LACROSSE SOLUTIONS

LA CROSSE BOILING WATER REACTOR
FINAL STATUS SURVEY RELEASE RECORD

SECURITY STATION
SURVEY UNIT B3-012-109

REVISION 1

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LIST OF ACRONYMS AND ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
ASP	Alarm Set Point
DQA	Data Quality Assessment
DQO	Data Quality Objective
DCGL	Derived Concentration Guideline Level
$DCGL_{AGB}$	Above Grade Building Derived Concentration Guideline Level
FSS	Final Status Survey
GPS	Global Positioning System
G-1	Genoa 1
HSA	Historical Site Assessment
IC	Insignificant Contributors
LACBWR	La Crosse Boiling Water Reactor
LBGR	Lower Bound of the Gray Region
LTP	License Termination Plan
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
MDCR	Minimal Detectable Count Rate
$OpDCGL_{AGB}$	Above Grade Building Operational Derived Concentration Guideline Level
QAPP	Quality Assurance Project Plan
QC	Quality Control
ROC	Radionuclides of Concern
SOF	Sum of Fractions
TEDE	Total Effective Dose Equivalent
UBGR	Upper Bound of the Gray Region
UCL	Upper Confidence Limit
URS	Unconditional Release Survey
USNRC	United States Nuclear Regulatory Commission

1. EXECUTIVE SUMMARY

This Final Status Survey (FSS) Release Record for survey unit B3-012-109, Security Station, has been generated in accordance with LaCrosse*Solutions* procedure LC-FS-PR-009, *Final Status Survey Data Reporting* (Reference 1) and satisfies the requirements of Section 5.11 of the *La Crosse Boiling Water Reactor License Termination Plan* (LACBWR LTP) (Reference 2).

An FSS sample plan for this survey unit was developed in accordance with LaCrosse*Solutions* procedures LC-FS-PR-015, *Final Status Surveys for Structures* (Reference 3) and LC-FS-PR-002, *Final Status Survey Package Development* (Reference 4), the LACBWR LTP, and with guidance from NUREG-1575, Revision 1, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) (Reference 5).

Survey unit B3-012-109, an above grade building survey unit, has a MARSSIM classification of 3. A survey plan was designed based upon use of the Sign Test as the nonparametric statistical test for compliance. Both the Type I (α) and Type II (β) decision error rates were set at 0.05. As a random measurement population, fourteen (14) static beta measurements were acquired from the survey unit. In addition, surface scanning was performed on approximately 12% of the total surface area in the survey unit. The data assessment results for survey unit B3-012-109 indicate that the maximum gross activity among random measurements is equal to 215 dpm/100 cm^2, which is 6.80% of the Adjusted Gross Operational Derived Concentration Guideline Level (DCGL) for above grade buildings (see Section 5 of this release record for the calculations of adjusted gross DCGLs). Therefore, the null hypothesis of the Sign test is rejected and survey unit B3-012-109 is acceptable for unrestricted release. The mean gross activity among random measurements is equal to 43 dpm/100 cm^2, which is 0.22% of the Adjusted Gross Base Case DCGL. The mean gross activity in the survey unit divided by the Adjusted Gross Base Case DCGL and then multiplied by 25 mrem/yr results in a calculated dose for the survey unit of 0.0541 mrem/yr.

2. SURVEY UNIT DESCRIPTION

B3-012-109 is an impacted Class 3 above grade building survey unit. The survey unit consists of the interior and exterior surfaces of the Security Station. The Security Station served as the security force housing and access point for the Dairyland Power property. The Security Station is a small one-story building measuring 4.3 m long by 3.1 m wide by 2.7 m high, which equates to a total surface area of 122 m^2. Refer to Attachment 1 of this report for figures and maps depicting survey unit B3-012-109.

3. CLASSIFICATION BASIS

Based on the *La Crosse Boiling Water Reactor* Historical Site Assessment (HSA) (Reference 6), survey unit B3-012-109 was identified as a Class 3 structure survey unit. The following summarizes the results of the characterization surveys for seven (7) of the above grade buildings to be left on-site upon termination of the license.

