamma total surface and removable contamination measurements.

The MDC is dependent on several factors, such as sample count time, background count time, background count rate and detector efficiency. The MDC for scan survey measurements was calculated using the above equation, with the scanning efficiency substituted for the efficiency term. The scanning efficiency was determined empiracally. A HP-100 probe was drawn over a 100 cm^2 source of the prescribed scan rate. The mean value of three measurements was used to determine the scanning efficiency.

Count times were selected to ensure that the measurements would be sufficiently sensitive with respect to applicable DCGLs. The count times associated with measurements for total surface contamination and gamma spectral analysis were set to ensure an MDC of <25% of the applicable DCGL.

5.2 Background Determination

DCGLs for residual radioactivity are at levels above background. Therefore, it was necessary to establish the response of instrumentation to the naturally occurring radioactivity present in non-impacted materials. Doing so enabled a comparison to be made of site radiological conditions with the acceptable guideline values. Background activity and radiation levels for the final status survey were determined from appropriate background reference areas and by obtaining local area measurements within the survey unit.

Background levels were established for each type of instrument to be used for total surface contamination measurements and exposure rate measurements during characterization. Background was verified

prior to performance of the final status survey. As a result, the appropriate background values were applied and subtracted from total radiation or radioactivity levels to determine the net residual contamination from licensed operations. Therefore, it was necessary that background levels be determined with a detection sensitivity and accuracy equivalent to data from which it will be subtracted. This was achieved by using the same instruments and techniques for background assessments as are used in evaluating the final site conditions. Background levels were obtained in accordance with procedure DD-CS-202, Background Assessment.

Table 5.2: Nominal Measurement Detection Sensitivities

Type of Measurement	Detector	Background	Efficiency (c/d)	Detection Sensitivity
Beta-Gamma Surface Scan	Pancake GM (HP-210/HP-260)	150 cpm	0.08	3650 dpm/ 100 cm^2
Beta-Gamma Surface Scan	100 cm^2 Gas Proportional (HP-100CGS)	550 cpm	0.10	850 dpm/100 cm^2
Beta-Gamma Surface Scan	425 cm^2 Gas Flow (Ludlum 43-37)	2000 cpm	0.07	500 dpm/100 cm^2
Beta-Gamma Direct	Pancake GM (HP-210/HP-260)	50 cpm	0.10	1800 dpm/100 cm^2
Beta-Gamma Direct	100 cm^2 Gas Proportional (HP-100CGS)	300 cpm	0.14	450 dpm/100 cm^2
Alpha Direct	100 cm^2 Gas Proportional (HP-100CGS)	1 cpm	0.25	20 dpm/100 cm^2
Gamma Scan	NaI (Tl) (SPA-3)	12,000 cpm	0.012	32,000 dpm/100 cm^2
Gamma Exposure Rate	Compensated GM (HP-300)	12 μR/h	1.22*	3 μR/h
Beta-Gamma Removable	Gas Flow Proportional (Protean)	1 cpm	0.22	70 dpm/100 cm^2
Alpha Removable	Gas Flow Proportional (Protean)	0.1 cpm	0.26	40 dpm/100 cm^2

Determining background levels for comparison with the conditions determined in a specific survey unit entailed conducting surveys in one or more reference areas to define the radiological conditions of the site. Reference areas are normally selected from non-impacted portions of the site.

5.3 Measurement Frequency

The minimum number of samples required in each survey unit is listed in Table 15 of the Characterization Report. The estimated sample sizes for each survey unit were determined using Table 5.3 in MARSSIM and have been determined to be adequate for use in the final status survey. However, as sufficient time has elapsed since the

* The term efficiency in this case represents a correction factor which compensates for the response of the energy compensated GM probe and the HP-360 probe.

Characterization Survey, and neither statistical test (Wilcoxon Rank and Sum or Sign) will be used to demonstrate compliance, DE&S believed that a substantially larger number of samples in each survey unit were warranted.

Measurement frequencies, or the physical spacing of samples and measurements, were selected to allow for a concentrated survey effort in those areas most likely to be contaminated or activated, taking into account the type and size of the survey unit. Measurement locations distributed throughout a survey unit were documented in accordance with the Final Status Survey Plan. Locations were clearly marked to facilitate re-survey. The measurement frequency and areas for each area type are described below.

5.3.1 Structures

Class 1 Survey Units: The final status survey of Class 1 Survey Units included:

- Area – up to 100 m^2 floor area
- A scan survey of 100% of the accessible surface area.
- A minimum of one Total Surface Contamination (fixed point) measurement location for every 2 square meters.
- Removable contamination (smears) were obtained at the location of each total surface contamination measurement.
- Exposure rate measurements were taken in each accessible survey unit at a frequency of at least one measurement per 10 square meters of floor area.
- In general, these areas were divided into one square meter grids, and the measurements were taken at the center of grid blocks.

Class 2 Survey Units: The final status survey of Class 2 Survey Units included:

- Area – 100 to 1,000 m^2
- A scan survey of 50% of the accessible surface area.
- Total surface contamination measurements for beta, as follows:
- A minimum of one measurement location for each 4 square meters.
- Removable contamination (smears) were obtained at the location of each total surface contamination measurement.
- In general, these areas were divided into one square meter grids, and the measurements were taken at the center of grid blocks.

Class 3 Survey Units: The final status survey of Class 3 Survey Units included:

- Area – no limit
- A scan survey of an area around each survey location so that the total area scanned was at least 10% of the accessible surface area of the survey unit.
- A minimum of 30 measurement locations for total surface contamination.
- Removable contamination (smears) were obtained at the location of each total surface contamination measurement.

- In general, these areas were identified by grid. Measurement locations were biased to high-traffic areas, distributed throughout the survey unit, or a combination of both.

5.4 Survey Methods

5.4.1 Scan Surveys

Scan surveys were performed to screen surface areas for the presence of any locations of elevated contamination above the release limits and to detect localized areas above the maximum release limit. The scanning methods (instruments and survey technique) for surface contamination measurements were designed to detect less than 75% of the mean total surface contamination limits. If an area of elevated contamination was identified during the scan of a survey unit, the location was marked and included as a part of the total surface contamination measurements.

5.4.2 Surface Contamination Measurements

Surface contamination measurements were taken at discrete measurement locations and at frequencies that were based on the classification of the survey unit. As no alpha contaminated areas were identified during characterization, only beta total surface contamination measurements were taken at each location.

5.4.3 Exposure Rate Measurements

Exposure rate measurements were obtained at discrete locations, based on the classification of the survey unit. Exposure rate measurements were taken at a distance of one meter from the surface. Exposure rate measurements were only obtained in accessible survey units, normally on floors.

5.4.4 Removable Surface Contamination

Removable contamination samples (smears) were collected at the frequency specified in Section 5.3.1. Smear samples for a given survey location were not collected until the scan survey and TSC measurements for that location were completed.

6.0 SURVEY RESULTS

6.1 Survey Unit Statistics

6.1.1 Conversion of Measurements to Reporting Units

With respect to the Final Status Survey, removable and total surface contamination are reported in units of dpm/100 cm2, exposure rate is reported in units of μR/hr, and volumetric material is reported in units of pCi/g (solids). Prior to comparison with any investigation level or DCGL, the appropriate background was subtracted from all radioactivity or exposure rate measurements. Corrections for detector size (total surface activity measurements) and instrument response (exposure rate measurements were also made, as discussed below).

6.1.2 Total Surface Contamination

Total surface contamination measurements was measured with 100 cm^2 detectors (if the detector was smaller, the data was area corrected to reflect a 100 square centimeter area) and compared to the 100 cm^2 average and maximum surface contamination limits.

When large area detectors were used, the observed contamination was limited to that

contamination, which would be acceptable when, confined to an area of 100 cm^2. Since it could not be discerned that the observed contamination is uniformly distributed, it was assumed that it could be attributed to an area of 100 cm^2 or less. In the event that contamination was in excess of what would be acceptable for an area of 100 cm^2 is observed when using a large area detector, an investigation survey was performed to ascertain compliance with the guideline values.

Total surface contamination results were reviewed to ensure that the applied background values were appropriate. If any background values were determined to be inappropriate they were adjusted as necessary. All adjustments, and their justifications, were documented to ensure traceability. Background subtracted was documented and provided.

6.1.3 Removable Surface Contamination

Measurements of removable surface contamination were converted from a gross count rate to units of net dpm/100 cm^2 by subtracting the background count rate of the smear counter and dividing the net count rate by the detector efficiency and correcting for the smear area (when necessary). Removable contamination results were then compared to the applicable guideline values. Details were documented and provided.

6.1.4 Comparison with Administrative Action Levels

Two categories of administrative action levels were established. The first was to initiate reclassification and re-survey of an area when results indicate that more extensive investigation was required. The second was to either directly initiate remediation, or to discern whether or not the survey unit met the release criteria. Each of these is specific to the type of survey (removable contamination, total surface contamination, soil and bulk material, or exposure rate) and to the classification of the area being surveyed (affected, suspect affected, non-suspect affected or unaffected).

Most action levels were based on a direct comparison of a single measurement or the mean of a group of measurements with the applicable guideline value. Two other comparisons were also described in this section. The first involves the calculation of a weighted mean for an elevated activity area, and the comparison of that weighted mean with the DCGL. The second comparison is done to ensure that the mean activity level in a survey unit meets the DCGL at the 95% confidence level.

6.1.5 Quality Control

A QC replicate survey was performed for 10% of the survey units (one per ten), with a minimum of one to be performed. The QC replicate survey consisted of a repeat of all measurements and samples obtained during the original final status survey, i.e., scan, TSC and smears. Replicate surveys were taken at the same locations as the original final status survey.

The technicians selected to perform the survey were different than those who performed the original survey. In addition, the serial numbers of the instrumentation selected to perform the survey were different than those which were used to perform the original survey.

6.1.6 Calibration and Maintenance

Instruments and detectors used in the final status survey were calibrated and maintained according to approved procedures. Detectors were calibrated using NIST traceable sources

6.1.7 Mean and Standard Deviation

In order to compare survey measurement results to investigation levels, a mean and standard deviation were calculated for each type of measurement for each survey unit.

The mean is calculated as follows:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n}(x_i)$$

where,

$\bar{x}$ = sample mean,

x_i = individual measurement values,

n = total number of measurements in the survey unit.

The standard deviation is calculated as follows:

$$s_x = \sqrt{\frac{\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}{n-1}}$$

where,

S_x = sample standard deviation,

x_i = individual measurement values,

$\bar{x}$ = sample mean,

n = number of measurements in the survey unit.

6.1.8 Calculation of the 95% Confidence Interval of the Mean

After the mean levels are shown to satisfy the guideline values and conditions, the results will be further evaluated to determine whether the data for each survey unit provides a 95% confidence level that the true mean activity level meets the guidelines. The confidence interval is calculated using normal statistics (one-tailed test) at the 95% confidence level, as follows:

$$\mu_\alpha = \bar{x} + t_{1-\alpha,df}\frac{S_x}{\sqrt{n}})$$

where:

$\mu\alpha$ = upper confidence limit of sample mean,

$\bar{x}$ = sample mean,

$t_{1-\alpha,df}$ = student t statistic for the degree of confidence and degrees of freedom; df (degrees of freedom) is equal to n - 1, and α is 0.05 for this test,

Sx = sample standard deviation, which includes the weighted means for any elevated areas, and

n = number of measurements in the survey unit.

The value $\mu\alpha$ will be compared with the guideline value. If $\mu\alpha$ is less than the guideline, the area being tested meets the guideline at a 95% confidence level. This

means that the probability is less than 5% that $\mu\alpha$ will pass the test when the true mean activity level exceeds the guideline value. Where $\mu\alpha$ is greater than the guideline value and the mean is less than the guideline value (i.e., the test of confidence is inconclusive), either (1) remediation will be conducted, followed by a re-survey, or (2) additional measurements/sampling will be performed.

A summary of all data collected for the UTR-10 Final Status Survey is presented in Tables 6.1-6.8. This summary data consists of the location, type, and count, minimum, maximum, mean standard deviation and Upper 95% confidence level for all the data collected. More detailed data for all of the survey are contained in Appendices B through I.

6.2 Class One Areas

6.2.1 Process Pit –P001

Survey of the process pit yielded no measurement above the DCGL. The survey area and data summary is depicted in Figure 6.1 and Table 6.1, respectively.

6.2.2 Area F001-Fuel Pit

Survey of the fuel pit yielded no measurement above the DCGL. The survey area and data summary is depicted in Figure 6.2 and Table 6.2, respectively.

Table 6.1: P001 Data Summary

Count	Minimum	Maximum	Area Mean	Standard Deviation	Upper 95% CL	DCGL	Units
26	62	703	340	140	386.79	5300	dpm/100cm^2

Table 6.2: Fuel Pit Summary Data

Count	Minimum	Maximum	Area Mean	Standard Deviation	Upper 95% CL	DCGL	Units
20	366	1703	937	442	1107.61	5300	dpm/100cm^2

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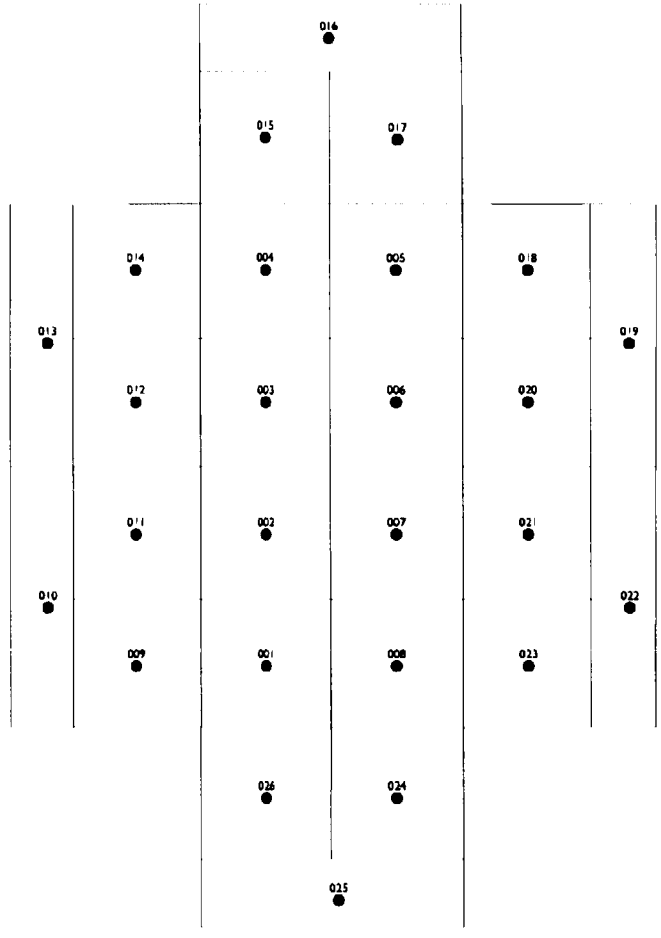
FINAL STATUS SURVEY MAP



Comments:

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PROJECT / SITE:
Iowa State University / UTR-10 Reactor

LOCATION / JOB DESCRIPTION:
Central Bay Area

AREA IDENTIFICATION #: Pp001

AREA NAME: Process Pit

BUILDING: Nuclear Engineering Lab

MAP IDENTIFICATION #: PP001.cdr

SURVEY UNIT NAME: Floor / Lower Walls

MATERIAL TYPE:	Bare Concrete	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001-026	
SURFACE AREA:	52	M^2
GRID SIZE	2	M^2
MATERIAL TYPE:		
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:		
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:		
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

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FIGURE 6.1: Process Pit

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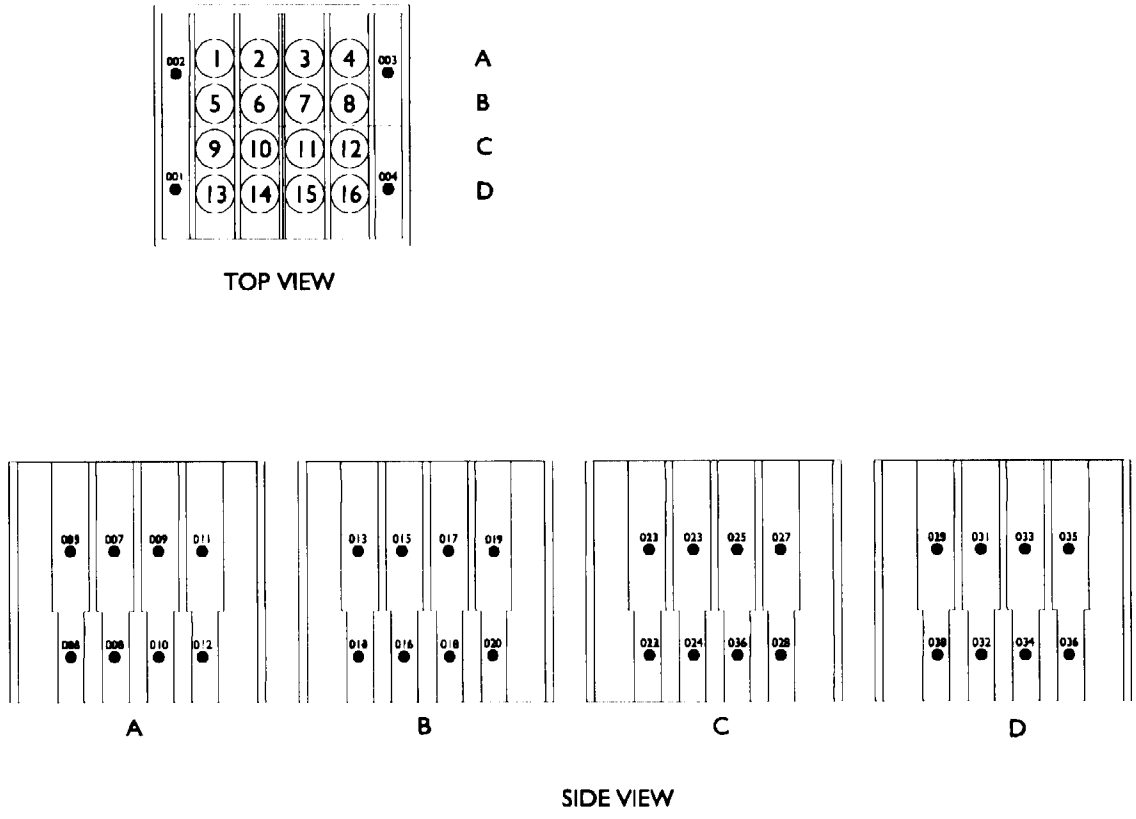
FINAL STATUS SURVEY MAP



Comments:

PROJECT / SITE:
Iowa State University / UTR-10 Reactor

LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - Central Bay Area

AREA IDENTIFICATION #: Fp001

AREA NAME: Fuel Storage Pit

BUILDING: Nuclear Engineering Lab

MAP IDENTIFICATION #: FP001.cdr

SURVEY UNIT NAME: Floor / Lower Walls

MATERIAL TYPE:	Bare Concrete	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001-004	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	Generic	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	005-036	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:		
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:		
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

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FIGURE 6.2: Fuel Storage Pit

6.2.3 Area CBA06- Reactor Footprint

Survey of the reactor footprint yielded no measurement above the DCGL. The survey area and data summary is depicted in Figure 6.3 and Table 6.3, respectively

6.3 Class 2 Areas

6.3.1 Area CBA01 – Central Bay Floors and Walls

Survey of the Central Bay floors and walls yielded no measurement above the DCGL. The survey area and data summary is depicted in Figure 6.4 and Table 6.4, respectively

6.4 Class 3 Areas

6.4.1 Area CBA-02 – Central Bay Upper walls and Ceilings

Survey of the Central Bay floors and walls yielded no measurement above the DCGL. The survey area and data summary is depicted in Figure 6.5 and Table 6.5, respectively.

Table 6.3: Reactor Footprint Data Summary

Count	Minimum	Maximum	Area Mean	Standard Deviation	Upper 95% Cl	DCGL	Units
28	338	2524	876	493	1034.20	5300	dpm/100cm^2

Table 6.4: Central Bay Floors and Walls Data Summary

Count	Minimum	Maximum	Area Mean	Standard Deviation	Upper 95% Cl	DCGL	Units
58	-3034	2241	627	1199	892.22	5300	dpm/100cm^2

Table 6.5: Central Bay Upper walls and Ceilings Data Summary

Count	Minimum	Maximum	Area Mean	Standard Deviation	Upper 95% Cl	DCGL	Units
30	586	3234*	1509	773	1748.53	5300	dpm/100cm^2

* The measurements were made at a location affected by source material in storage and not associated with reactor operations. These elevated measurements were previously identified during characterization and described in Section 7.5 of the Characterization Report.