The characterization surveys for the above grade buildings were conducted between November 8, 2016, and November 18, 2016. In total, fifty-six (56) static beta measurements were collected in the buildings (eight [8] in each of seven [7] buildings). No measurements exceeded their respective action levels. A summary of the static measurements is presented in Table 3-1. The summary statistics for the characterization data are provided in Table 3-2.

Table 3-1 –Static Measurements for Characterization of Above Grade Buildings

Static Beta Measurements (dpm/100 cm^2)						
LACBWR Crib House	**G-3 Crib House**	**Back-Up Control Center**	**Transmission Sub-Station Switch House**	**Barge Wash Break Room**	**G-1 Crib House**	**Security Station**
313	1,264	588	213	0	751	0
13	13	363	226	38	0	150
0	38	0	0	0	0	0
1,702	26	88	889	0	1,514	0
138	0	0	376	0	0	38
0	450	0	238	0	551	100
0	100	0	0	163	438	225
0	2,203	651	0	0	1,089	13

Table 3-2 – Summary Statistics for Characterization of Above Grade Buildings

Mean (dpm/100 cm^2)	**Median** (dpm/100 cm^2)	**Minimum** (dpm/100 cm^2)	**Maximum** (dpm/100 cm^2)	**Standard Deviation** (dpm/100 cm^2)
267	32	0	2,203	473

Based upon review of the historical information, the results of the characterization survey data, and completion of a final Survey Unit Classification Worksheet, the correct final classification of survey unit B3-012-109 was determined to be Class 3.

4. DATA QUALITY OBJECTIVES (DQO)

FSS planning and design relies on a properly executed Data Quality Objective (DQO) process to ensure, through compliance with explicitly defined inputs and boundaries, that the primary objective of the survey is satisfied. The DQO process, utilized in accordance with MARSSIM, is described in the LACBWR LTP. The appropriate design for a given survey was developed using the DQO process as outlined in Appendix D of MARSSIM.

The DQO process incorporated hypothesis testing and probabilistic sampling distributions to control decision errors during data analysis. Hypothesis testing is a process based on the scientific method that compares a baseline condition to an alternate condition. The baseline condition is technically known as the null hypothesis. Hypothesis testing rests on the premise that the null hypothesis is true and that sufficient evidence must be provided for rejection. In designing the survey plan, the underlying assumption, or null hypothesis was that residual activity in the survey unit exceeded the release criteria. Rejection of the null hypothesis would indicate that residual activity within the survey unit does not exceed the release criteria. Therefore, the survey unit would satisfy the primary objective of the FSS sample plan.

The primary objective of the FSS sample plan is to demonstrate that the level of residual radioactivity in survey unit B3-012-109 did not exceed the release criteria specified in the LTP and that the potential dose from residual radioactivity is As Low As Reasonably Achievable (ALARA).

Energy*Solutions* TSD RS-TD-313196-001, *Radionuclides of Concern during LACBWR Decommissioning* (Reference 7) established the basis for an initial suite of potential ROC for decommissioning. Insignificant contributors (IC) were determined consistent with the guidance contained in Section 3.3 of NUREG-1757, Volume 2, Revision 1, *Consolidated Decommissioning Guidance – Characterization, Survey, and Determination of Radiological Criteria, Final Report* (Reference 8). In all soil and concrete scenarios, Cs-137, Co-60, Sr-90, Eu-152 and Eu-154 contribute nearly 100% of the total dose. The remaining radionuclides were designated as IC and were eliminated from further detailed evaluation. Therefore, the final ROCs for LACBWR above grade buildings, soil, basement concrete, and buried piping are Cs-137, Co-60, Sr-90, Eu-152 and Eu-154.

The LTP, Section 6.14.1 discusses the process used to derive the ROC for the decommissioning of LACBWR, including the elimination of IC from the initial suite. Table 4-1 presents the ROC for the decommissioning of above grade buildings at LACBWR and the normalized mixture fractions based on the radionuclide mixture.

Table 4-1 - Dose Significant Radionuclides and Mixture for Above Grade Buildings

Radionuclide	Fraction of Total Activity (normalized)(1)
Co-60	0.0644
Sr-90	0.0981
Cs-137	0.829
Eu-152	0.00549
Eu-154	0.00281

(1) Based on maximum percent of total activity from Table 22 of RS-TD-313196-001, normalized to one for the dose significant radionuclides.