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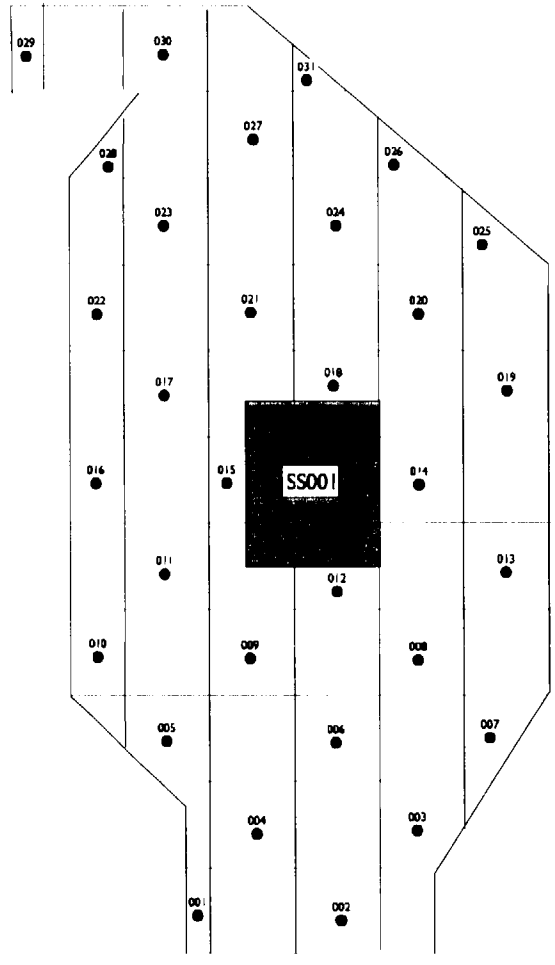
FINAL STATUS SURVEY MAP



PROJECT / SITE:
Iowa State University / UTR-10 Reactor

LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - Central Bay

AREA IDENTIFICATION #: **CBA06**

AREA NAME: **Reactor Housing Foundation**

BUILDING: **Nuclear Engineering Lab**

MAP IDENTIFICATION #: **CBA06.cdr**

SURVEY UNIT NAME: **Floor**

MATERIAL TYPE:	**Bare Concrete**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001 - 031	
SURFACE AREA:	50	M^2
GRID SIZE	1	M^2
MATERIAL TYPE:	**N/A**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	**N/A**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	4	M^2
MATERIAL TYPE:	**N/A**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

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Comments:

FIGURE 6.3: Central Bay CBA06

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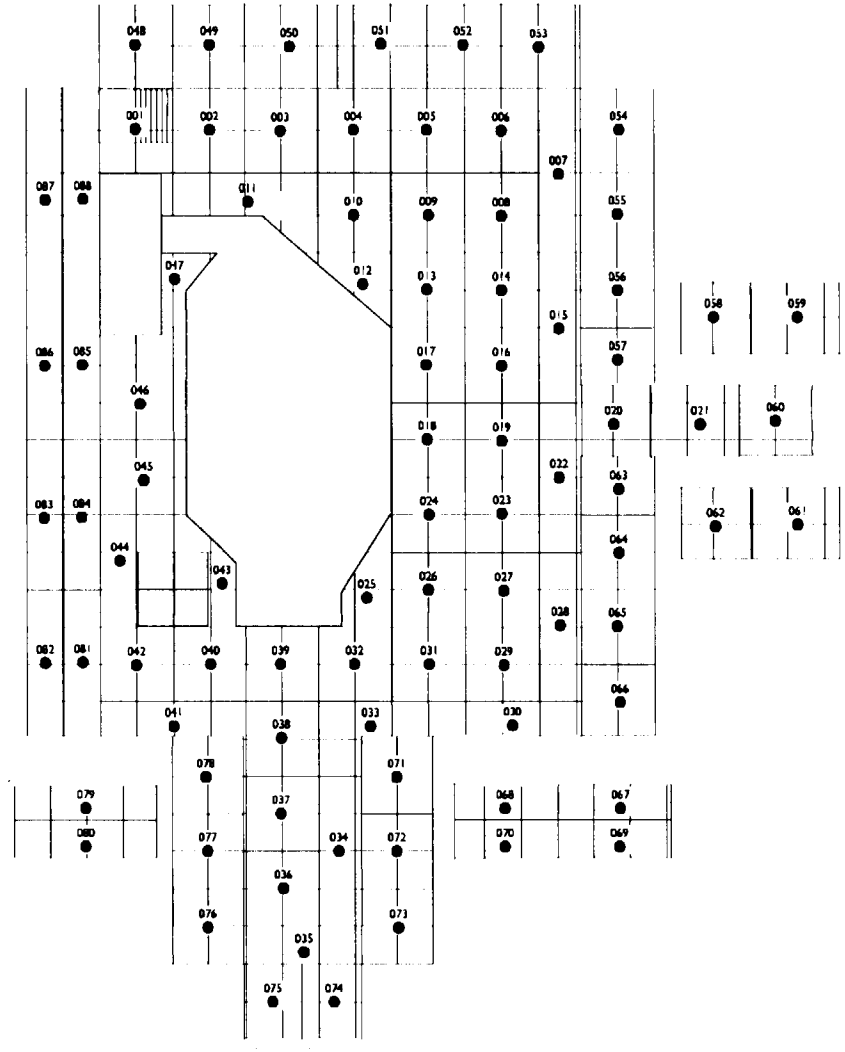
FINAL STATUS SURVEY MAP



PROJECT / SITE:	Iowa State University / UTR-10 Reactor	
LOCATION / JOB DESCRIPTION:	Nuclear Engineering Lab - Central Bay	
AREA IDENTIFICATION #:	CBA01	
AREA NAME:	Central Bay	
BUILDING:	Nuclear Engineering Lab	
MAP IDENTIFICATION #:	CBA01.cdr	
SURVEY UNIT NAME:	Floor / Lower Walls	
MATERIAL TYPE:	Bare Concrete	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	01-47,67,68,79,81,84,85	
SURFACE AREA:	N/A	M^2
GRID SIZE	4	M^2
MATERIAL TYPE:	Brick	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	48-50,69-73,76-78,80,82,83	
SURFACE AREA:	N/A	M^2
GRID SIZE	4	M^2
MATERIAL TYPE:	Generic	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	51-66,74,75	
SURFACE AREA:	N/A	M^2
GRID SIZE	4	M^2
MATERIAL TYPE:	N/A	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

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Comments:

FIGURE 6.4: Central Bay CBA01

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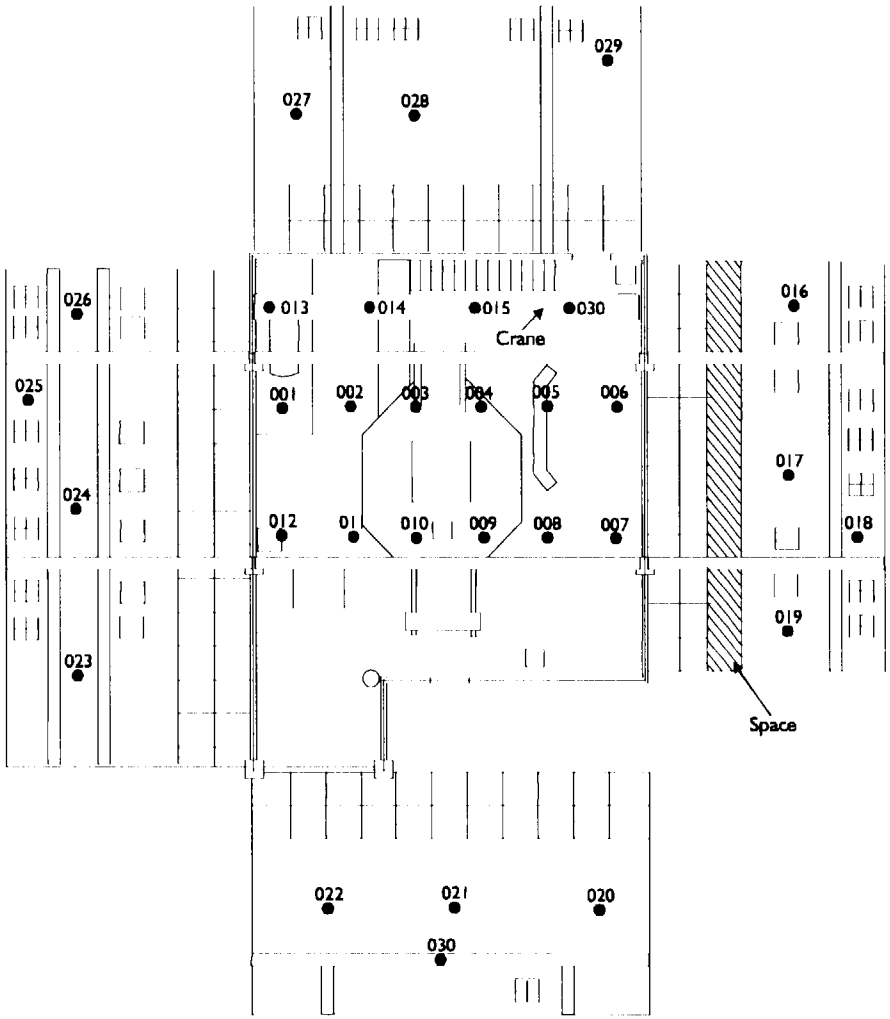
FINAL STATUS SURVEY MAP



Comments: Survey locations 013, 014, 015 and 030 taken on top-side of crane.

PROJECT / SITE:
Iowa State University / UTR-10 Reactor

LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - Central Bay

AREA IDENTIFICATION #: CBA02

AREA NAME: Central Bay

BUILDING: Nuclear Engineering Lab

MAP IDENTIFICATION #: CBA02.cdr

SURVEY UNIT NAME: Upper Walls/Ceiling

MATERIAL TYPE:	Painted Concrete	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001-012	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	Generic	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	013-030	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	N/A	
LOCATION CODE:		
SURVEY LOCATION #'S		
SURFACE AREA:		M^2
GRID SIZE		M^2
MATERIAL TYPE:	N/A	
LOCATION CODE:		
SURVEY LOCATION #'S		
SURFACE AREA:		M^2
GRID SIZE		M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

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FIGURE 6.5: Central Bay CBA02

6.4.2 Area NEL01- Nuclear Engineering Laboratory Basement Lower Walls and Floors

Survey of the laboratory basement floors and walls yielded no measurement above the DCGL. The survey area and data summary is depicted in Figure 6.6 and Table 6.6, respectively.

6.4.3 Area NEL-002 – Nuclear Engineering Laboratory- First Floor and Walls

Survey of the laboratory first floor and walls yielded no measurement above the DCGL. The survey area and data summary is depicted in Figure 6.7 and Table 6.7, respectively.

6.4.4 Area NEL-03 – Nuclear Engineering Laboratory – Second Floor and Walls

Survey of the laboratory second floor and walls yielded no measurement above the DCGL. The survey area and data summary is depicted in Figure 6.8 and Table 6.8, respectively.

Table 6.6: Nuclear Engineering Laboratory Basement Lower Walls and Floors

Count	Minimum	Maximum	Area Mean	Standard Deviation	Upper 95% CI	DCGL	Units
30	-90	821	357	242	431.92	5300	dpm/100cm^2

Table 6.7: Nuclear Engineering Laboratory First Floor and Walls

Count	Minimum	Maximum	Area Mean	Standard Deviation	Upper 95% CI	DCGL	Units
29	-2972	9248*	408	2238	1115.14	5300	dpm/100cm^2

Table 6.8: Nuclear Engineering Laboratory Second Floor and Walls

Count	Minimum	Maximum	Area Mean	Standard Deviation	Upper 95% CI	DCGL	Units
30	179	3434*	946	731	1173.31	5300	dpm/100cm^2

* The measurements were made at a location affected by source material in storage and not associated with reactor operations. These elevated measurements were previously identified during characterization and described in Section 7.5 of the Characterization Report.

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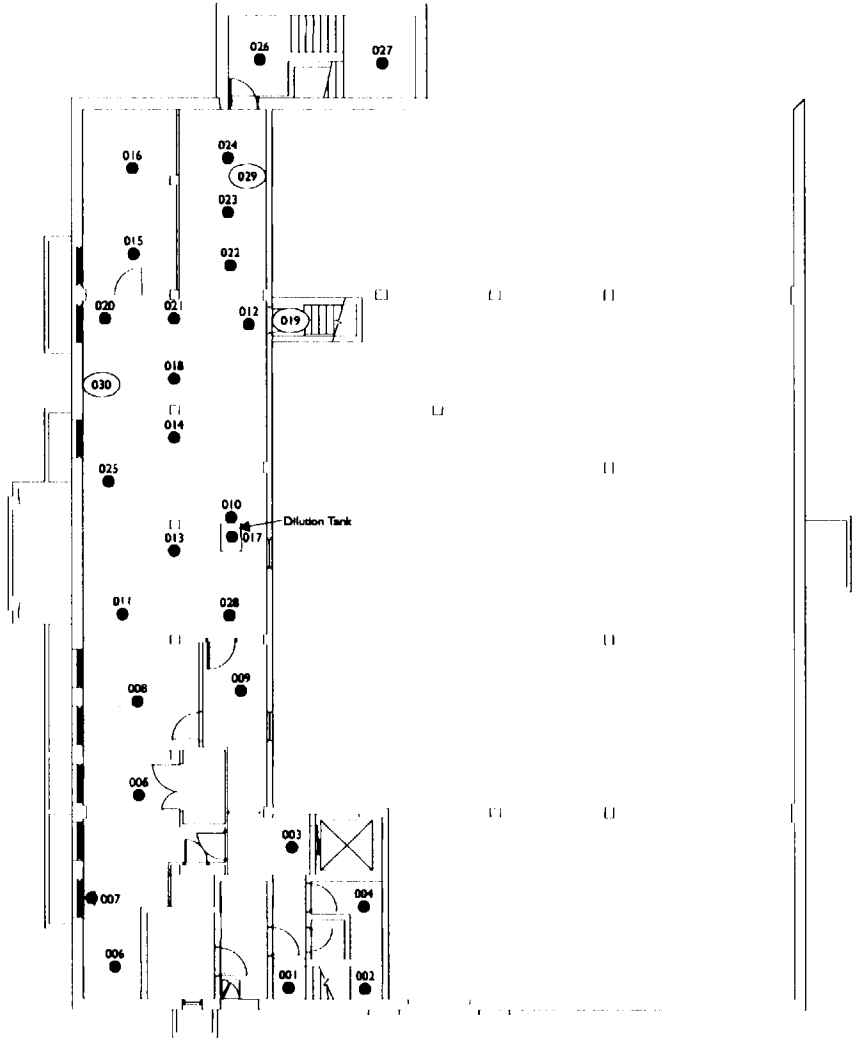
FINAL STATUS SURVEY MAP



Comments:

PROJECT / SITE:
Iowa State University / UTR-10 Reactor

LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - Basement

AREA IDENTIFICATION #: **NEL01**

AREA NAME: **Basement**

BUILDING: **Nuclear Engineering Lab**

MAP IDENTIFICATION #: **NEL01.cdr**

SURVEY UNIT NAME: **Floor / Lower Walls**

MATERIAL TYPE:	**Bare Concrete**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001-006,009,014-017,020-028	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	**Porcelain**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	007	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	**Generic**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	008,010,013,018,019	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	**Painted Concrete**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	012,029-030	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

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FIGURE 6.6: Basement

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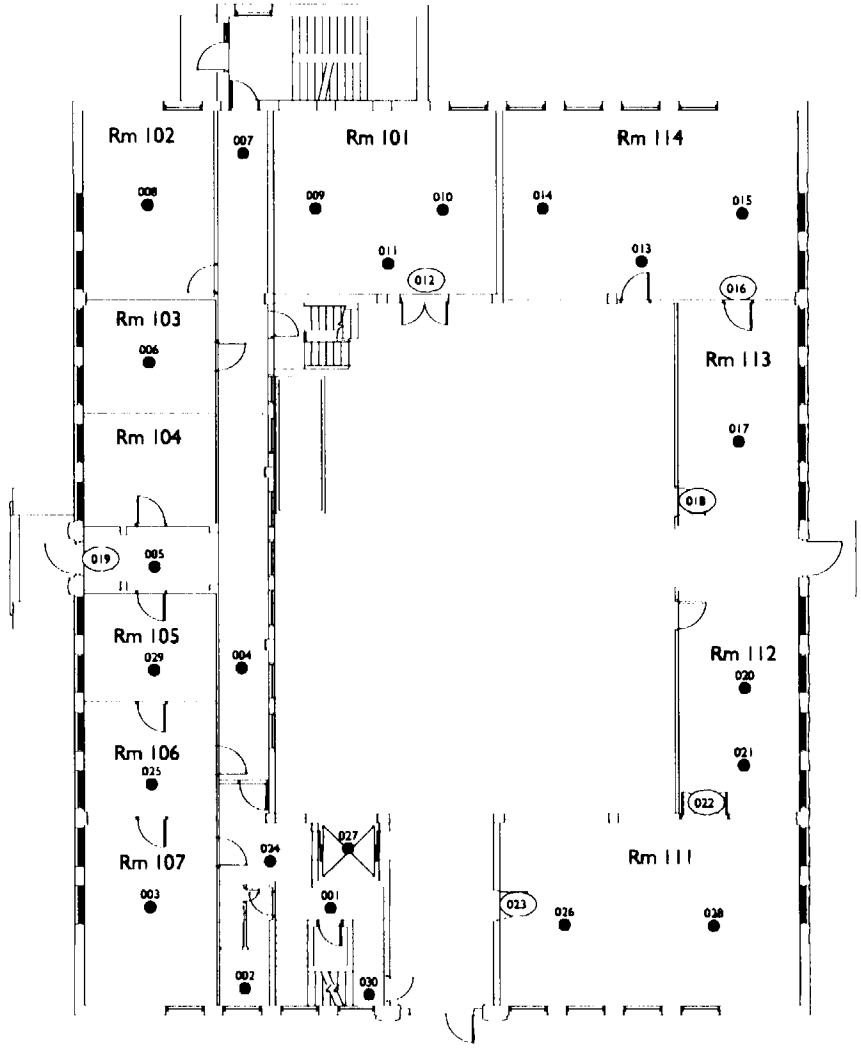
FINAL STATUS SURVEY MAP



Comments:

PROJECT / SITE:
Iowa State University / UTR-10 Reactor

LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - 1st Floor

AREA IDENTIFICATION #: NEL02

AREA NAME: First Floor

BUILDING: Nuclear Engineering Lab

MAP IDENTIFICATION #: NEL02.cdr

SURVEY UNIT NAME: Floor / Lower Walls

MATERIAL TYPE:	Generic	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001-008,012,16-19,22-25,27,29	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	Bare Concrete	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	009-011,013-015,020,021, 026,028,030	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	N/A	
LOCATION CODE:		
SURVEY LOCATION #'S		
SURFACE AREA:		M^2
GRID SIZE		M^2
MATERIAL TYPE:	N/A	
LOCATION CODE:		
SURVEY LOCATION #'S		
SURFACE AREA:		M^2
GRID SIZE		M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

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FIGURE 6.7: First Floor

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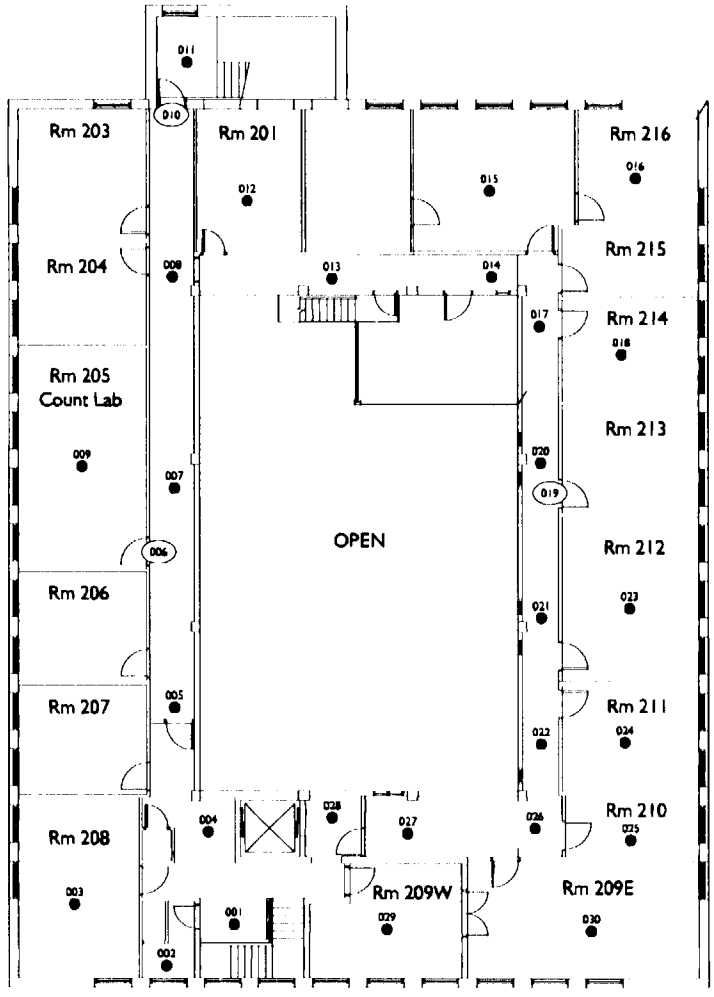
FINAL STATUS SURVEY MAP



Comments:

PROJECT / SITE:
Iowa State University / UTR-10 Reactor

LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - 2nd Floor

AREA IDENTIFICATION #: NEL03

AREA NAME: Second Floor

BUILDING: Nuclear Engineering Lab

MAP IDENTIFICATION #: NEL03.cdr

SURVEY UNIT NAME: Floor / Lower Walls

MATERIAL TYPE:	Bare Concrete	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001,003-005,007,008,011-014, 017,020-022,026-028	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	Generic	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	002,006,009,010,015-016 018-019,023-025,029,030	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	N/A	
LOCATION CODE:		
SURVEY LOCATION #'S		
SURFACE AREA:		M^2
GRID SIZE		M^2
MATERIAL TYPE:	N/A	
LOCATION CODE:		
SURVEY LOCATION #'S		
SURFACE AREA:		M^2
GRID SIZE		M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

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FIGURE 6.8: Second Floor

6.5 Total Effective Dose Equivalent (TEDE)

A calculation was performed to estimate the TEDE from residual radioactivity contracted in the reactor foot print. Using the upper 95%CL data from each survey area, and the ratios of nuclides comprising the reactor concrete, a conservative input to the DandD code was developed. Because the University intends the Nuclear Engineering Laboratory for future use, the building occupancy scenario was executed using default parameters. The resultant TEDE from this conservative scenario was 2.86 millirem, occurring in the first year following decommissioning.

7.0 SUMMARY

All Data Quality Objectives were met. In addition, no single measurement exceeded the investigation levels specified in the Final Status Survey Plan.

The final status survey measurement data indicate that all areas defined within the scope of the UTR-10 facility contain residual radioactivity that would result in a dose of less than 25 millirem. Thus, compliance with the provisions of 10CFR20.1402 has been demonstrated.

8.0 REFERENCES

1) Title 10, Code of Federal Regulations, Part 20, Standards for Protection Against Radiation, various subsections; 10 CFR 20.1402, Final Rule on License Termination, Radiological Criteria for Unrestricted Release

2) Title 10, Code of Federal Regulations, Part 61, Licensing Requirements for the Land Disposal of Radioactive Waste.

3) USNRC, NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), December 1997.

4) USNRC, NUREG-1537, Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Appendix 17.1, February 1996

5) USNRC, D and D, Version 1.0, 1998.

6) DE&S' Document No. 00752.F02.A01, Characterization Report for the Iowa State University UTR-10 Reactor, December 1998.

7) DE&S Document No. 00752.F03.A01, Decommissioning Plan for the Iowa State University UTR-10 Reactor

8) DE&S Document No. DD-FS-300, Rev.0; Iowa State University UTR-10 Final Status Survey Plan

9) DE&S, Quality Assurance Project Plan For Site Characterization and Final Survey Activities, August, 1998.

10) DE&S, Laboratory Quality Assurance Plan, DESEL Manual 100, Revision 0, July 1998.

11) DE&S Document, Memorandum, S. Roberts to E. Heath, Technical Basis for SH-360/ GM Correction Factor.

9.0 GLOSSARY

Accessible Surface Area - An area accessible to a 100 cm^2 proportional detector or a 15.5 cm^2 GM detector for direct or scanning measurements.

Administrative Action Level - A contamination level used as the investigation threshold in survey units to evaluate the need for additional investigation, reclassification or remediation.

Background Radiation - Naturally occurring radiation which may include cosmic, terrestrial (radiation from the naturally radioactive elements) and man-made radiation from global fallout.

Characterization Survey - A radiological survey and its supporting evaluations performed to establish the radiological condition for planning decommissioning activities.

Confidence Interval - A range of values derived from a sample such that there is a probability that a population parameter being estimated, e.g., a mean value, lies within the range.

Confidence Level - The probability associated with a confidence interval which expresses the probability that the confidence interval contains the population parameter value being estimated.

Elevated Area - Areas of residual contamination exceeding the guideline value.

Final Status Survey - (FSS) Radiological measurements, evaluations and supporting activities undertaken to demonstrate that the facility satisfies the criteria for unrestricted use.

DCGL, - residual radioactivity levels that equate to the site release criteria for that particular pathway or measurement.

History File - A compilation of information prepared for use in planning the final status survey of a survey area. It summarizes the operational history, characterization survey data, operational surveys and other information to help establish the basis for the design of the final status survey.

Minimum Detectable Concentration - (MDC) The minimum activity concentration on a surface or material volume that can be statistically detected above background. This is usually set at the 95% confidence level.

Release Criteria - A term used to identify the radiological requirements for release of the facility for unrestricted use.

Replicate Survey - A survey which consists of repeat measurements on a specified fraction of survey areas. The survey areas are usually selected at random to provide an independent check of final status survey measurements.

Scan Survey - A qualitative radiological monitoring technique which is performed by moving a detector over a surface at a specified constant speed to detect elevated activity levels. Also called Surface Scan.

Structures - All site buildings and their surfaces. In addition, platforms, restraints and supports, and external surfaces of piping systems, heating and ventilation systems, tanks, stacks, etc. are also treated as structures in the final status survey.

Surface Contamination - The total of both fixed and removable contamination. For the purposes of this Plan, this would also include any remaining neutron-activated material. Also called total surface contamination.

Survey Area - The basic entity for the management of the Final Status Survey. It is comprised of one or more survey units, the bounds of which are defined by existing facility physical features, such as a room, intersection of walls, column-and-row layout of a floor elevation, or structural I-beams.

Survey Location - In a structural or open land survey area, a survey location is usually represented by a single grid block. In a system survey area, a specified length of piping or a component such as a valve or tank is referred to as a survey location. A survey location can contain one or more survey points. Also referred to as a Measurement Location.

Survey Package - A collection of information in a standardized format for controlling and documenting field measurements taken for the Final Status Survey. A survey package is prepared for each survey area. The survey package may include the survey instructions, a control form, grid map(s), survey measurement data sheets and survey maps.

Survey Point - A smaller subdivision within a survey location (grid block, system, component) where local measurements are taken. For structures and systems, a survey point generally refers to an area covered by a detector, or an area of 100 cm^2 when a smear is taken. For open land areas, a survey point refers to the area covered by a detector (for paved surfaces), the point at which an exposure rate measurement is taken, or the point at which a soil or pavement sample is collected.

APPENDIX A: Final Status Survey Plan

Appendix A contains 73 pages.

APPENDIX B: Area CBA06 Data Summary

Appendix B contains 3 pages.

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Removable Contamination Results

beta

Type: Removable Contamination

Area: CBA006

bkg count time = 10 bkg cpm= 48
samp. count time = 1 eff. beta= 0.345
dcgl= 1325 mda= 77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
C006001	46	46	-2	-5.80	NO	NO
C006002	50	50	2	5.80	NO	NO
C006003	65	65	17	49.28	NO	NO
C006004	50	50	2	5.80	NO	NO
C006005	52	52	4	11.59	NO	NO
C006006	52	52	4	11.59	NO	NO
C006007	48	48	0	0.00	NO	NO
C006008	47	47	-1	-2.90	NO	NO
C006009	55	55	7	20.29	NO	NO
C006010	50	50	2	5.797	NO	NO
C006011	42	42	-6	-17.39	NO	NO
C006012	49	49	1	2.90	NO	NO
C006013	48	48	0	0.00	NO	NO
C006014	47	47	-1	-2.90	NO	NO
C006015	61	61	13	37.68	NO	NO
C006016	45	45	-3	-8.70	NO	NO
C006017	49	49	1	2.90	NO	NO
C006018	59	59	11	31.88	NO	NO
C006019	46	46	-2	-5.80	NO	NO
C006020	54	54	6	17.39	NO	NO
C006021	57	57	9	26.09	NO	NO
C006022	62	62	14	40.58	NO	NO
C006023	44	44	-4	-11.59	NO	NO
C006024	45	45	-3	-8.70	NO	NO
C006025	48	48	0	0.00	NO	NO
C006026	55	55	7	20.29	NO	NO
C006027	58	58	10	28.99	NO	NO
C006028	54	54	6	17.39	NO	NO
C006029	58	58	10	28.99	NO	NO
C006030	49	49	1	2.90	NO	NO
C006031	43	43	-5	-14.49	NO	NO

APPENDIX C: Area PP001 Data Summary

Appendix C contains 3 pages.

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Removable Contamination Results

beta

Type: Removable Contamination

Area: PP001

bkg count time =	10	bkg cpm=	48
samp. count time =	1	eff. beta=	0.345
dcgl=	1325	mda=	77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
P001001	52	52	4	11.59	NO	NO
P001002	41	41	-7	-20.29	NO	NO
P001003	54	54	6	17.39	NO	NO
P001004	47	47	-1	-2.90	NO	NO
P001005	42	42	-6	-17.39	NO	NO
P001006	41	41	-7	-20.29	NO	NO
P001007	50	50	2	5.80	NO	NO
P001008	49	49	1	2.90	NO	NO
P001009	44	44	-4	-11.59	NO	NO
P001010	41	41	-7	-20.29	NO	NO
P001011	47	47	-1	-2.90	NO	NO
P001012	49	49	1	2.90	NO	NO
P001013	48	48	0	0.00	NO	NO
P001014	39	39	-9	-26.09	NO	NO
P001015	44	44	-4	-11.59	NO	NO
P001016	57	57	9	26.09	NO	NO
P001017	48	48	0	0.00	NO	NO
P001018	50	50	2	5.80	NO	NO
P001019	46	46	-2	-5.80	NO	NO
P001020	39	39	-9	-26.09	NO	NO
P001021	45	45	-3	-8.70	NO	NO
P001022	42	42	-6	-17.39	NO	NO
P001023	43	43	-5	-14.49	NO	NO
P001024	49	49	1	2.90	NO	NO
P001025	43	43	-5	-14.49	NO	NO
P001026	51	51	3	8.70	NO	NO

APPENDIX D: Area F001 Data Summary

Appendix D contains 4 pages.

Duke Engineering & Services
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Removable Contamination Results

beta

Type: Removable Contamination

Area: F001

bkg count time = 10 bkg cpm= 48
samp. count time = 1 eff. beta= 0.345
dcgl= 1325 mda= 77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
F001001	42	42	-6	-17.39	NO	NO
F001002	39	39	-9	-26.09	NO	NO
F001003	38	38	-10	-28.99	NO	NO
F001004	55	55	7	20.29	NO	NO
F001005		0	-48	-139.13	NO	NO
F001006		0	-48	-139.13	NO	NO
F001007		0	-48	-139.13	NO	NO
F001008		0	-48	-139.13	NO	NO
F001009	41	41	-7	-20.29	NO	NO
F001010	44	44	-4	-11.59	NO	NO
F001011	41	41	-7	-20.29	NO	NO
F001012	45	45	-3	-8.70	NO	NO
F001013	52	52	4	11.59	NO	NO
F001014	51	51	3	8.70	NO	NO
F001015	51	51	3	8.70	NO	NO
F001016	37	37	-11	-31.88	NO	NO
F001017	57	57	9	26.09	NO	NO
F001018	51	51	3	8.70	NO	NO
F001019	48	48	0	0.00	NO	NO
F001020	37	37	-11	-31.88	NO	NO
F001021	56	56	8	23.18	NO	NO
F001022	46	46	-2	-5.80	NO	NO
F001023	46	46	-2	-5.80	NO	NO
F001024	64	64	16	46.38	NO	NO
F001025	51	51	3	8.70	NO	NO
F001026	50	50	2	5.80	NO	NO
F001027	44	44	-4	-11.59	NO	NO
F001028	46	46	-2	-5.80	NO	NO
F001029	50	50	2	5.80	NO	NO
F001030	62	62	14	40.58	NO	NO
F001031	44	44	-4	-11.59	NO	NO
F001032	54	54	6	17.39	NO	NO
F001033	50	50	2	5.80	NO	NO
F001034	48	48	0	0.00	NO	NO
F001035	57	57	9	26.09	NO	NO
F001036	53	53	5	14.49	NO	NO

Duke Engineering & Services
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Removable Contamination Results

beta

Type: Removable Contamination

Area: F001

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
F001037	46	46	-2	-5.80	NO	NO
F001038	49	49	1	2.90	NO	NO
F001039	53	53	5	14.49	NO	NO
F001040	51	51	3	8.70	NO	NO

APPENDIX E: Area CBA01 Data Summary

Appendix E contains 5 pages.

Duke Engineering & Services
A Duke Energy Company

Removable Contamination Results

beta

Type: Removable Contamination
Area: CBA001

bkg count time = 10 bkg cpm= 48
samp. count time = 1 eff. beta= 0.345
dcgl= 1325 mda= 77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
C001001	35	35	-13	-37.68	NO	NO
C001002	43	43	-5	-14.49	NO	NO
C001003	40	40	-8	-23.19	NO	NO
C001004	37	37	-11	-31.88	NO	NO
C001005	49	49	1	2.90	NO	NO
C001006	50	50	2	5.80	NO	NO
C001007	52	52	4	11.59	NO	NO
C001008	43	43	-5	-14.49	NO	NO
C001009	48	48	0	0.00	NO	NO
C001010	38	38	-10	-28.99	NO	NO
C001011	49	49	1	2.90	NO	NO
C001012	44	44	-4	-11.59	NO	NO
C001013	42	42	-6	-17.39	NO	NO
C001014	35	35	-13	-37.68	NO	NO
C001015	44	44	-4	-11.59	NO	NO
C001016	43	43	-5	-14.49	NO	NO
C001017	39	39	-9	-26.09	NO	NO
C001018	40	40	-8	-23.19	NO	NO
C001019	46	46	-2	-5.80	NO	NO
C001020	49	49	1	2.90	NO	NO
C001021	43	43	-5	-14.49	NO	NO
C001022	37	37	-11	-31.88	NO	NO
C001023	52	52	4	11.59	NO	NO
C001024	48	48	0	0.00	NO	NO
C001025	45	45	-3	-8.70	NO	NO
C001026	38	38	-10	-28.99	NO	NO
C001027	47	47	-1	-2.90	NO	NO
C001028	39	39	-9	-26.09	NO	NO
C001029	53	53	5	14.49	NO	NO
C001030	37	37	-11	-31.88	NO	NO
C001031	55	55	7	20.29	NO	NO
C001032	47	47	-1	-2.90	NO	NO
C001033	45	45	-3	-8.70	NO	NO
C001034	62	62	14	40.58	NO	NO
C001035	40	40	-8	-23.19	NO	NO

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Removable Contamination Results

beta

Type: Removable Contamination
Area: CBA001

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
C001036	50	50	2	5.80	NO	NO
C001037	52	52	4	11.59	NO	NO
C001038	54	54	6	17.39	NO	NO
C001039	43	43	-5	-14.49	NO	NO
C001040	48	48	0	0.00	NO	NO
C001041	45	45	-3	-8.70	NO	NO
C001042	37	37	-11	-31.88	NO	NO
C001043	53	53	5	14.49	NO	NO
C001044	59	59	11	31.88	NO	NO
C001045	51	51	3	8.70	NO	NO
C001046	39	39	-9	-26.09	NO	NO
C001047	54	54	6	17.39	NO	NO
C001048	55	55	7	20.29	NO	NO
C001049	47	47	-1	-2.90	NO	NO
C001050	41	41	-7	-20.29	NO	NO
C001051	51	51	3	8.70	NO	NO
C001052	48	48	0	0.00	NO	NO
C001053	53	53	5	14.49	NO	NO
C001054	52	52	4	11.59	NO	NO
C001055	53	53	5	14.49	NO	NO
C001056	52	52	4	11.59	NO	NO
C001057	57	57	9	26.09	NO	NO
C001058	47	47	-1	-2.90	NO	NO
C001059	40	40	-8	-23.19	NO	NO
C001060	45	45	-3	-8.70	NO	NO
C001061	55	55	7	20.29	NO	NO
C001062	39	39	-9	-26.09	NO	NO
C001063	46	46	-2	-5.80	NO	NO
C001064	43	43	-5	-14.49	NO	NO
C001065	48	48	0	0.00	NO	NO
C001066	43	43	-5	-14.49	NO	NO
C001067	44	44	-4	-11.59	NO	NO
C001068	47	47	-1	-2.90	NO	NO
C001069	42	42	-6	-17.39	NO	NO
C001070	43	43	-5	-14.49	NO	NO
C001071	36	36	-12	-34.78	NO	NO
C001072	46	46	-2	-5.80	NO	NO
C001073	47	47	-1	-2.90	NO	NO
C001074	50	50	2	5.80	NO	NO

Duke Engineering & Services
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Removable Contamination Results

beta

Type: Removable Contamination
Area: CBA001

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
C001075	52	52	4	11.59	NO	NO
C001076	42	42	-6	-17.39	NO	NO
C001077	43	43	-5	-14.49	NO	NO
C001078	41	41	-7	-20.29	NO	NO
C001079	39	39	-9	-26.09	NO	NO
C001080	42	42	-6	-17.40	NO	NO
C001081	60	60	12	34.78	NO	NO
C001082	49	49	1	2.90	NO	NO
C001083	46	46	-2	-5.80	NO	NO
C001084	52	52	4	11.59	NO	NO
C001085	57	57	9	26.09	NO	NO
C001086	41	41	-7	-20.29	NO	NO
C001087	38	38	-10	-28.99	NO	NO
C001088	51	51	3	8.70	NO	NO

APPENDIX F: Area CBA02 Data Summary

Appendix F contains 3 pages.

Duke Engineering & Services.
A Duke Energy Company

Removable Contamination Results

beta

Type: Removable Contamination
Area: CBA002

bkg count time = 10 bkg cpm= 48
samp. count time = 1 eff. beta= 0.345
dcgl= 1325 mda= 77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
C002001	37	37	-11	-31.88	NO	NO
C002002	46	46	-2	-5.80	NO	NO
C002003	39	39	-9	-26.09	NO	NO
C002004	51	51	3	8.70	NO	NO
C002005	43	43	-5	-14.49	NO	NO
C002006	42	42	-6	-17.39	NO	NO
C002007	36	36	-12	-34.78	NO	NO
C002008	48	48	0	0.00	NO	NO
C002009	48	48	0	0.00	NO	NO
C002010	48	48	0	0.00	NO	NO
C002011	62	62	14	40.60	NO	NO
C002012	44	44	-4	-11.59	NO	NO
C002013	50	50	2	5.80	NO	NO
C002014	58	58	10	28.99	NO	NO
C002015	54	54	6	17.39	NO	NO
C002016	58	58	10	28.99	NO	NO
C002017	46	46	-2	-5.80	NO	NO
C002018	61	61	13	37.68	NO	NO
C002019	49	49	1	2.90	NO	NO
C002020	52	52	4	11.59	NO	NO
C002021	39	39	-9	-26.09	NO	NO
C002022	36	36	-12	-34.78	NO	NO
C002023	52	52	4	11.59	NO	NO
C002024	43	43	-5	-14.49	NO	NO
C002025	41	41	-7	-20.29	NO	NO
C002026	38	38	-10	-28.99	NO	NO
C002027	42	42	-6	-17.39	NO	NO
C002028	51	51	3	8.70	NO	NO
C002029	52	52	4	11.59	NO	NO
C002030	46	46	-2	-5.80	NO	NO

APPENDIX G: Area NEL01 Data Summary

Appendix G contains 3 pages.

Duke Engineering & Services.
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Removable Contamination Results

beta

Type: Removable Contamination
Area: NEL001

bkg count time = 10 bkg cpm= 50
samp. count time = 1 eff. beta= 0.35
dcgl= 1325 mda= 77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
N001001	51	51	1	2.86	NO	NO
N001002	61	61	11	31.43	NO	NO
N001003	45	45	-5	-14.29	NO	NO
N001004	47	47	-3	-8.57	NO	NO
N001005	53	53	3	8.57	NO	NO
N001006	49	49	-1	-2.86	NO	NO
N001007	55	55	5	14.29	NO	NO
N001008	52	52	2	5.71	NO	NO
N001009	48	48	-2	-5.71	NO	NO
N001010	48	48	-2	-5.71	NO	NO
N001011	51	51	1	2.86	NO	NO
N001012	49	49	-1	-2.86	NO	NO
N001013	43	43	-7	-20.00	NO	NO
N001014	48	48	-2	-5.71	NO	NO
N001015	54	54	4	11.43	NO	NO
N001016	48	48	-2	-5.71	NO	NO
N001017	47	47	-3	-8.57	NO	NO
N001018	46	46	-4	-11.43	NO	NO
N001019	48	48	-2	-5.71	NO	NO
N001020	59	59	9	25.71	NO	NO
N001021	48	48	-2	-5.71	NO	NO
N001022	43	43	-7	-20.00	NO	NO
N001023	60	60	10	28.57	NO	NO
N001024	50	50	0	0.00	NO	NO
N001025	46	46	-4	-11.43	NO	NO
N001026	47	47	-3	-8.57	NO	NO
N001027	45	45	-5	-14.29	NO	NO
N001028	57	57	7	20.00	NO	NO
N001029	55	55	5	14.29	NO	NO
N001030	45	45	-5	-14.29	NO	NO

APPENDIX H: Area NEL02 Data Summary

Appendix H contains 3 pages.

Duke Engineering & Services.
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Removable Contamination Results

beta

Type: Removable Contamination

Area: NEL002

bkg count time =	10	bkg cpm=	48
samp. count time =	1	eff. beta=	0.345
dcgl=	1325	mda=	77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
N002001	39	39	-9	-26.09	NO	NO
N002002	53	53	5	14.49	NO	NO
N002003	39	39	-9	-26.09	NO	NO
N002004	45	45	-3	-8.70	NO	NO
N002005	46	46	-2	-5.80	NO	NO
N002006	50	50	2	5.80	NO	NO
N002007	58	58	10	28.99	NO	NO
N002008	49	49	1	2.90	NO	NO
N002009	38	38	-10	-28.99	NO	NO
N002010	65	65	17	49.28	NO	NO
N002011	48	48	0	0.00	NO	NO
N002012	35	35	-13	-37.68	NO	NO
N002013	45	45	-3	-8.70	NO	NO
N002014	57	57	9	26.09	NO	NO
N002015	42	42	-6	-17.39	NO	NO
N002016	49	49	1	2.90	NO	NO
N002017	40	40	-8	-23.19	NO	NO
N002018	45	45	-3	-8.70	NO	NO
N002019	35	35	-13	-37.68	NO	NO
N002020	40	40	-8	-23.19	NO	NO
N002021	46	46	-2	-5.80	NO	NO
N002022	44	44	-4	-11.59	NO	NO
N002023	52	52	4	11.59	NO	NO
N002024	49	49	1	2.90	NO	NO
N002025	60	60	12	34.78	NO	NO
N002026	45	45	-3	-8.70	NO	NO
N002027	53	53	5	14.49	NO	NO
N002028	58	58	10	28.99	NO	NO
N002029	48	48	0	0.00	NO	NO
N002030	48	48	0	0.00	NO	NO

APPENDIX I: Area NEL03 Data Summary

Appendix I contains 3 pages.

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Removable Contamination Results

beta

Type: Removable Contamination

Area: NEL003

bkg count time = 10 bkg cpm= 50
samp. count time = 1 eff. beta= 0.35
dcgl= 1325 mda= 77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
N003001	45	45	-5	-14.29	NO	NO
N003002	49	49	-1	-2.86	NO	NO
N003003	47	47	-3	-8.57	NO	NO
N003004	47	47	-3	-8.57	NO	NO
N003005	46	46	-4	-11.43	NO	NO
N003006	44	44	-6	-17.14	NO	NO
N003007	46	46	-4	-11.43	NO	NO
N003008	52	52	2	5.71	NO	NO
N003009	51	51	1	2.86	NO	NO
N003010	55	55	5	14.29	NO	NO
N003011	52	52	2	5.71	NO	NO
N003012	41	41	-9	-25.71	NO	NO
N003013	43	43	-7	-20.00	NO	NO
N003014	49	49	-1	-2.86	NO	NO
N003015	51	51	1	2.86	NO	NO
N003016	52	52	2	5.71	NO	NO
N003017	43	43	-7	-20.00	NO	NO
N003018	42	42	-8	-22.86	NO	NO
N003019	43	43	-7	-20.00	NO	NO
N003020	45	45	-5	-14.29	NO	NO
N003021	52	52	2	5.71	NO	NO
N003022	64	64	14	40.00	NO	NO
N003023	59	59	9	25.71	NO	NO
N003024	51	51	1	2.86	NO	NO
N003025	62	62	12	34.29	NO	NO
N003026	59	59	9	25.71	NO	NO
N003027	56	56	6	17.14	NO	NO
N003028	50	50	0	0.00	NO	NO
N003029	54	54	4	11.43	NO	NO
N003030	49	49	-1	-2.86	NO	NO

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APPENDIX J: Quality Control Data Summaries

Appendix J contains 15 pages.

Duke Engineering & Services
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Removable Contamination Results

beta

Type: Removable Contamination

Area: CBA006qc

bkg count time =	10	bkg cpm=	48
samp. count time =	1	eff. beta=	0.345
dcgl=	1325	mda=	77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
C006Q10	55	55	7	20.29	NO	NO
C006Q15	45	45	-3	-8.70	NO	NO
C006Q20	46	46	-2	-5.80	NO	NO
C006Q22	45	45	-3	-8.70	NO	NO

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Removable Contamination Results

beta

Type: Removable Contamination

Area: PP001qc

bkg count time =	10	bkg cpm=	48
samp. count time =	1	eff. beta=	0.345
dcgl= 1325		mda=	77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
P001Q01	42	42	-6	-17.39	NO	NO
P001Q11	36	36	-12	-34.78	NO	NO
P001Q21	40	40	-8	-23.19	NO	NO

Duke Engineering & Services.
A Duke Energy Company

Removable Contamination Results

beta

Type: Removable Contamination

Area: CBA001qc

bkg count time =	10	bkg cpm=	48
samp. count time =	1	eff. beta=	0.345
dcgl=	1325	mda=	77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
C001Q13	41	41	-7	-20.29	NO	NO
C001Q18	60	60	12	34.78	NO	NO
C001Q20	46	46	-2	-5.80	NO	NO
C001Q24	51	51	3	8.70	NO	NO
C001Q39	54	54	6	17.39	NO	NO
C001Q42	56	56	8	23.19	NO	NO
C001Q45	45	45	-3	-8.70	NO	NO
C001Q47	54	54	6	17.39	NO	NO
C001Q84	47	47	-1	-2.90	NO	NO
C001Q85	54	54	6	17.39	NO	NO

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Removable Contamination Results

beta

Type: Removable Contamination

Area: CBA002qc

bkg count time =	10	bkg cpm=	48
samp. count time =	1	eff. beta=	0.345
dcgl=	1325	mda=	77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
C002Q01	41	41	-7	-20.29	NO	NO
C002Q24	41	41	-7	-20.29	NO	NO
C002Q25	44	44	-4	-11.59	NO	NO

Duke Engineering & Services
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Removable Contamination Results

beta

Type: Removable Contamination

Area: NEL001qc

bkg count time =	10	bkg cpm=	50
samp. count time =	1	eff. beta=	0.35
dcgl=	1325	mda=	77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
N001Q01	51	51	1	2.86	NO	NO
N001Q03	45	45	-5	-14.29	NO	NO
N001Q12	49	49	-1	-2.86	NO	NO

Duke Engineering & Services
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Removable Contamination Results

beta

Type: Removable Contamination

Area: NEL002qc

bkg count time =	10	bkg cpm=	48
samp. count time =	1	eff. beta=	0.345
dcgl=	1325	mda=	77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
N002Q04	45	45	-3	-8.70	NO	NO
N002Q20	51	51	3	8.70	NO	NO
N002Q30	40	40	-8	-23.19	NO	NO

Duke Engineering & Services
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Removable Contamination Results

beta

Type: Removable Contamination

Area: NEL003qc

bkg count time =	10	bkg cpm=	50
samp. count time =	1	eff. beta=	0.35
dcgl=	1325	mda=	77

Location	Counts	cpm	net cpm	dpm	>MDA	>DCGL
N003Q01	43	43	-7	-20.00	NO	NO
N003Q07	56	56	6	17.14	NO	NO
N003Q20	60	60	10	28.57	NO	NO

IOWA STATE UNIVERSITY
UTR-10 REACTOR
FINAL STATUS SURVEY PLAN

DD-FS-300, REV. 0

July 2000

Prepared by
Duke Engineering & Services
400 Donald Lynch Boulevard
Marlborough, MA 01752

DECONTAMINATION & DECOMMISSIONING PROJECTS SIGNATURE SHEET

Document Title: Final Status Survey Plan

Document Number: DD-FS-300 Revision Number: 0

Document Description/Purpose of Revision

Prepared By:

Signature: _____ Date: _____
Title: _____

Reviewed By:

Signature: _____ Date: _____
Title: _____

Signature: _____ Date: _____
Title: _____

Signature: _____ Date: _____
Title: _____

Signature: _____ Date: _____
Title: _____

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Title: _____

Signature: _____ Date: _____
Title: _____

Signature: _____ Date: _____
Title: _____

Approved By:

Signature: _____ Date: _____
Title: DE&S Project Manager

DECONTAMINATION & DECOMMISSIONING PROJECTS CHANGE REVISION SHEET		
DOCUMENT TITLE: Final Status Survey Plan	DOCUMENT NO.: DD-FS-300	REVISION NO.: Rev. 0

REASON FOR CHANGE(S):	PAGES TO BE CHANGED:
	PAGES TO BE ADDED:
	PAGES TO BE REMOVED:
PREPARER'S SIGNATURE:	DATE:

ENGINEERING PEN AND INK CHANGES

PROCEDURE NO: **DD-FS-300, Rev. 0**

Change No.	Affected Pages	Reason/Description	Signature	Single Use/ Permanent Change	Date
			DE&S Rep.:		
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			DE&S Rep.:		

This row to be used only if a revision would require stop of work.

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1.0 INTRODUCTION

This document describes the methods to be used by Duke Engineering & Services (DE&S) to demonstrate that radiation and radioactive contamination levels at the Iowa State University (ISU) UTR-10 Reactor have been reduced to levels below criteria established for unrestricted use.

This plan is intended to provide the basis for the implementing procedures governing the conduct of the final status survey. The methods described have been derived from regulatory guidance, specifically NUREG-1575 "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM).

In addition, this plan provides specific instructions for the performance of the final status survey including the survey measurement type, frequency and location within each survey unit. Survey/Sampling Work Plans (SSWP) are provided as Appendix A to this plan. Each SSWP will contain a FSS General Instructions Form (DD-FS-300-1), a FSS Survey Location Designation, Results and Comment Form (DD-FS-300-2) and all necessary Final Status Survey Maps (DD-FS-300-3). Examples of these forms are found in Attachments 1, 2, and 3. These forms will be customized for each survey package and specific data to be collected in each survey location indicated as an unshaded area on the form.

The results and conclusions of the characterization survey report and/or remediation efforts that describe the current radiological characteristics of the ISU Nuclear Engineering Laboratory (NEL) site will be used to develop the final status survey plan. Following the decontamination and decommissioning process, the final status survey will consist of radiation measurements, field samples and data evaluations of the ISU NEL site.

MARSSIM recommends using the graded approach in designing a final status survey. This type of approach to data collection places the greatest survey efforts on areas that have, or had, the highest potential for residual radioactivity and demonstrates that all radiological parameters do not exceed the established release criteria.

2.0 SITE INFORMATION

2.1 Historical Information

The UTR-10 was housed in the Nuclear Engineering Laboratory (NEL) building located on the west edge of the main campus of ISU, in Ames, Iowa. The facility is a two-story, three-level building of brick construction built in 1934 by the U.S. Department of Agriculture. It was deeded to the University in 1946 and served as a chemical Engineering Building until 1959. A map indicating the location of the University with respect to Ames and major highways is shown in Figure 1.1. The location of the NEL building within the ISU campus is shown in Figure 1.2.

The building floor space is divided into four levels: the basement (west side only), the ground floor (which includes the central bay), the first floor (west side only) and the second floor which surrounds the central bay. The central bay is approximately 34 feet high and has a floor area of 37 feet by 56 feet, of which a space approximately 37 feet by 38 feet was allocated to the reactor room. The reactor room housed the reactor, which was enclosed in a concrete biological shield, the process pit, the fuel storage pit, and a five-ton bridge crane. The enclosure surrounding the reactor facility included the central section of the building defined by the interior walls of offices, laboratories, and corridors. The original facility layout is shown in Figure 1.3.

The UTR-10 was an Argonaut type which used uranium enriched to 19.75% in ^{235}U in a graphite reflected, water moderated core. The reactor was installed in 1959 on the ground floor level, central bay area, of the NEL. In 1991 the reactor fuel was changed from its original high-enrichment uranium to low-enrichment uranium. The reactor was controlled with four window-shade type Boral control rods. Heat from fission was removed from the primary coolant by a 34,000 BTU/hr shell-and-tube heat exchanger that utilized city water as a heat sink. The reactor was designed to be inherently safe. It would automatically shut down if there was a loss of AC power or if parameters important to safety were exceeded. The reactor was provided with multiple experiment features including beam ports, thermal column, shield tank, internal reflector, rabbit tube, and radiation cavity.

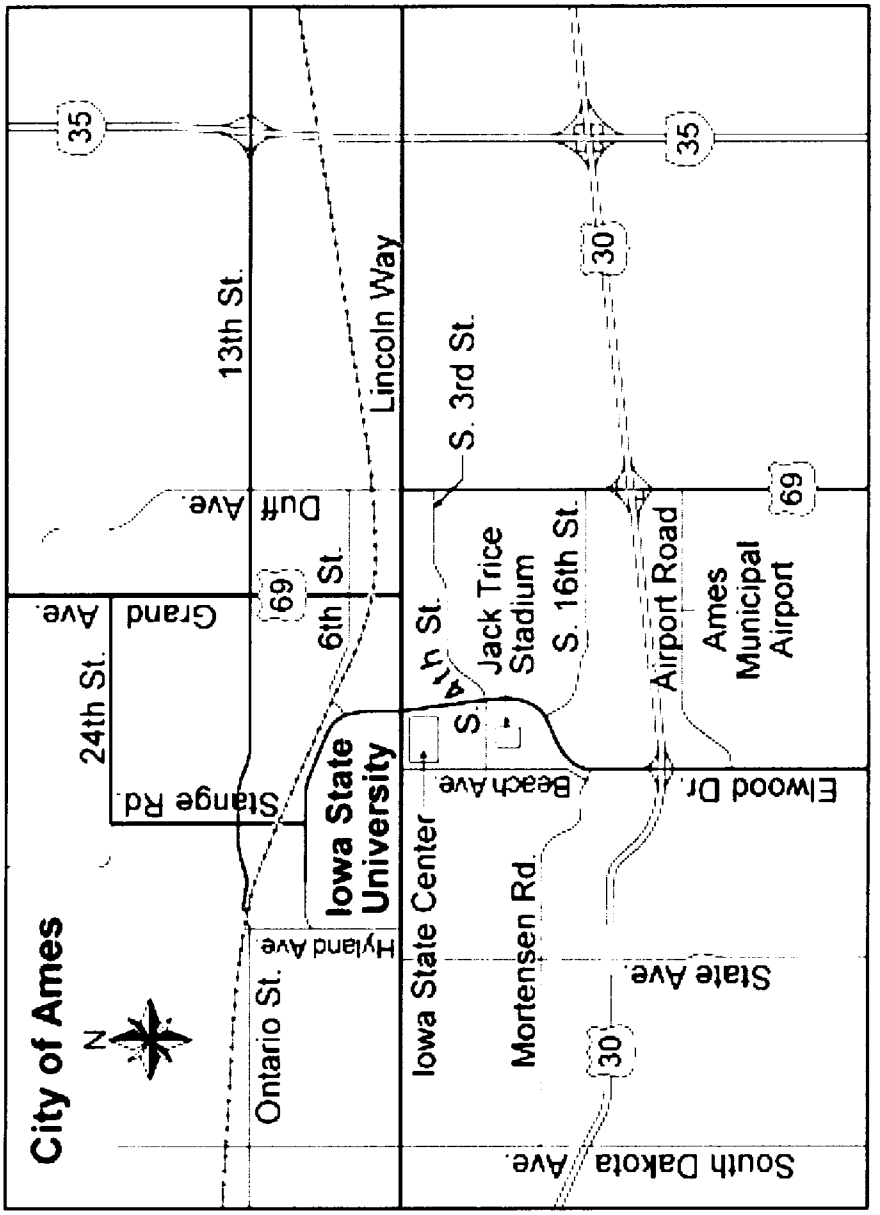


Figure 1.1: Location of ISU

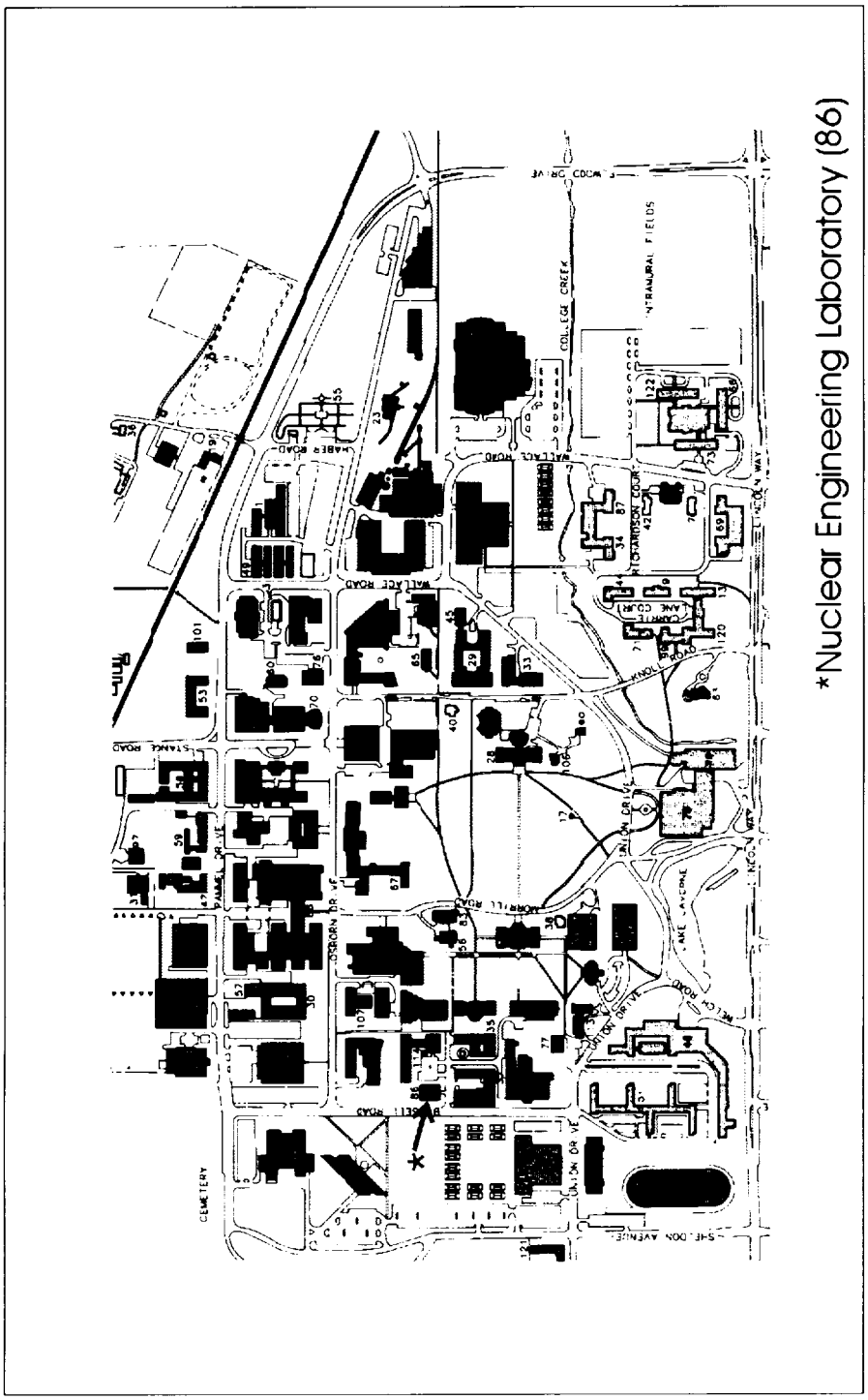


Figure 1.2: Location of NEL on ISU Campus

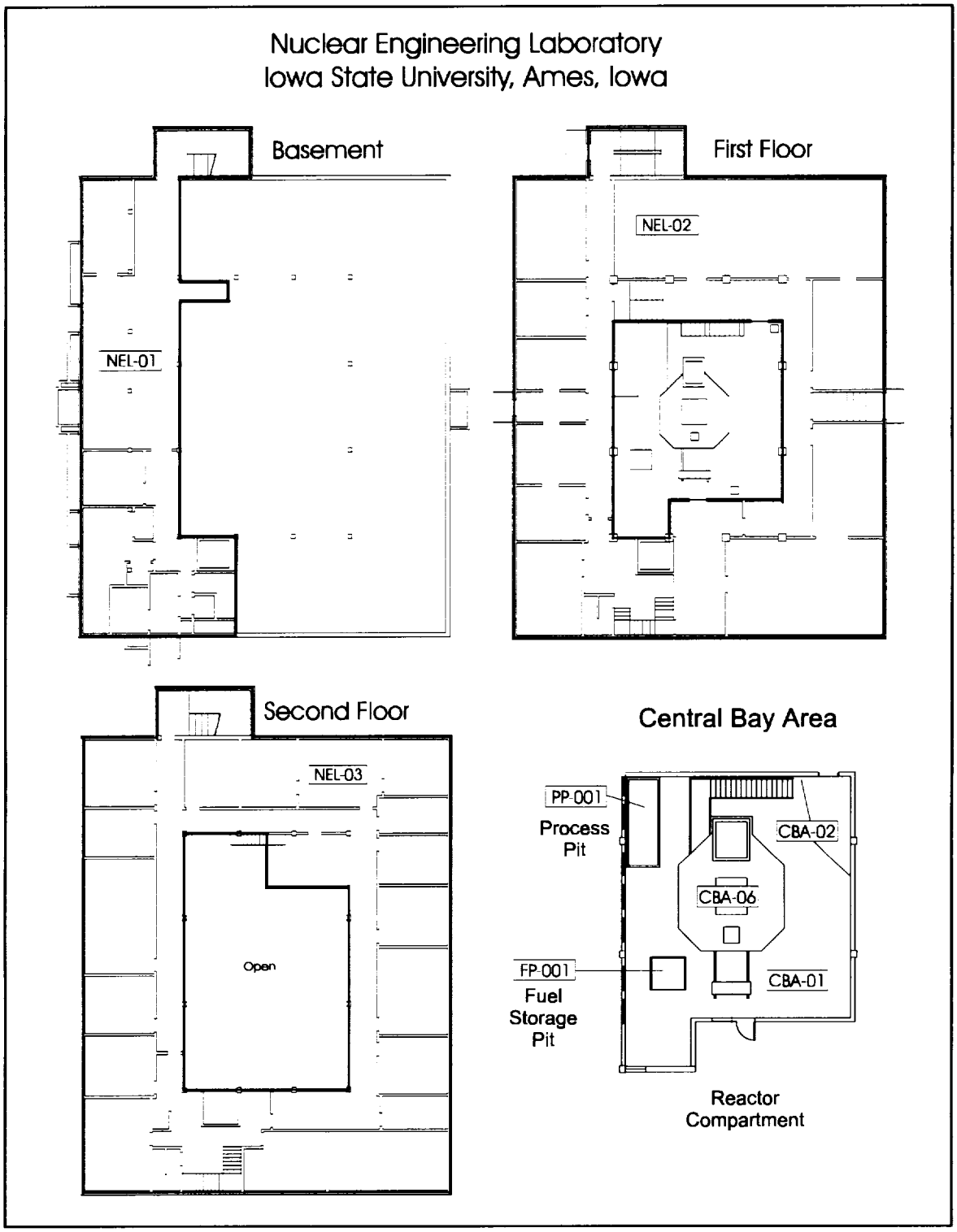


Figure 1.3: Facility Layout

3.0 OPERATIONAL HISTORY

The UTR-10 is an Argonaut type nuclear reactor designed and built in 1959 by the Advanced Technology Laboratories division of the American Radiator and Standard Sanitary Corporation. Initial reactor criticality was on December 31, 1959. Final reactor criticality was on May 8, 1998 and reactor operations officially ceased on May 15, 1998.

Radiological characterization surveys and sampling efforts began in July 1998 and finished in September 1998. Results of the characterization survey are found in DE&S' Document No. 00752.F02.A01, Characterization Report for the Iowa State University UTR-10 Reactor. This report was submitted with the Decommissioning Plan in January of 1999 and was approved by the NRC on July 8, 2000.

3.1 Site Conditions at Time of Final Status Survey

At the time of the final status survey, the structure will be largely intact. All contaminated systems and components have been removed from the site. Potentially contaminated structural surfaces identified during characterization surveys have been remediated or removed. At the time of the final status survey, all structures and systems within the scope of the survey have been remediated. Section 2 of the Decommissioning Plan provides additional information on demolition and construction activities including the methodologies used to implement them.

During remediation, engineering and health physics controls were in place to ensure and later confirm that the integrity of survey area classifications was maintained.

4.0 FINAL STATUS SURVEY OVERVIEW

4.1 Radiological Release Criteria

The NRC Final Rule on License Termination, 10 CFR 20.1402, provides radiological criteria for release of a site for unrestricted use. Acceptability criterion for unrestricted use is a maximum Total Effective Dose Equivalent (TEDE) of 25 mrem per year from residual radioactivity above background. Application of As Low As Reasonably Achievable (ALARA) is also a requirement.

4.2 Demonstrating Compliance with Release Criteria

DE&S intends to employ an alternate method described in MARSSIM Section 2.6.1, which is to perform a direct comparison of each measurement result to the $DCGL_W$. Specifically, MARSSIM Section 2.6 states "At some sites a simple comparison of each measurement result to the DCGLw, to demonstrate that all the measurement results are below the release criterion, may be more effective than statistical tests for the overall demonstration of compliance with the regulation provided an adequate number of measurements are performed". A degree of conservatism is built into this method, given that an elevated measurement criterion ($DCGL_{EMC}$) will not be utilized. DE&S believes that this type of conservatism is warranted, especially at a facility where a low potential for residual contamination exists. The overall result in implementing this As-Low-As-Reasonably-Achievable (ALARA) method is reduced risk to a building occupant following license termination.

4.3 Derived Concentration Guideline Levels (DCGLs)

4.3.1 DCGLs for Structural Materials

The DCGLs utilized to screen individual measurement values are based on the results of radioanalytical data as input into D and D. ISU site-specific DCGLs are established by adjusting the generic limits to account for Hard-to-Detect Radionuclides (HTDN) that cannot be measured with typical survey instrumentation.

Section 7.1 of the Characterization Report provides the equations utilized to calculate these site-specific DCGLs. Table 4.1 provides a summary of the bulk material sample Part 61 analysis results and the calculated HTDN ratios utilized to calculate the DCGLs. The corresponding DCGLs for each material are shown in Table 4.2.

Table 4.1: Bulk Material Composite Sample 10 CFR Part 61 Analytical Results Summary

Sample Description	Identified Detectable Radionuclides	ISU Radionuclide-Specific D and D Limit (dpm/100 cm^2)	F_n/L_n (Fraction/ Limit)	Identified HTDNs	ISU Radionuclide-Specific D and D Limit (dpm/100 cm^2)	F_n/L_n (Fraction/ Limit)
Composite Smear Sample	None	N/A	N/A	None	N/A	N/A
Rx. Graphite	None	N/A	N/A	None	N/A	N/A
Rx. Concrete	Co-60	7,040	4.09E-05	H-3	1.23E+08	9.76E-10
	Eu-152	12,700	3.76E-05	Fe-55	1.10E+04	2.06E-07
	Fe-59	88,300	1.30E-06			
Rx. Steel	Co-60	7,040	4.36E-05	Zn-65	48,100	1.44E-05
Rx. Aluminum	None	N/A	N/A	None	N/A	N/A

Table 4.2: ISU Site-Specific DCGLs

Material	Total Surface Contamination DCGL (dpm/100 cm^2)
Structural Surfaces	5.3E03
Reactor Graphite	5.3E03
Reactor Steel	5.3E03
Reactor Aluminum	5.3E03
Reactor Concrete (Activated Portions)	1.1E04
Alpha	1.0E02

4.3.2 DCGLs for Soil

A DCGL for soil has been developed to address the contaminated soil that lies beneath the former location of the Reactor Housing (CBA06). D and D v.1 was used to develop screening values for each of the five nuclides identified in the analysis of soil samples taken during the remediation phase of the project. The samples were obtained from a localized area of activated soil at the core center-line. The only input to the D and D code was the nuclide soil concentration (@ 1 pCi/g). All other input parameters were left at the default values. In addition, the resident farmer scenario was applied. Given the use of default parameter values and the application of the resident farmer scenario, DE&S believes the screening values to be conservative. Table 4.3 shows the radionuclides of concern along with their published NRC screening values.

If the affected area is small, and continuation of activation products under the concrete slab can be ruled out, then DE&S may prefer to "free release" the remaining soil after remedial activities have been completed. In this instance, the soil would be surveyed and released I accordance with DD-RP-109, Radiation Protection Release of Equipment, Materials and Vehicles. Sufficient samples will be obtained

to show the remaining soil contains no detectable licensed radioactive materials. All samples will be analyzed to the appropriate environmental LLDs.

Table 4.3: ISU Screening Values for Soil

	DE&S E-Lab		D and D SV*		SV
Radionuclide	**uCi/g**	**fraction**	**pCi/g**	**uCi/g**	**fraction****
Fe55	6.90E-06	3.56E-01	9470	9.47E-03	7.29E-04
Co60	2.00E-06	1.03E-01	3.64	3.64E-06	5.49E-01
Cs134	9.80E-08	5.06E-03	1.75	1.75E-06	5.60E-02
Eu152	9.89E-06	5.10E-01	8.65	8.65E-06	1.14E+00
Eu154	4.93E-07	2.54E-02	8.01	8.01E-06	6.15E-02
TOTAL	1.94E-05	1.00E+00			1.81E+00
*SV = Screening Value; corresponds to 25 mrem/y					** DE&S E-Lab results/SV
Maximum total concentration in soil				**1.07E-05 uCi/g**	
				10.7 pCi/g	
Maximum detectable gamma concentration in soil				**6.89E-06 uCi/g**	
				6.9 pCi/g	

4.4 Data Quality Objectives

The Data Quality Objectives (DQO) process will be implemented in the final status survey plan using a graded approach as recommended in MARSSIM. The DQOs for the NEL site are:

- Selecting and verifying survey unit classification.
- Collecting sufficient data of high quality to ensure that a comparison can be made with the release criteria for each survey unit to determine if residual radioactivity in each unit has been reduced to a level below the release criteria.
- Ensuring that the potential risk from the site as a whole is below the dose limit release criteria.

4.5 Final Area Classification and Survey Unit Designation

The final area classification of the ISU NEL facility have been subdivided into Class 1, Class 2, and Class 3 areas, according to MARSSIM. These three categories are defined as follows:

- **Class 1 Areas:** Areas that had, prior to remediation, known contamination based on characterization survey in excess of the DCGL.
- **Class 2 Areas:** Areas that had, prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGL.

- **Class 3 Areas:** Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGL.

Since the Characterization Report has shown that only Class 1 areas had contamination that could be confirmed, these areas will receive the highest degree of survey efforts during the final survey.

The Characterization Report (section 8.0, Conclusions) provided guidance on the classification of survey areas for the final status survey. However, due to the demolition of the Reactor Housing, two survey areas (CBA04 and CBA05) have been deleted from the scope of the final status survey. A new survey area (CBA06) has been initiated to address the Reactor Housing footprint. In addition, all miscellaneous equipment or components within the Reactor Room (CBA03) will be surveyed as part of CBA02. To address the soil beneath CBA06, survey area SS001 has also been initiated. The area classification of the ISU NEL facility for the final survey is shown in Table 4.4.

Table 4.4: Final Status Survey Unit Designation and Classification

Nuclear Engineering Laboratory – Basement			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
NEL01	Floors and Lower Walls (including the basement sump)	556	3
Nuclear Engineering Laboratory – First Floor			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
NEL02	Floors and Lower Walls	1396	3
Nuclear Engineering Laboratory – Second Floor			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
NEL03	Floors and Lower Walls	1467	3
Central Bay Area – Reactor Room			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
CBA01	Floors and Lower Walls	240	2
CBA02	Upper Walls and Ceiling	770	3
Central Bay Area – Reactor Housing (Foundation)			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
CBA06	Reactor Housing Foundation	<100	1
Central Bay Area – Process Pit			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
PP001	Process Pit	52	1
Central Bay Area – Fuel Storage Pit			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
FP001	Fuel Storage Pit	<100m^2	1
Soil Beneath Reactor Housing			
Survey Unit #	**Survey Unit Description**	**Surface Area (m^2)**	**Classification**
SS001	Subsurface Soil	<100m^2	1

4.6 Survey Areas, Units, Locations and Points

A survey documentation package will be prepared for each survey unit. Each documentation package will be comprised of, at a minimum:

- General Work Instructions that define the measurements, instrumentation and instructions for conduct of the survey (Attachment 1).
- Survey Location Designations, Results and Comments regarding conditions encountered (Attachment 2).
- A Map of the survey area (Attachment 3).

4.6.1 Survey Areas and Survey Units

A survey area is usually a contiguous area with similar characteristics and contamination potential. Engineering judgement have been used to divide a survey area into survey units to support reproducible confirmatory measurements. This will be accomplished by selecting existing facility characteristics such as horizontal and vertical structural support beams, concrete pour seams or piping runs to define the boundaries of survey units within survey areas. Distance measurements will be included as necessary to support reproducibility.

In addition, the use of photographs, drawings or maps will be included to support survey unit identification. This method for area designation will also serve to help survey personnel to define areas of elevated activity requiring additional investigation surveys and/or remediation.

4.6.2 Survey Locations and Survey Points

Survey locations will be clearly identified to allow for reproducibility of measurements. Whenever it is appropriate and cost effective, grids will be used. However, the use of appropriate surface markings may be substituted for a physical grid layout. Survey locations will be clearly identified to provide a method of referencing survey results to survey unit locations. Designated Class 1 and Class 2 survey units will be subdivided uniformly for survey design, measurement control purposes, and to identify survey locations. Normally, Class 3 survey units will not be evidided by grids.

A unique reference location ID code or number will identify survey points. The numbering convention will allow the survey data to be easily referenced to survey points identified on maps or drawings and is summarized in Table 4.5.

Table 4.5: Survey Location Code Index

1	2	3	4	5	6	9	10	11	7	8
x	n	n	n	x	x	n	n	n	x	x
Survey Unit I.D. (Per Survey Unit Classification and Description list				**Survey Type Code** C = Characterization F = Final Status I = Investigation Q = QC Replicate S = Special	**Survey Material Code** A = Asphalt B = Brick C = Concrete (bare) D = Concrete (painted) E = Cinder Block (paint) F = Cinder Block (bare) G = Generic O = Other P = Porcelain T = Ceramic Tile	**Survey Point** (Numbered Sequentially)			**Survey Unit Classification Code** A = Class 1 B = Class 2 C = Class 3	**Survey Unit Code** A = Upper Walls/Ceiling B = Floor/Lower Walls C = Ceiling D = Sub Floor E = Equipment F = Floors G = Grounds L = Lower Walls S = System U = Upper Walls X = Structural Exterior

4.7 Walkdown

The principal objective of the walkdown is to assess the physical scope of the survey area. The walkdown is best completed when the final configuration is known, usually near or after completion of decommissioning activities.

Specific requirements will be identified for accessing the survey area and obtaining support functions necessary to conduct the final status surveys, such as scaffolding, interference removal, and electrical tagout. Safety concerns such as access to confined spaces, high walls, and ceilings will be identified.

4.8 Turnover for Final Status Survey

Prior to acceptance of a survey area for the final status survey, a number of conditions should be satisfied. These include:

- Decommissioning activities having the potential to contaminate the survey area must be completed.
- All tools and equipment not required to perform the survey must be removed, and housekeeping and area cleanup must be completed.
- Decontamination activities in the survey area must be completed.

Final operational radiological surveys must be completed in affected areas to ensure that no additional remediation is necessary and will consist of:

- Scan surveys to ensure that surface contamination is within the FSS total surface contamination limits.
- Smear surveys to ensure that the removable surface contamination is within the FSS removable surface contamination limits.

4.9 Investigation

When an action level is reached, an investigation is performed to confirm the initial final status survey measurement, and if verified to exceed action levels, to define the bounds of the elevated activity and extent of remediation, and/or reclassify and re-survey. Investigation action levels may be found in Table 4.6. Any additional required actions are specified in the applicable sections of Appendix A.

4.10 Reclassification

Based on information obtained during final status survey activities, it may be necessary to reclassify certain survey units to ensure that the measurement frequency is appropriate for the contamination potential. Following reclassification, the newly classified survey unit will be re-surveyed under the appropriate survey requirements for that area. The existing final status survey measurements may be included with the additional survey data. Action levels for reclassification are found in Table 4.6.

4.11 Access Control Measures

If all decommissioning activities have not been completed prior to the start of final status survey, measures will be implemented to protect survey areas from contamination during and subsequent to the final status survey. In all cases, decommissioning activities creating a potential for the spread of contamination must be completed within each survey area prior to the final status survey. Additionally, decommissioning activities, which create a potential for the spread of contamination to adjacent survey areas will be evaluated and controlled. Controls will be implemented in accordance with DD-FS-301, FSS Survey Area Turnover and Control.

Upon commencement of the final status survey for survey areas where there is a potential for contamination, implementation of one or more of the following control measures may be required:

- Personnel training,
- Installation of barriers to control access to surveyed areas,
- Installation of postings requiring personnel to perform contamination monitoring prior to surveyed area access,
- Locking of entrances to surveyed areas of the facility,
- Installation of tamper-evident labels.

4.12 Training Program

All personnel directly involved with the performance of the final status survey and data quality review will be trained commensurate with the activity being performed. The scope of the required training will include, as necessary:

- MARSSIM
- Final Status Survey Procedures
- Equipment operation

Previous documentation of training, experience performing final survey and demonstration of proficiency may be utilized as a means to demonstrate equivalency with the training requirements of this plan.

4.13 Laboratory Services

The DE&S radioanalytical programs are administered in accordance with written procedures and an approved quality assurance program. Off-site laboratory sample analysis may be provided by the Duke Engineering & Services Environmental Laboratory or procured from other qualified vendors.

Table 4.6: Remediation and/or Classification Reevaluation Action Levels

Remediation/ Reclassification Action Levels	Survey Type		
	Removable Contamination	**Total Surface Contamination**	**Exposure Rate**
Class 1	Remediate if single measurement > DCGL (1000 dpm/100 cm^2 beta-100 dpm/100 cm^2 alpha).	Remediate and resurvey if single measurement > DCGL.	Remediate and resurvey if single measurement > 25 μR/hr.
Class 2	Remediate and reclassify if single measurement > DCGL (1000 dpm/100 cm^2 beta-100 dpm/100 cm^2 alpha).	Remediate and reclassify if single measurement > DCGL.	Remediate and reclassify if single measurement > 25 μR/hr.
Class 3	Remediate and reclassify if single measurement >25% DCGL (1000 dpm/100 cm^2 beta-100 dpm/100 cm^2 alpha).	Remediate and reclassify if single measurement > 25% DCGL.	Remediate and reclassify if single measurement > 25 μR/hr.

Note: All levels are net results.

5.0 SAMPLING APPROACH

5.1 Instrumentation

To perform the final status survey, both field survey instrumentation and analytical laboratory equipment will be selected based on: (1) the necessary Minimum Detectable Concentrations (MDC), and (2) stability and reliability under environmental conditions. DE&S will utilize the appropriate instrumentation shown in Table 5.1 to perform the final status survey of the NEL site. All field survey instrumentation will be calibrated, operated and controlled in accordance with applicable DE&S procedures.

Table 5.1: Nuclear Engineering Laboratory Final Survey Instrumentation

Instrument/Detector Type	Description	Measurement Types(s)
Eberline E-600	Data Logger	Electronic Storage of Data
Eberline SHP-100 Ludlum 43-37	100 cm^2 sealed-gas proportional detector 435 cm^2 sealed-gas proportional detector	Beta scan Beta surface contamination Alpha surface contamination
Eberline SHP-360	15.5 cm^2 GM detector	Beta-gamma scan Beta-gamma surface contamination
Eberline SHP-300	Pressurized GM	Gamma exposure rates
Eberline SPA-3 or Canberra Ge Detector	2" X 2" NaI or closed-end coaxial Ge detector	Gamma-scans
Low Background Gas Flow Proportional Detector	Alpha and beta activity on smear samples	Laboratory analysis
Liquid Scintillation	Low energy beta activity on smear samples	Laboratory analysis
Gamma Spectroscopy	Gamma-emitting radionuclide identification and activity quantification on smear & bulk material samples	Laboratory analysis

5.1.1 Minimum Detectable Concentration Calculation

Minimum Detectable Concentration (MDC) values for field and laboratory counting instrumentation will be determined using the following equation, taken from Equation 3-10 in Draft NUREG-1507:

$$MDC = \frac{3 + 3.29\sqrt{R_b t_s\left(1 + \frac{t_s}{t_b}\right)}}{E\left(\frac{A}{100}\right)t_s}$$

where,

MDC = the minimum activity concentration on a surface or material volume that can be statistically detected above background with a 95% probability,

t_s = sample counting time interval,

R_b = background counting rate,

t_b = background counting time interval,

E = counting efficiency, and

A = area of the detector, or the area sampled for smear samples.

5.1.2 Detector Sensitivity

The detection sensitivity of some of the detectors being selected for surface contamination measurements has been estimated. These results are summarized in Table 5.2. The results are shown for the principal instruments that are expected to be used for field and laboratory beta-gamma total surface and removable contamination measurements.

The MDC is dependent on several factors, such as sample count time, background count time, background count rate and detector efficiency. The MDC for scan survey measurements will be calculated using the above equation, with the scanning efficiency substituted for the efficiency term.

Count times will be selected to ensure that the measurements will be sufficiently sensitive with respect to applicable DCGLs. The count times associated with measurements for total surface contamination and gamma spectral analysis will normally be set to ensure an MDC of <25% of the applicable guideline value.

It should be noted that it may not be possible to scan or take exposure rate measurements at 25% of the applicable DCGL, based on significant background interference and the relative instrument sensitivities, as shown in Table 5.2.

Table 5.2: Nominal Measurement Detection Sensitivities

Type of Measurement	Detector	Background	Efficiency (c/d)	Detection Sensitivity
Beta-Gamma Surface Scan	Pancake GM (HP-210/HP-260)	150 cpm	0.08	3650 dpm/ 100 cm^2
Beta-Gamma Surface Scan	100 cm^2 Gas Proportional (HP-100CGS)	550 cpm	0.10	850 dpm/100 cm^2
Beta-Gamma Surface Scan	425 cm^2 Gas Flow (Ludlum 43-37)	2000 cpm	0.07	500 dpm/100 cm^2
Beta-Gamma Direct	Pancake GM (HP-210/HP-260)	50 cpm	0.10	1800 dpm/100 cm^2
Beta-Gamma Direct	100 cm^2 Gas Proportional (HP-100CGS)	300 cpm	0.14	450 dpm/100 cm^2
Alpha Direct	100 cm^2 Gas Proportional (HP-100CGS)	1 cpm	0.25	20 dpm/100 cm^2
Gamma Scan	NaI (Tl) (SPA-3)	12,000 cpm	0.012	32,000 dpm/100 cm^2
Gamma Exposure Rate	Compensated GM (HP-300)	12 μR/h	1.22	3 μR/h
Beta-Gamma Removable	Gas Flow Proportional (Protean)	1 cpm	0.22	70 dpm/100 cm^2
Alpha Removable	Gas Flow Proportional (Protean)	0.1 cpm	0.26	40 dpm/100 cm^2

5.2 Background Determination

DCGLs for residual radioactivity are at levels above background. Therefore, it is necessary to establish the response of instrumentation to the naturally occurring radioactivity present in non-impacted materials to enable a comparison of site radiological conditions with the acceptable guideline values. Background activity and radiation levels for the final status survey will be determined from appropriate background reference areas and by obtaining local area measurements within the survey unit.

Background levels will be established for each type of instrument to be used for total surface contamination measurements and exposure rate measurements. Background levels will be subtracted from total radiation or radioactivity levels to determine the net residual contamination from licensed operations. Therefore, it is necessary that background levels be determined with a detection sensitivity and accuracy equivalent to data from which it will be subtracted. This will be achieved by using the same instruments and techniques for background assessments as are used in evaluating the final site conditions. Background levels will be obtained in accordance with procedure DD-CS-202, Background Assessment.

Determining background levels for comparison with the conditions determined in specific survey units entails conducting surveys in one or more reference areas to define the radiological conditions of the site. A site background reference area should have similar physical characteristics as the survey unit

being evaluated. Reference areas are normally selected form non-impacted portions of the site. The radioactivity present in a reference area would be ideally the same as the survey unit had it never been contaminated. If the site includes physical characteristics variability that is not represented by a single reference background area, then selecting more than one reference area may be necessary.

In some situations, a reference area may be associated with the survey unit being evaluated. Section 4.5 of MARSSIM states that "In some situations a reference area may be associated with the survey unit being evaluated, but is not potentially contaminated by site activities." In this instance, special instrumentation (e.g. portable gamma-spec) will be used to assure the area selected for a background reference area is free of plant-related radioactive material. The use of an area within the survey unit for a background reference minimizes the variation among material-specific backgrounds and local area backgrounds, thus minimizes the error incurred from these variations.

5.3 Measurement Frequency

The minimum number of samples required in each survey unit is given in Table 15 of the Characterization Report. The estimated sample sizes for each survey unit were determined using Table 5.3 in MARSSIM and have been determined to be adequate for use in the final status survey. However, as sufficient time has elapsed since the Characterization Survey, and neither statistical test (Wilcoxon Rank and Sum or Sign) will be used to demonstrate compliance, DE&S believes that a substantially larger number of samples in each survey unit are warranted.

Measurement frequencies, or the physical spacing of samples and measurements, are selected to allow for a concentrated survey effort in those areas most likely to be contaminated or activated, taking into account the type and size of the survey unit. Measurement locations distributed throughout a survey unit will be documented in accordance with Appendix A. Locations will be clearly marked to facilitate re-survey. The measurement frequency and suggested areas for each area type is described below.

5.3.1 Structures

***Class 1 Survey Units*:** The final status survey of Class 1 Survey Units will include:

- Area – up to 100 m^2 floor area
- A scan survey of 100% of the accessible surface area.
- A minimum of one Total Surface Contamination (fixed point) measurement location for every 2 square meters.
- Removable contamination (smears) will be obtained at the location of each total surface contamination measurement.
- Exposure rate measurements will be taken in each accesible survey unit at a frequency of at least one measurement per 10 square meters of floor area.
- In general, these areas will be divided into one square meter grids, and the measurements will be taken at the center of grid blocks.

Class 2 Survey Units: The final status survey of Class 2 Survey Units will include:

- Area – 100 to 1,000 m2
- A scan survey of 50% of the accessible surface area.
- Total surface contamination measurements for beta, as follows:
- A minimum of one measurement location for each 4 square meters.
- Removable contamination (smears) will be obtained at the location of each total surface contamination measurement.
- In general, these areas will be divided into one square meter grids, and the measurements will be taken at the center of grid blocks.

Class 3 Survey Units: The final status survey of Class 3 Survey Units will include:

- Area – no limit
- A scan survey of an area around each survey location so that the total area scanned is at least 10% of the accessible surface area of the survey unit.
- A minimum of 30 measurement locations for total surface contamination measurements
- Removable contamination (smears) will be obtained at the location of each total surface contamination measurement.
- In general, these areas will not be identified by grid. Measurement locations will be biased to high-traffic areas, distributed throughout the survey unit, or a combination of both.

5.3.2 Soil

Class 1 Survey Units: The final status survey of Class 1 Survey Units will include:

- Area – up to 100 m^2 floor area
- A scan survey of 100% of the accessible surface area.
- A minimum of one soil sample (15 centimeters deep), for every 10 square meters.
- Exposure rate measurements taken at one meter from the surface at the location of each soil sample.

These areas will normally be gridded. Samples and measurements will be taken systematically within those grids.

5.4 Survey Methods

5.4.1 Scan Surveys

Scan surveys will be performed to screen surface areas to identify the presence of any locations of elevated contamination in order to search for areas above the release limits and to detect localized areas above the maximum release limit. The scanning methods (instruments and survey technique) for surface contamination measurements will normally be designed to detect less than 75% of the average total surface contamination release limits. If an area of elevated contamination is identified during the scan of a survey unit, the location will be marked and included as a part of the total surface contamination measurements.

5.4.2 Surface Contamination Measurements

Surface contamination measurements will be taken at discrete measurement locations and at frequencies that are based on the classification of the survey unit. As no alpha contaminated areas were identified during characterization, only beta total surface contamination measurement will be taken at each location.

For surfaces decontaminated previously, before final status surveys are initiated, turnover surveys are performed by DE&S Health Physics personnel to verify that the measurement results are within the final status survey limits for removable and total surface contamination. Final status survey total surface contamination measurements will detect both removable and fixed contamination.

5.4.3 Exposure Rate Measurements

Exposure rate measurements will be obtained at discrete locations, which are based on the classification of the survey unit. Exposure rate measurements will be taken at a distance of one meter from the surface. Exposure rate measurements will only be obtained in accessible survey units, normally on floors.

5.4.4 Removable Surface Contamination

Removable contamination samples (smears) will be collected at a frequency specified in Section 5.3.1. Smear samples for a given survey location should not be collected until the scan survey and TSC measurements for that location have been completed.

6.0 HEALTH AND SAFETY

All health and safety issues will be addressed in accordance with ISU programs and procedures as defined in the ISU *Radiation Safety Manual* and *Chemical Hygiene Plan* and DD-HS-100, DE&S Health and Safety Plan for Decontamination and Decommissioning. All DE&S personnel will be expected to comply with all pertinent OSHA requirements as well as those requirements listed in the above references.

7.0 QUALITY CONTROL AND QUALITY ASSURANCE MEASURES

Quality control (QC) and quality assurance (QA) are integrated into the final status survey, by way of the DE&S Quality Assurance Project Plan for Site Characterization and Final Survey Activities that was put into place at the beginning of the project. All final status survey activities essential to data quality will be implemented and performed under approved procedures.

With regard to the final status survey effort, QA/QC activities will serve to ensure that surveys are performed by trained individuals using approved written procedures and properly calibrated instruments that are sensitive to the suspected contaminant. In addition, QC measurements will be taken to obtain quantitative information to demonstrate that measurement results have the required precision and are sufficiently free of errors to accurately represent the ISU site.

7.1 QC Replicate Survey for Structural Survey Units

A QC replicate survey will be performed for 5% of the survey units (one per twenty), with a minimum of one to be performed. The QC replicate survey will consist of a repeat of all measurements and samples obtained during the original final status survey, i.e., scan, TSC and exposure rate measurements, and smears. Replicate surveys will be taken at the same locations as the original final status survey. Survey locations added as a result of an investigation will be included in the QC replicate survey.

The Project Manager will ensure that the technicians selected to perform the survey are different than those who performed the original survey. In addition, the Project Manager will ensure that the serial numbers of the instrumentation selected to perform the survey are different than those which were used to perform the original survey.

NOTE: Because of the limited number of survey personnel and instrumentation, it may be necessary to utilize the same technicians and instrumentation for the QC replicate survey as were used in the original final status survey.

7.2 QC Soil and Bulk Material Samples

A minimum of 10% of all bulk media samples obtained for quantitative analyses shall consist of duplicate or split samples. Smear samples are exempt from this requirement since they will be included in the replicate survey for structures.

8.0 FINAL STATUS SURVEY REPORT

Upon completion of the final status survey phase of the project a report will prepared for review by the Nuclear Regulatory Commission. The report will meet the intent of MARSSIM. Documentation of the final status survey will provide a complete and unambiguous record of the radiological status of each survey unit relative to the established DCGLs. In addition, sufficient data and information will be provided to enable an independent evaluation of the results of the survey including repeating measurements at some future time.

To the extent practicable, the report will be a stand-alone document with minimum information incorporated by reference. The document will describe instrumentation or analytical methods used, how the data were converted to DCGL units, the process of comparing the results to the DCGLs, and the process of determining that the data quality objectives were met.

8.1 Topical Outline

The following outline illustrates a general format for the final report for the final status survey. The outline below may be adjusted to provide a clearer presentation of the information. The level of detail will be sufficient to clearly describe the final status survey program and certify the results.

1.0 Background Information

2.0 Site Description

3.0 Operating History

4.0 Decommissioning Activities

5.0 Final Status Survey Methodology

6.0 Final Status Survey Results

7.0 Summary

8.2 Reporting of Survey Findings

8.2.1 Detail Data Reporting for Each Survey Area

A computer generated report for each survey area will be generated and will show all measurement results, both positive and negative. In addition, the reports will show the conversion factors, backgrounds and the MDCs to allow independent verification of the results. These measurement results may also be presented graphically.

8.2.2 Summary Data Reporting for Each Survey Area

A computer generated summary of the measurement results for each survey area will be provided. The number of measurements, the average and maximum values, and upper limit of confidence interval about the mean for each survey unit in a survey area will be reported for comparison to the release criteria.

8.2.3 Final TEDE Evaluation

Following completion of the final status survey, the survey data will be used to produce an annual TEDE to an average member of the critical population group. An assessment tool, such as the computer code D&D Screen, will be utilized in accordance with applicable NRC guidance to perform this dose analysis. All realistic pathways for exposure, including direct exposure, drinking water, and agriculture, will be included. The objective of this analysis will be to demonstrate that the annual dose to any real individual will be well below the 25 mrem. In accordance with 10 CFR 20.1401(d), the dose calculated shall be the peak annual TEDE expected within the first 1000 years after decommissioning.

9.0 REFERENCES

1) USNRC, NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), December 1997

2) DE&S' Document No. 00752.F02.A01, Characterization Report for the Iowa State University UTR-10 Reactor, December 1998

3) DE&S' Document No. 00752.F03.A01, Iowa State University UTR-10 Reactor Decommissioning Plan, January 1999

4) USNRC, D and D, Version 1.0, 1998

5) USNRC, 10 CFR 20.1401(d)

6) DE&S, Quality Assurance Project Plan for Site Characterization and Final Survey Activities, August 1998

7) Iowa State University, Radiation Safety Manual, May 1996

8) DD-HS-100, Health and Safety Plan for Decontamination and Decommissioning

9) DD-RP-100, Radiation Protection Program for Decommissioning

10) DD-RP-109, Radiation Protection Release of Equipment, Material and Vehicles

11) DD-CS-201, Chain of Custody

12) DD-CS-202, Background Assessment

13) DD-FS-301, FSS Survey Area Turnover and Control

14) DD-FS-304, Control of Characterization and FSS Survey Instrumentation

Attachment 1
Form DD-FS-300-1
Final Status Survey General Instruction

General Information			
Package ID:	**Survey Area ID:**	**Category:**	**Type:**
Survey Unit:	**Survey Location:**		**Classification:**

Survey Instructions			
Measurement Type	**Instrument & Detector**	**Count Time**	**Instructions/Remarks**

Attachment 2
Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID:	Survey Area Name:
Survey Unit:	Survey Location:

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special

Comments:

Survey Performed By/Date:

_____

Attachment 3
Form DD-FS-300-3

Duke Engineering & Services
FINAL STATUS SURVEY MAP

PROJECT / SITE:

LOCATION / JOB DESCRIPTION:

AREA IDENTIFICATION #:

AREA NAME:

BUILDING:

MAP IDENTIFICATION #:

SURVEY UNIT NAME:

MATERIAL TYPE:	
LOCATION CODE:	
SURVEY LOCATION #'S	
SURFACE AREA:	M^2
GRID SIZE	M^2
MATERIAL TYPE:	
LOCATION CODE:	
SURVEY LOCATION #'S	
SURFACE AREA:	M^2
GRID SIZE	M^2
MATERIAL TYPE:	
LOCATION CODE:	
SURVEY LOCATION #'S	
SURFACE AREA:	M^2
GRID SIZE	M^2
MATERIAL TYPE:	
LOCATION CODE:	
SURVEY LOCATION #'S	
SURFACE AREA:	M^2
GRID SIZE	M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

Comments:

Duke Engineering & Services
A Duke Energy Company

APPENDIX A

SURVEY/SAMPLING WORK PLAN

Form DD-FS-300-1
Final Status Survey General Instruction

General Information			
Package ID: N001	**Survey Area ID:** NEL01	**Category:** Structure	**Type:** Final Status
Survey Unit: Floors and Lower Walls	**Survey Location:**		**Classification:** Class 3

Survey Instructions			
Measurement Type	**Instrument & Detector**	**Count Time**	**Instructions/Remarks**
Beta Scan	E600/HP-100CGS	N/A	Perform a beta scan survey, using audible indicators, 1.85m^2 (3 ft. radius) around each TSC location so that the total area surveyed is 10% of the accessible surface area of the survey unit. If an elevated area is confirmed, mark the elevated area on the surface, indicate the location on the survey map, record the survey point number and the surface contamination level in the comments section of Attachment 2 and notify the Design Engineer.
Total Surface Contamination	E600/HP-100CGS	60 sec.	Collect a total surface contamination measurement directly below the bar code or the location sticker unless there is a physical obstruction to taking the measurement at that point. In this instance, collect the total surface contamination measurement adjacent to the bar code or location sticker, noting the location in the comment section of Attachment 2.
Smears	N/A	N/A	Collect a smear sample at each TSC location.

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: N001	**Survey Area Name:** NEL-Basement
Survey Unit: Floors and Lower Walls	**Survey Location:**

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate µR/hr	Smears	Special
N001FC001CB						
N001FC002CB						
N001FC003CB						
N001FC004CB						
N001FC005CB						
N001FC006CB						
N001FC007CB						
N001FC008CB						
N001FC009CB						
N001FC0010CB						
N001FC0011CB						
N001FC0012CB						
N001FC0013CB						
N001FC0014CB						
N001FC0015CB						
N001FC0016CB						
N001FC0017CB						
N001FC0018CB						
N001FC0019CB						
N001FC0020CB						
N001FC0021CB						
N001FC0022CB						
N001FC0023CB						
N001FC0024CB						

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: N001	**Survey Area Name:** NEL-Basement
Survey Unit: Floors and Lower Walls	**Survey Location:**

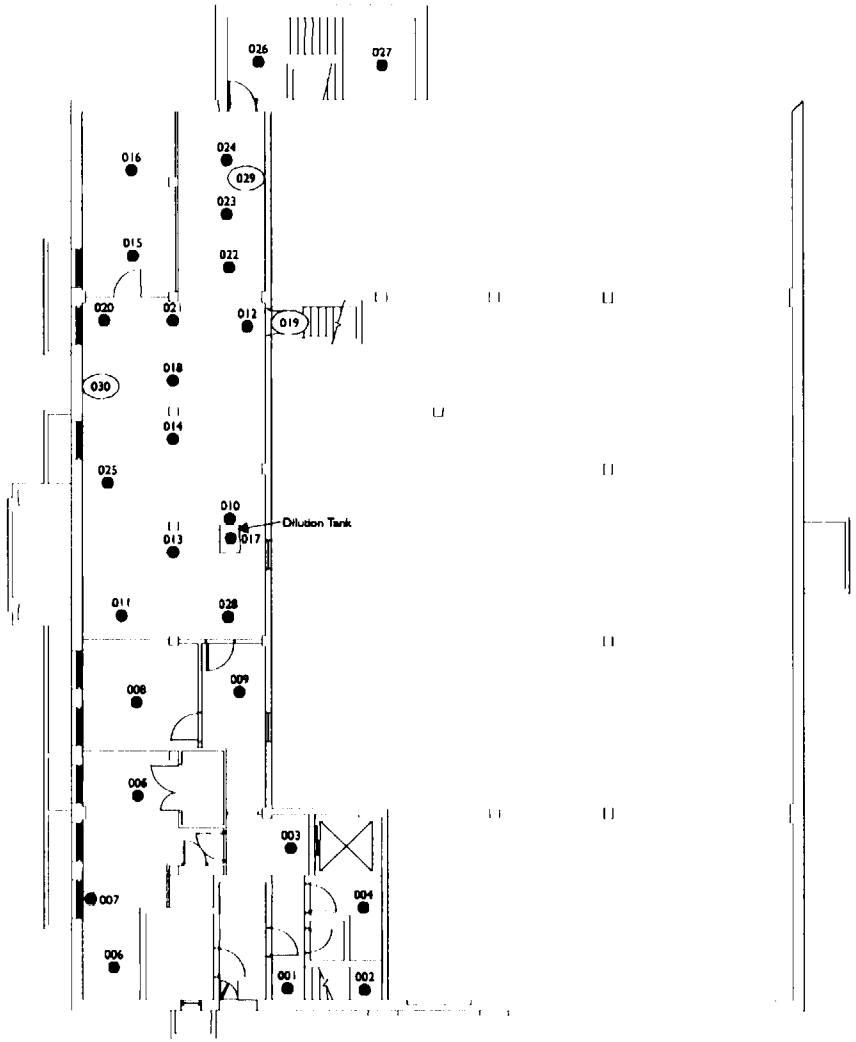
Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
N001FC0025CB						
N001FC0026CB						
N001FC0027CB						
N001FC0028CB						
N001FC0029CB						
N001FC0030CB						

Comments:

Survey Performed By/Date:

_____

Duke Engineering & Services
FINAL STATUS SURVEY MAP



Comments:

PROJECT / SITE:
Iowa State University / UTR-10 Reactor

LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - Basement

AREA IDENTIFICATION #: **NEL01**

AREA NAME: **Basement**

BUILDING: **Nuclear Engineering Lab**

MAP IDENTIFICATION #: **NEL01.cdr**

SURVEY UNIT NAME: **Floor / Lower Walls**

MATERIAL TYPE:	**Bare Concrete**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001-006,009,014-017,020-028	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	**Porcelain**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	007	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	**Generic**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	008,010,013,018,019	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	**Painted Concrete**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	012,029-030	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

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Form DD-FS-300-3

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A Duke Energy Company

Final Status Survey Plan
ISU UTR-10 Reactor

Form DD-FS-300-1
Final Status Survey General Instruction

General Information			
Package ID: N002	**Survey Area ID:** NEL02	**Category:** Structure	**Type:** Final Status
Survey Unit: Floors and Lower Walls	**Survey Location:**		**Classification:** Class 3

Survey Instructions			
Measurement Type	**Instrument & Detector**	**Count Time**	**Instructions/Remarks**
Beta Scan	E600/HP-100CGS	N/A	Perform a beta scan survey, using audible indicators, 4.65m^2 (4 ft. radius) around each TSC location so that the total area surveyed is 10% of the accessible surface area of the survey unit. If an elevated area is confirmed, mark the elevated area on the surface, indicate the location on the survey map, record the survey point number and the surface contamination level in the comments section of Attachment 2 and notify the Design Engineer.
Total Surface Contamination	E600/HP-100CGS	60 sec.	Collect a total surface contamination measurement directly below the bar code or the location sticker unless there is a physical obstruction to taking the measurement at that point. In this instance, collect the total surface contamination measurement adjacent to the bar code or location sticker, noting the location in the comment section of Attachment 2.
Smears	N/A	N/A	Collect a smear sample at each TSC location.

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: N002	**Survey Area Name:** NEL-Level 1
Survey Unit: Floors and Lower Walls	**Survey Location:**

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
N002FG001CB						
N002FG002CB						
N002FG003CB						
N002FG004CB						
N002FG005CB						
N002FG006CB						
N002FG007CB						
N002FG008CB						
N002FG009CB						
N002FG0010CB						
N002FG0011CB						
N002FG0012CB						
N002FG0013CB						
N002FG0014CB						
N002FG0015CB						
N002FG0016CB						
N002FG0017CB						
N002FG0018CB						
N002FG0019CB						
N002FG0020CB						
N002FG0021CB						
N002FG0022CB						
N002FG0023CB						
N002FG0024CB						

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: N002	**Survey Area Name:** NEL-Level 1
Survey Unit: Floors and Lower Walls	**Survey Location:**

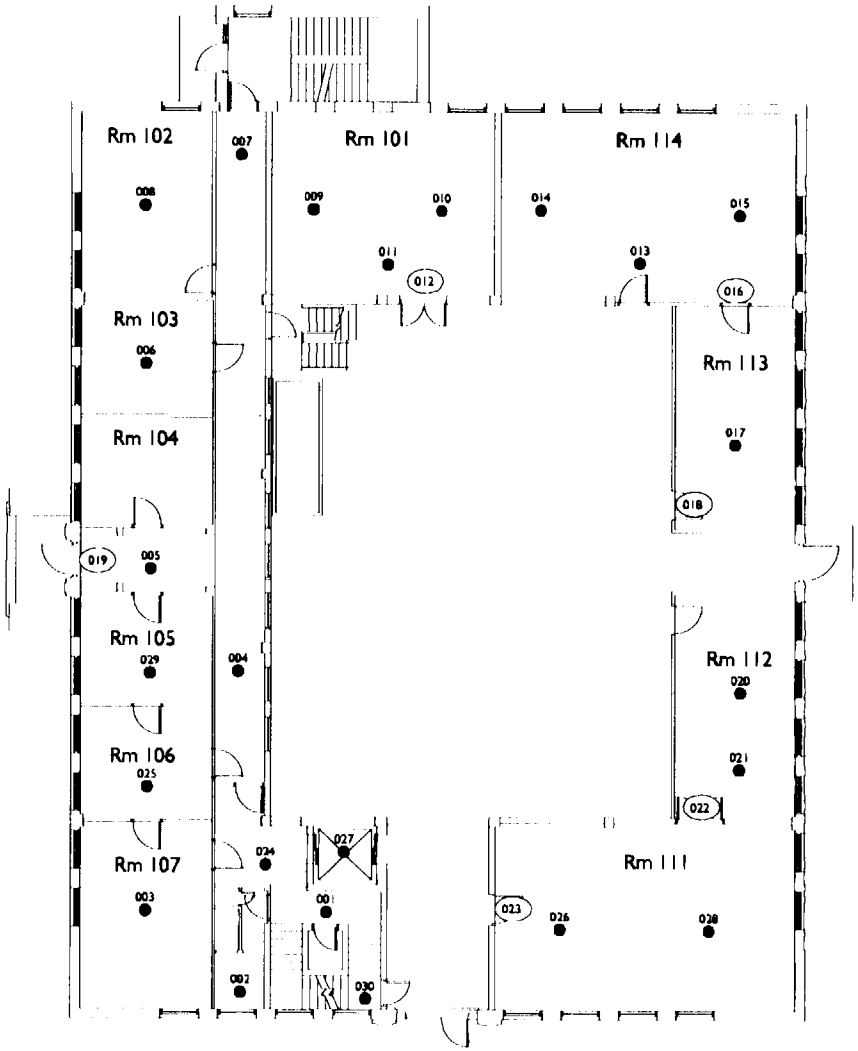
Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate µR/hr	Smears	Special
N002FG0025CB						
N002FG0026CB						
N002FG0027CB						
N002FG0028CB						
N002FG0029CB						
N002FG0030CB						

Comments:

Survey Performed By/Date:

_____

Duke Engineering & Services
FINAL STATUS SURVEY MAP



Comments:

PROJECT / SITE:
Iowa State University / UTR-10 Reactor

LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - 1st Floor

AREA IDENTIFICATION #: **NEL02**

AREA NAME: **First Floor**

BUILDING: **Nuclear Engineering Lab**

MAP IDENTIFICATION #: **NEL02.cdr**

SURVEY UNIT NAME: **Floor / Lower Walls**

MATERIAL TYPE:	**Generic**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001-008,012,16-19,22-25,27,29	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	**Bare Concrete**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	009-011,013-015,020,021, 026,028,030	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	N/A	
LOCATION CODE:		
SURVEY LOCATION #'S		
SURFACE AREA:		M^2
GRID SIZE		M^2
MATERIAL TYPE:	N/A	
LOCATION CODE:		
SURVEY LOCATION #'S		
SURFACE AREA:		M^2
GRID SIZE		M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

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Form DD-FS-300-3

Duke Engineering & Services
A Duke Energy Company

Final Status Survey Plan
ISU UTR-10 Reactor

Form DD-FS-300-1
Final Status Survey General Instruction

General Information			
Package ID: N003	**Survey Area ID:** NEL03	**Category:** Structure	**Type:** Final Status
Survey Unit: Floors and Lower Walls	**Survey Location:**		**Classification:** Class 3

Survey Instructions

Measurement Type	Instrument & Detector	Count Time	Instructions/Remarks
Beta Scan	E600/HP-100CGS	N/A	Perform a beta scan survey, using audible indicators, 4.89m^2 (4.5 ft. radius) around each TSC location so that the total area surveyed is 10% of the accessible surface area of the survey unit. If an elevated area is confirmed, mark the elevated area on the surface, indicate the location on the survey map, record the survey point number and the surface contamination level in the comments section of Attachment 2 and notify the Design Engineer.
Total Surface Contamination	E600/HP-100CGS	60 sec.	Collect a total surface contamination measurement directly below the bar code or the location sticker unless there is a physical obstruction to taking the measurement at that point. In this instance, collect the total surface contamination measurement adjacent to the bar code or location sticker, noting the location in the comment section of Attachment 2.
Smears	N/A	N/A	Collect a smear sample at each TSC location.

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: N003	**Survey Area Name:** NEL-Level 2
Survey Unit: Floors and Lower Walls	**Survey Location:**

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
N003FG001CB						
N003FG002CB						
N003FG003CB						
N003FG004CB						
N003FG005CB						
N003FG006CB						
N003FG007CB						
N003FG008CB						
N003FG009CB						
N003FG0010CB						
N003FG0011CB						
N003FG0012CB						
N003FG0013CB						
N003FG0014CB						
N003FG0015CB						
N003FG0016CB						
N003FG0017CB						
N003FG0018CB						
N003FG0019CB						
N003FG0020CB						
N003FG0021CB						
N003FG0022CB						
N003FG0023CB						
N003FG0024CB						

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: N003	**Survey Area Name:** NEL-Level 2
Survey Unit: Floors and Lower Walls	**Survey Location:**

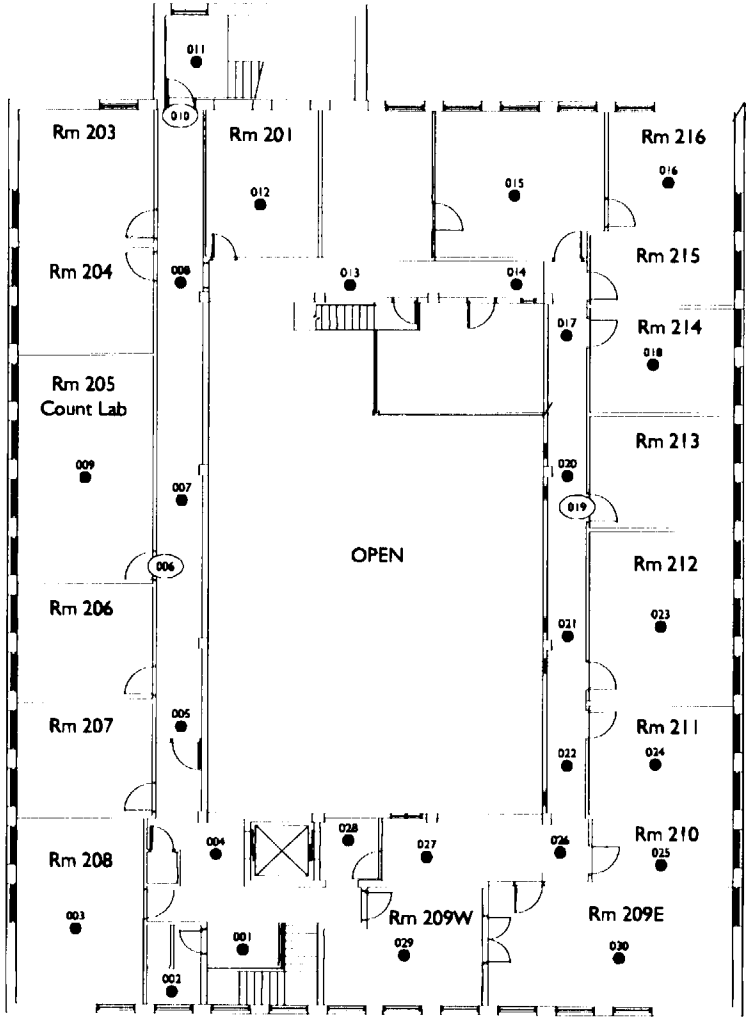
Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
N003FG0025CB						
N003FG0026CB						
N003FG0027CB						
N003FG0028CB						
N003FG0029CB						
N003FG0030CB						

Comments:

Survey Performed By/Date:

_____

Duke Engineering & Services
FINAL STATUS SURVEY MAP



Comments:

PROJECT / SITE:
Iowa State University / UTR-10 Reactor

LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - 2nd Floor

AREA IDENTIFICATION #: NEL03

AREA NAME: Second Floor

BUILDING: Nuclear Engineering Lab

MAP IDENTIFICATION #: NEL03.cdr

SURVEY UNIT NAME: Floor / Lower Walls

MATERIAL TYPE:	Bare Concrete	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001,003-005,007,008,011-014, 017,020-022,026-028	
SURFACE AREA:	N/A	M²
GRID SIZE	N/A	M²
MATERIAL TYPE:	Generic	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	002,006,009,010,015-016 018-019,023-025,029,030	
SURFACE AREA:	N/A	M²
GRID SIZE	N/A	M²
MATERIAL TYPE:	N/A	
LOCATION CODE:		
SURVEY LOCATION #'S		
SURFACE AREA:		M²
GRID SIZE		M²
MATERIAL TYPE:	N/A	
LOCATION CODE:		
SURVEY LOCATION #'S		
SURFACE AREA:		M²
GRID SIZE		M²

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

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Form DD-FS-300-3

Duke Engineering & Services
A Duke Energy Company

Final Status Survey Plan
ISU UTR-10 Reactor

Form DD-FS-300-1
Final Status Survey General Instruction

General Information			
Package ID: P001	**Survey Area ID:** PP001	**Category:** Structure	**Type:** Final Status
Survey Unit: Floors and Lower Walls	**Survey Location:**		**Classification:** Class 1

Survey Instructions			
Measurement Type	**Instrument & Detector**	**Count Time**	**Instructions/Remarks**
Beta Scan	E600/HP-100CGS	N/A	Perform a beta scan survey over 100% of accessible floor and lower wall surfaces. Use the bar code that corresponds to the TSC location to record the data. If an elevated area is confirmed, mark the elevated area on the surface, indicate the location on the survey map, record the survey point number and the surface contamination level in the comments section of Attachment 2 and notify the Design Engineer.
Total Surface Contamination	E600/HP-100CGS	60 sec.	Collect a total surface contamination measurement directly below the bar code or the location sticker unless there is a physical obstruction to taking the measurement at that point. In this instance, collect the total surface contamination measurement adjacent to the bar code or location sticker, noting the location in the comment section of Attachment 2.
Exposure Rate Measurements	E600/HP-300	60 sec.	Collect exposure rate measurements at the locations of the original total surface contamination measurement as indicated on Attachment 2.
Smears	N/A	N/A	Collect a smear sample at each TSC location.

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: P001	**Survey Area Name:** Process Pit
Survey Unit: Floors and Lower Walls	**Survey Location:**

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
P001FC001AB						
P001FC002AB						
P001FC003AB						
P001FC004AB						
P001FC005AB						
P001FC006AB						
P001FC007AB						
P001FC008AB						
P001FC009AB						
P001FC0010AB						
P001FC0011AB						
P001FC0012AB						
P001FC0013AB						
P001FC0014AB						
P001FC0015AB						
P001FC0016AB						
P001FC0017AB						
P001FC0018AB						
P001FC0019AB						
P001FC0020AB						
P001FC0021AB						
P001FC0022AB						
P001FC0023AB						
P001FC0024AB						

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: P001	**Survey Area Name:** Process Pit
Survey Unit: Floors and Lower Walls	**Survey Location:**

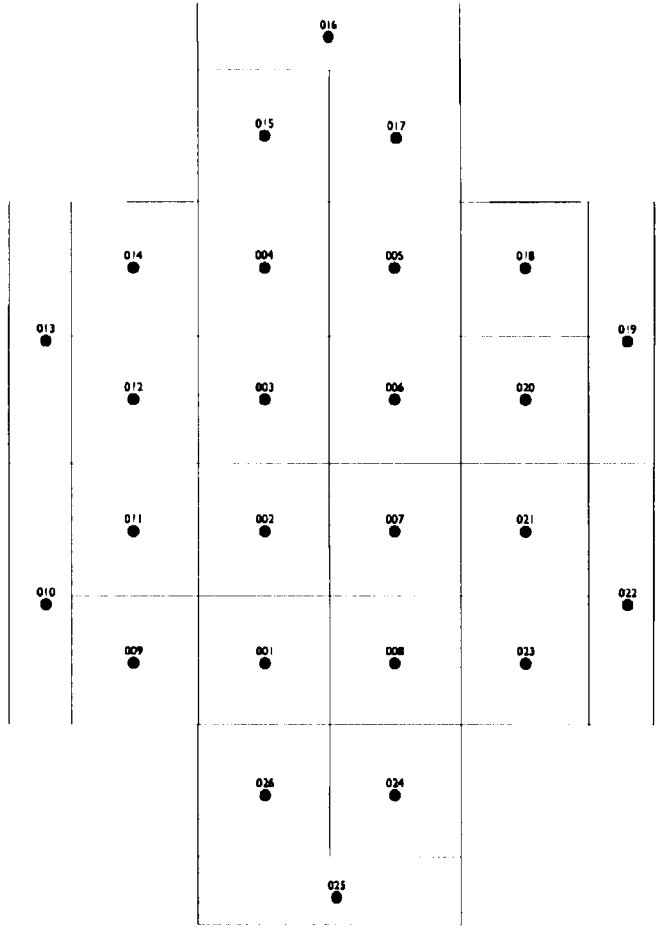
Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
P001FC0025AB						
P001FC0026AB						

Comments:

Survey Performed By/Date:

_____

Duke Engineering & Services
FINAL STATUS SURVEY MAP



Comments:

PROJECT / SITE:
Iowa State University / UTR-10 Reactor
LOCATION / JOB DESCRIPTION:
Central Bay Area

AREA IDENTIFICATION #: **Pp001**

AREA NAME: **Process Pit**

BUILDING: **Nuclear Engineering Lab**

MAP IDENTIFICATION #: **PP001.cdr**

SURVEY UNIT NAME: **Floor / Lower Walls**

MATERIAL TYPE:	**Bare Concrete**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001-026	
SURFACE AREA:	52	M^2
GRID SIZE	2	M^2
MATERIAL TYPE:		
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:		
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:		
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

Duke Engineering & Services
A Duke Energy Company

Form DD-FS-300-3

Form DD-FS-300-1
Final Status Survey General Instruction

General Information			
Package ID: F001	**Survey Area ID:** F001	**Category:** Structure	**Type:** Final Status
Survey Unit: Floors and Lower Walls	**Survey Location:**		**Classification:** Class 1

Survey Instructions			
Measurement Type	**Instrument & Detector**	**Count Time**	**Instructions/Remarks**
Beta Scan	E600/HP-100CGS SHP 360	N/A	Perform a beta scan survey over 100% of accessible floor and lower wall surfaces. Use the bar code that corresponds to the TSC location to record the data. If an elevated area is confirmed, mark the elevated area on the surface, indicate the location on the survey map, record the survey point number and the surface contamination level in the comments section of Attachment 2 and notify the Design Engineer.
Total Surface Contamination	E600/HP-100CGS SHP 360	60 sec.	Collect a total surface contamination measurement directly below the bar code or the location sticker unless there is a physical obstruction to taking the measurement at that point. In this instance, collect the total surface contamination measurement adjacent to the bar code or location sticker, noting the location in the comment section of Attachment 2.
Exposure Rate Measurements	E600/HP-300	60 sec.	Collect exposure rate measurements at the locations of the original total surface contamination measurement as indicated on Attachment 2.
Smears	N/A	N/A	Collect a smear sample at each TSC location.

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: F001	**Survey Area Name:** Fuel Storage Pit
Survey Unit: Floors and Lower Walls	**Survey Location:**

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
F001FG001AB						
F001FG002AB						
F001FG003AB						
F001FG004AB						
F001FG005AB						
F001FG006AB						
F001FG007AB						
F001FG008AB						
F001FG009AB						
F001FG0010AB						
F001FG0011AB						
F001FG0012AB						
F001FG0013AB						
F001FG0014AB						
F001FG0015AB						
F001FG0016AB						
F001FG0017AB						
F001FG0018AB						
F001FG0019AB						
F001FG0020AB						
F001FG0021AB						
F001FG0022AB						
F001FG0023AB						
F001FG0024AB						

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: F001	**Survey Area Name:** Fuel Storage Pit
Survey Unit: Floors and Lower Walls	**Survey Location:**

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
F001FG0025AB						
F001FG0026AB						
F001FG0027AB						
F001FG0028AB						
F001FG0029AB						
F001FG0030AB						
F001FG0031AB						
F001FG0032AB						
F001FG0033AB						
F001FG0034AB						
F001FG0035AB						
F001FG0036AB						

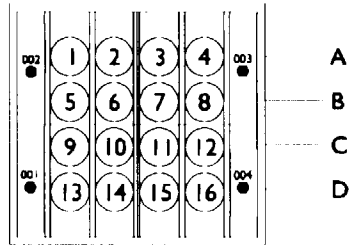
Comments:

Survey Performed By/Date:

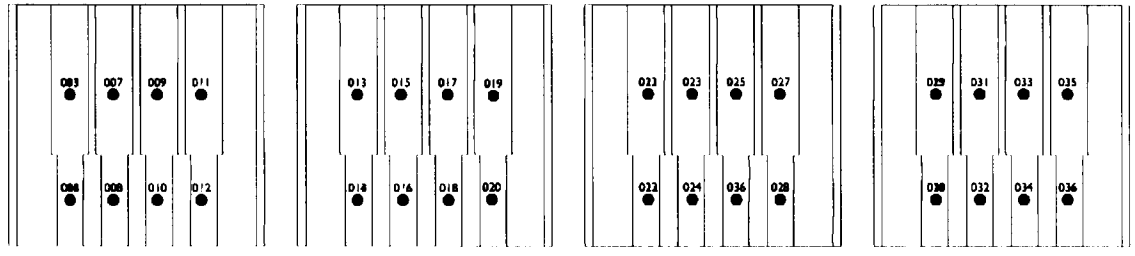
_____

Duke Engineering & Services
FINAL STATUS SURVEY MAP

Form DD-FS-300-3



TOP VIEW



SIDE VIEW

Comments:

PROJECT / SITE:
Iowa State University / UTR-10 Reactor

LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - Central Bay Area

AREA IDENTIFICATION #: Fp001

AREA NAME: Fuel Storage Pit

BUILDING: Nuclear Engineering Lab

MAP IDENTIFICATION #: FP001.cdr

SURVEY UNIT NAME: Floor / Lower Walls

MATERIAL TYPE:	Bare Concrete	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001-004	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	Generic	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	005-036	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:		
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:		
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

Duke Engineering & Services
A Duke Energy Company

Form DD-FS-300-1
Final Status Survey General Instruction

General Information			
Package ID: C001	**Survey Area ID:** CBA01	**Category:** Structure	**Type:** Final Status
Survey Unit: Floors and Lower Walls	**Survey Location:**		**Classification:** Class 2

Survey Instructions			
Measurement Type	**Instrument & Detector**	**Count Time**	**Instructions/Remarks**
Beta Scan	E600/HP-100CGS	N/A	Perform a beta scan survey over 100% of accessible floor and lower wall surfaces. Use the bar code that corresponds to the TSC location to record the data. If an elevated area is confirmed, mark the elevated area on the surface, indicate the location on the survey map, record the survey point number and the surface contamination level in the comments section of Attachment 2 and notify the Design Engineer.
Total Surface Contamination	E600/HP-100CGS	60 sec.	Collect a total surface contamination measurement directly below the bar code or the location sticker unless there is a physical obstruction to taking the measurement at that point. In this instance, collect the total surface contamination measurement adjacent to the bar code or location sticker, noting the location in the comment section of Attachment 2.
Smears	N/A	N/A	Collect a smear sample at each TSC location.

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: C001	**Survey Area Name:** Central Bay
Survey Unit: Floors and Lower Walls	**Survey Location:**

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
C001FC001BB						
C001FC002BB						
C001FC003BB						
C001FC004BB						
C001FC005BB						
C001FC006BB						
C001FC007BB						
C001FC008BB						
C001FC009BB						
C001FC0010BB						
C001FC0011BB						
C001FC0012BB						
C001FC0013BB						
C001FC0014BB						
C001FC0015BB						
C001FC0016BB						
C001FC0017BB						
C001FC0018BB						
C001FC0019BB						
C001FC0020BB						
C001FC0021BB						
C001FC0022BB						
C001FC0023BB						
C001FC0024BB						

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: C001	**Survey Area Name:** Central Bay
Survey Unit: Floors and Lower Walls	**Survey Location:**

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
C001FC0025BB						
C001FC0026BB						
C001FC0027BB						
C001FC0028BB						
C001FC0029BB						
C001FC0030BB						
C001FC0031BB						
C001FC0032BB						
C001FC0033BB						
C001FC0034BB						
C001FC0035BB						
C001FC0036BB						
C001FC0037BB						
C001FC0038BB						
C001FC0039BB						
C001FC0040BB						
C001FC0041BB						
C001FC0042BB						
C001FC0043BB						
C001FC0044BB						
C001FC0045BB						
C001FC0046BB						
C001FC0047BB						
C001FC0048BB						

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: C001	**Survey Area Name:** Central Bay
Survey Unit: Floors and Lower Walls	**Survey Location:**

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
C001FC0049BB						
C001FC0050BB						
C001FC0051BB						
C001FC0052BB						
C001FC0053BB						
C001FC0054BB						
C001FC0055BB						
C001FC0056BB						
C001FC0057BB						
C001FC0058BB						
C001FC0059BB						
C001FC0060BB						
C001FC0061BB						
C001FC0062BB						
C001FC0063BB						
C001FC0064BB						
C001FC0065BB						
C001FC0066BB						
C001FC0067BB						
C001FC0068BB						
C001FC0069BB						
C001FC0070BB						
C001FC0071BB						
C001FC0072BB						

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: C001	**Survey Area Name:** Central Bay
Survey Unit: Floors and Lower Walls	**Survey Location:**

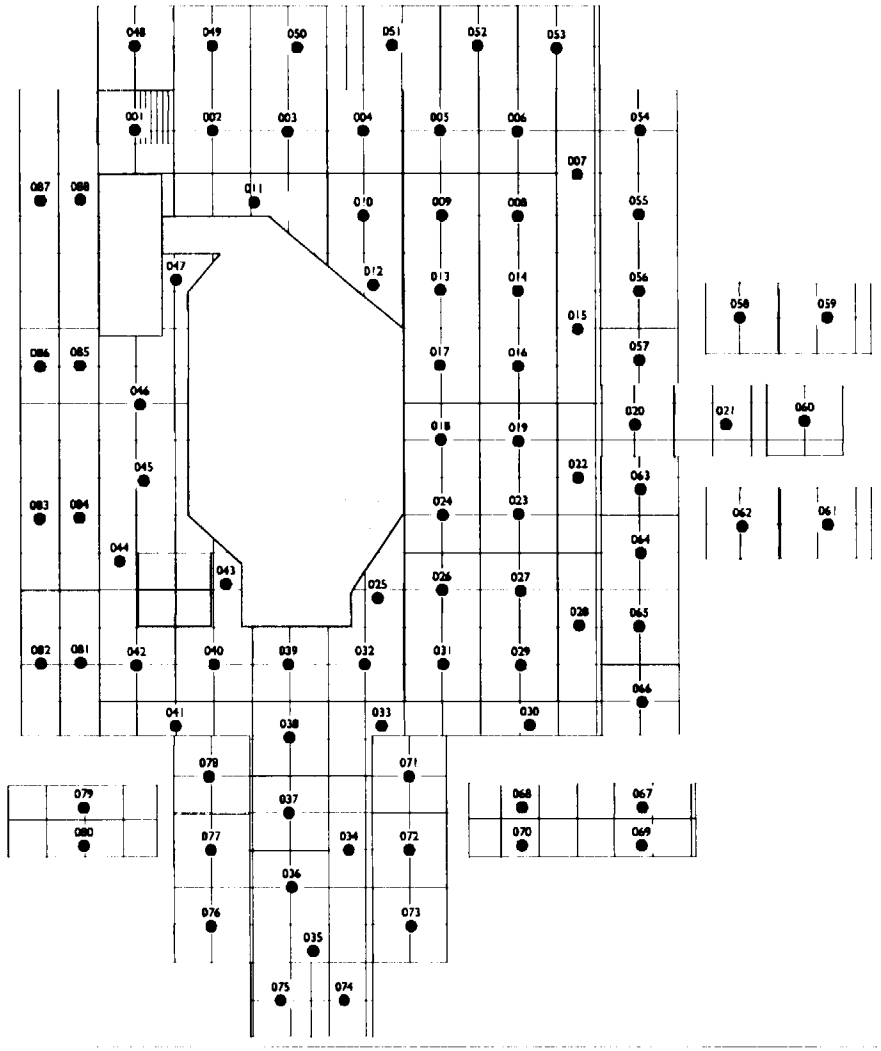
Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
C001FC0073BB						
C001FC0074BB						
C001FC0075BB						
C001FC0076BB						
C001FC0077BB						
C001FC0078BB						
C001FC0079BB						
C001FC0080BB						
C001FC0081BB						
C001FC0082BB						
C001FC0083BB						
C001FC0084BB						
C001FC0085BB						
C001FC0086BB						
C001FC0087BB						
C001FC0088BB						

Comments:

Survey Performed By/Date:

_____

Duke Engineering & Services
FINAL STATUS SURVEY MAP



Comments:

PROJECT / SITE:
Iowa State University / UTR-10 Reactor
LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - Central Bay

AREA IDENTIFICATION #: CBA01

AREA NAME: Central Bay

BUILDING: Nuclear Engineering Lab

MAP IDENTIFICATION #: CBA01.cdr

SURVEY UNIT NAME: Floor / Lower Walls

MATERIAL TYPE:	Bare Concrete	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	01-47,67,68,79,81,84,85	
SURFACE AREA:	N/A	M^2
GRID SIZE	4	M^2
MATERIAL TYPE:	Brick	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	48-50,69-73,76-78,80,82,83	
SURFACE AREA:	N/A	M^2
GRID SIZE	4	M^2
MATERIAL TYPE:	Generic	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	51-66,74,75	
SURFACE AREA:	N/A	M^2
GRID SIZE	4	M^2
MATERIAL TYPE:	N/A	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

Duke Engineering & Services
A Duke Energy Company

Form DD-FS-300-3

Form DD-FS-300-1
Final Status Survey General Instruction

General Information			
Package ID: C002	**Survey Area ID:** CBA02	**Category:** Structure	**Type:** Final Status
Survey Unit: Upper Walls and Ceiling	**Survey Location:**		**Classification:** Class 3

Survey Instructions			
Measurement Type	**Instrument & Detector**	**Count Time**	**Instructions/Remarks**
Beta Scan	E600/HP-100CGS	N/A	Perform a beta scan survey, using audible indicators, 2.57m^2 (3 ft. radius) around each TSC location so that the total area surveyed is 10% of the accessible surface area of the survey unit. If an elevated area is confirmed, mark the elevated area on the surface, indicate the location on the survey map, record the survey point number and the surface contamination level in the comments section of Attachment 2 and notify the Design Engineer.
Total Surface Contamination	E600/HP-100CGS	60 sec.	Collect a total surface contamination measurement directly below the bar code or the location sticker unless there is a physical obstruction to taking the measurement at that point. In this instance, collect the total surface contamination measurement adjacent to the bar code or location sticker, noting the location in the comment section of Attachment 2.
Smears	N/A	N/A	Collect a smear sample at each TSC location.

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: C002	**Survey Area Name:** Central Bay
Survey Unit: Upper Walls and Ceiling	**Survey Location:**

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
C002FD001CA						
C002FD002CA						
C002FD003CA						
C002FD004CA						
C002FD005CA						
C002FD006CA						
C002FD007CA						
C002FD008CA						
C002FD009CA						
C002FD0010CA						
C002FD0011CA						
C002FD0012CA						
C002FD0013CA						
C002FD0014CA						
C002FD0015CA						
C002FD0016CA						
C002FD0017CA						
C002FD0018CA						
C002FD0019CA						
C002FD0020CA						
C002FD0021CA						
C002FD0022CA						
C002FD0023CA						
C002FD0024CA						

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: C002	**Survey Area Name:** Central Bay
Survey Unit: Upper Walls and Ceiling	**Survey Location:**

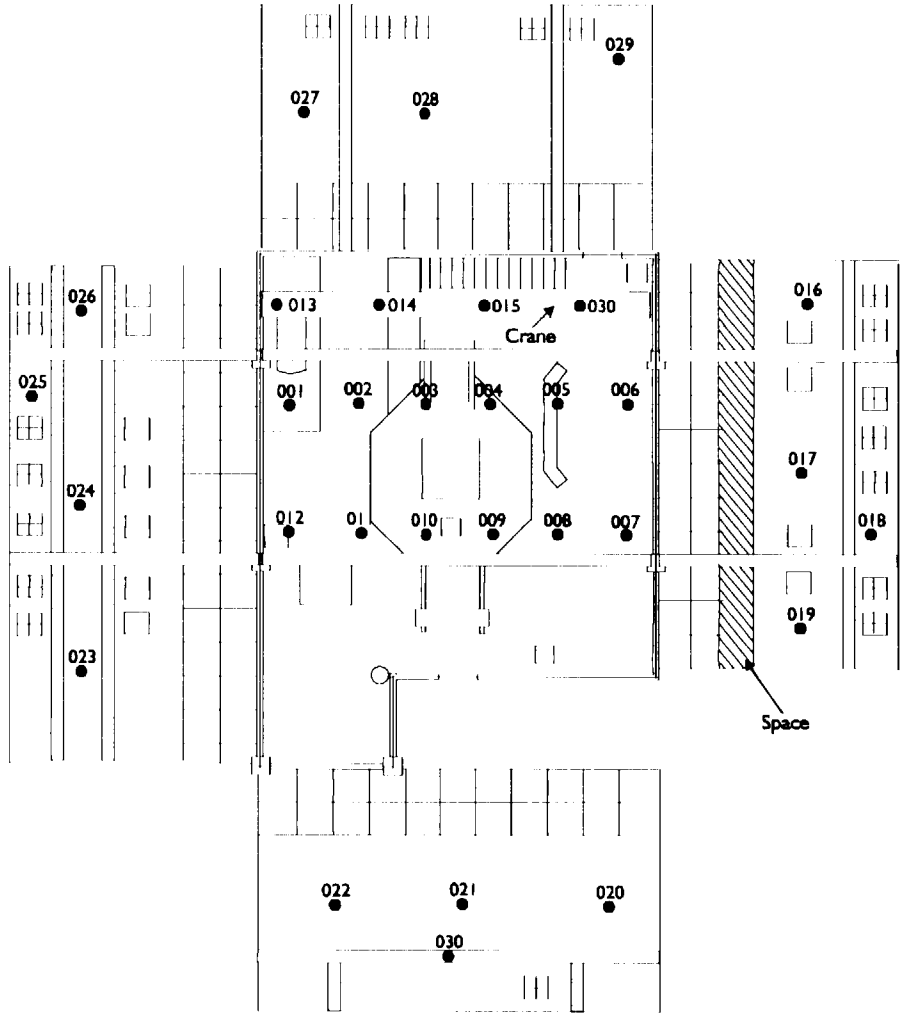
Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
C002FD0025CA						
C002FD0026CA						
C002FD0027CA						
C002FD0028CA						
C002FD0029CA						
C002FD0030CA						

Comments:

Survey Performed By/Date:

_____

Duke Engineering & Services
FINAL STATUS SURVEY MAP



Comments: Survey locations 013, 014, 015 and 030 taken on top-side of crane.

PROJECT / SITE:
Iowa State University / UTR-10 Reactor
LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - Central Bay

AREA IDENTIFICATION #: CBA02

AREA NAME: Central Bay

BUILDING: Nuclear Engineering Lab

MAP IDENTIFICATION #: CBA02.cdr

SURVEY UNIT NAME: Upper Walls/Ceiling

MATERIAL TYPE:	Painted Concrete	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001-012	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	Generic	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	013-030	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	N/A	
LOCATION CODE:		
SURVEY LOCATION #'S		
SURFACE AREA:		M^2
GRID SIZE		M^2
MATERIAL TYPE:	N/A	
LOCATION CODE:		
SURVEY LOCATION #'S		
SURFACE AREA:		M^2
GRID SIZE		M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

Duke Engineering & Services
A Duke Energy Company

Form DD-FS-300-3

Form DD-FS-300-1
Final Status Survey General Instruction

General Information			
Package ID: C006	**Survey Area ID:** CBA06	**Category:** Structure	**Type:** Final Status
Survey Unit: Floors	**Survey Location:**		**Classification:** Class 1

Survey Instructions			
Measurement Type	**Instrument & Detector**	**Count Time**	**Instructions/Remarks**
Beta Scan	E600/HP-100CGS	N/A	Perform a beta scan survey over 100% of accessible floor and lower wall surfaces. Use the bar code that corresponds to the TSC location to record the data. If an elevated area is confirmed, mark the elevated area on the surface, indicate the location on the survey map, record the survey point number and the surface contamination level in the comments section of Attachment 2 and notify the Design Engineer.
Total Surface Contamination	E600/HP-100CGS	60 sec.	Collect a total surface contamination measurement directly below the bar code or the location sticker unless there is a physical obstruction to taking the measurement at that point. In this instance, collect the total surface contamination measurement adjacent to the bar code or location sticker, noting the location in the comment section of Attachment 2.
Exposure Rate Measurements	E600/HP-300	60 sec.	Collect exposure rate measurements at the locations of the original total surface contamination measurement as indicated on Attachment 2.
Smears	N/A	N/A	Collect a smear sample at each TSC location.

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

Package ID: C006	**Survey Area Name:** Reactor Housing Foundation
Survey Unit: Floor	**Survey Location:**

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
C006FC001AF						
C006FC002AF						
C006FC003AF						
C006FC004AF						
C006FC005AF						
C006FC006AF						
C006FC007AF						
C006FC008AF						
C006FC009AF						
C006FC0010AF						
C006FC0011AF						
C006FC0012AF						
C006FC0013AF						
C006FC0014AF						
C006FC0015AF						
C006FC0016AF						
C006FC0017AF						
C006FC0018AF						
C006FC0019AF						
C006FC0020AF						
C006FC0021AF						
C006FC0022AF						
C006FC0023AF						
C006FC0024AF						

Form DD-FS-300-2
Final Status Survey Location Designation, Results and Comment

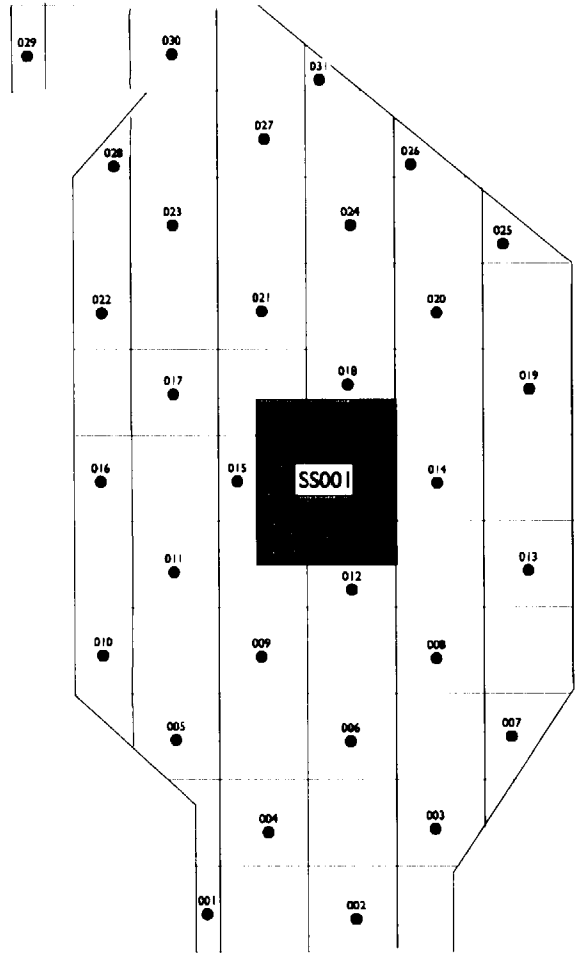
Package ID: C006	**Survey Area Name:** Reactor Housing Foundation
Survey Unit: Floor	**Survey Location:**

Location Code	Scan cpm/100 cm^2	TSC β cpm/100 cm^2	TSC α cpm/100 cm^2	Exp. Rate μR/hr	Smears	Special
C006FC0025AF						
C006FC0026AF						
C006FC0027AF						
C006FC0028AF						
C006FC0029AF						
C006FC0030AF						
C006FC0031AF						

Comments:

Survey Performed By/Date:

Duke Engineering & Services
FINAL STATUS SURVEY MAP



Comments:

PROJECT / SITE:
Iowa State University / UTR-10 Reactor

LOCATION / JOB DESCRIPTION:
Nuclear Engineering Lab - Central Bay

AREA IDENTIFICATION #: **CBA06**

AREA NAME: **Reactor Housing Foundation**

BUILDING: **Nuclear Engineering Lab**

MAP IDENTIFICATION #: **CBA06.cdr**

SURVEY UNIT NAME: **Floor**

MATERIAL TYPE:	**Bare Concrete**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	001 - 031	
SURFACE AREA:	50	M^2
GRID SIZE	1	M^2
MATERIAL TYPE:	**N/A**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2
MATERIAL TYPE:	**N/A**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	4	M^2
MATERIAL TYPE:	**N/A**	
LOCATION CODE:	N/A	
SURVEY LOCATION #'S	N/A	
SURFACE AREA:	N/A	M^2
GRID SIZE	N/A	M^2

LEGEND:

GRID BOUNDARY

SURVEY LOCATION (HORIZONTAL SURFACE) ● ###

SURVEY LOCATION (VERTICAL SURFACE) (###)

Duke Engineering & Services
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Form DD-FS-300-3