LTP, Section 5.2 states that each radionuclide-specific Base Case DCGL is equivalent to the level of residual radioactivity (above background levels) that could, when considered independently, result in a Total Effective Dose Equivalent (TEDE) of 25 mrem/yr to an Average Member of the Critical Group. To ensure that the summation of dose from each source term is 25 mrem/yr or less after all FSS is completed, the Base Case DCGLs are reduced based on an expected, or *a priori*, fraction of the 25 mrem/yr dose limit from each source term. The reduced DCGLs, or "Operational" DCGLs can be related to the Base Case DCGLs as an expected fraction of dose based on an *a priori* assessment of what the expected dose should be based on the results of site characterization, process knowledge, and the extent of planned remediation. The Operational DCGL is then used as the DCGL for the FSS design of the survey unit (calculation of surrogate DCGLs, investigations levels, etc.). Details of the Operational DCGLs derived for each dose component and the basis for the applied *a priori* dose fractions are provided in LC-FS-TSD-002, *Operational Derived Concentration Guideline Levels for Final Status Survey* (Reference 9).

At LACBWR, compliance is demonstrated through the summation of dose from five (5) distinct source terms (i.e., basements, soils, buried pipe, above grade buildings, and groundwater) for the end-state. When applied to above grade buildings, the DCGLs are expressed in units of activity per surface area (dpm/100 cm^2).

The Screening Values in NUREG-1757, Volume 2, Revision 1, *Consolidated Decommissioning Guidance – Characterization, Survey, and Determination of Radiological Criteria, Final Report,* Table H-1, are applied to the FSS of above grade buildings. The Table H-1 Screening Values are presented as Base Case DCGLs (equivalent to 25 mrem/yr) and are reproduced in Table 4-2 below.

Table 4-2 - Base Case DCGLs for Above Grade Buildings ($DCGL_{AGB}$)

Radionuclide	$DCGL_{AGB}$ ($dpm/100cm^2$)
Co-60	7,100
Sr-90	8,700
Cs-137	28,000
Eu-152	12,700
Eu-154	11,500

The Operational DCGLs are then used as the DCGL for the FSS design of the survey unit (calculation of surrogate DCGLs, investigation levels, etc.). The Operational DCGLs for the unrestricted release of above grade buildings are provided in Table 4-3.

Table 4-3 - Operational DCGLs for Above Grade Buildings ($OpDCGL_{AGB}$)

Radionuclide	$OpDCGL_{AGB}$ ($dpm/100cm^2$)
Co-60	1,136
Sr-90	1,392
Cs-137	4,480
Eu-152	2,032
Eu-154	1,840

Instrument DQOs included a verification of the ability of the survey instrument to detect the radiation(s) of interest relative to the Operational DCGL. Survey instrument response checks were required prior to issuance and after the instrument had been used. Control and accountability of survey instruments was required to assure the quality and prevent the loss of data. The minimum acceptable MDC for measurements obtained using field instruments was 50% of the applicable Operational DCGL.

5. SURVEY DESIGN

The level of effort associated with planning a survey is based on the complexity of the survey and nature of the hazards. Guidance for preparing FSS plans is provided in procedures LC-FS-PR-015, *Final Status Surveys for Structures* and LC-FS-PR-002, *Final Status Survey Package Development*.

For the FSS of above grade buildings, Adjusted Gross DCGLs are calculated. This is done

because radionuclide-specific data is not acquired with static measurements. The equation for calculating the Adjusted Gross DCGL is as follows:

Equation 1

$$DCGL_{AG} = \frac{1}{\left[\left(\frac{f_1}{DCGL_1}\right) + \left(\frac{f_2}{DCGL_2}\right) + \cdots \left(\frac{f_i}{DCGL_i}\right)\right]}$$

Where: $DCGL_{AG}$ = Adjusted Gross DCGL in units of dpm/100 cm^2

$DCGL_i$ = Gross DCGL for detectable radionuclide in units of dpm/100 cm^2

f_i = Mixture fraction of detectable radionuclides

Using Equation 1, and values within Tables 4-1 and 4-3, the Adjusted Gross Operational DCGL was calculated as follows:

Equation 2

$$OpDCGL_{AG} = \frac{1}{\left[\left(\frac{0.0644}{1136_{(Co-60)}}\right) + \left(\frac{0.0981}{1392_{(Sr-90)}}\right) + \left(\frac{0.829}{4480_{(Cs-137)}}\right) + \left(\frac{0.00549}{2032_{(Eu-152)}}\right) + \left(\frac{0.00281}{1840_{(Eu-154)}}\right)\right]}$$
$$= 3160\ dpm/100\ cm^2$$

The Adjusted Gross Operational DCGL was calculated as 3,160 dpm/100 cm^2. The action level for survey unit B3-012-109 was equivalent to 50% of the Adjusted Gross Operational DCGL, or 1,580 dpm/100 cm^2.

Using Equation 1, and values within Tables 4-1 and 4-2, the Adjusted Gross Base Case DCGL was calculated as follows:

Equation 3

$$BcDCGL_{AG} = \frac{1}{\left[\left(\frac{0.0644}{7100_{(Co-60)}}\right) + \left(\frac{0.0981}{8700_{(Sr-90)}}\right) + \left(\frac{0.829}{28000_{(Cs-137)}}\right) + \left(\frac{0.00549}{12700_{(Eu-152)}}\right) + \left(\frac{0.00281}{11500_{(Eu-154)}}\right)\right]}$$
$$= 19751\ dpm/100\ cm^2$$

The Adjusted Gross Base Case DCGL was calculated as 19,751 dpm/100 cm^2. The mean activity from the FSS random measurements is compared to the Adjusted Gross Base Case DCGL, and the dose contribution from the survey unit is calculated.

The Sign test was selected as the non-parametric statistical test for compliance with the release criteria. The number of measurements for use with the Sign test was determined in accordance with procedures LC-FS-PR-002 and LC-FS-PR-015. The relative shift (Δ/σ) for the survey unit data set is defined as shift (Δ), which is the Upper Boundary of the Gray Region (UBGR), or the DCGL, minus the Lower Bound of the Gray Region (LBGR), divided by sigma (σ), which is the standard deviation of the data set used for survey design. The optimal value for Δ/σ should range between one (1) and three (3). The largest value the Δ/σ can have is three (3). If the calculated value of Δ/σ exceeds three (3), an adjusted value of three (3) will be used for Δ/σ. The Δ/σ for survey unit B3-012-109, based on the amalgamated gross measurement data from characterization of the LACBWR above grade buildings to remain at license termination, was calculated as follows:

Equation 4

$$\Delta/\sigma = 1580/473 = 3.34$$

As the calculated relative shift was greater than three (3), a value of three (3) was used as the adjusted Δ/σ. Both the Type I error (i.e., α value) and the Type II error (i.e., β value) was set at 0.05. The sample size from Table 5.5 of MARSSIM that equates to the Type I and Type II error of 0.05 for use with the Sign test is an N value of fourteen (14).

A Prospective Power Curve was generated using COMPASS, a software package developed under the sponsorship of the United States Nuclear Regulatory Commission (USNRC) for implementation of the MARSSIM in support of the decommissioning license termination rule (10CFR20, Subpart E). The result of the COMPASS computer run showed adequate power for the survey design.

As the survey unit was designated Class 3, measurement locations were selected at random. The random locations of the static measurements were selected using Visual Sample Plan (VSP). Input parameters included the use of survey unit drawings and the random sampling tool set with a predetermined number (14) of samples. The random measurement locations were identified in the field using dimension parameters provided on the survey unit map (see Attachment 1). Table 5-1 lists the random, judgmental, and QC measurements collected for FSS of survey unit B3-012-109.

Table 5-1 – Survey Unit B3-012-109 Measurement Designations

Measurement ID
B3-012-109-FRWW-001-BD
B3-012-109-FRWM-002-BD
B3-012-109-FRWM-003-BD
B3-012-109-FRCW-004-BD
B3-012-109-FRFC-005-BD
B3-012-109-FRWM-006-BD
B3-012-109-FRWM-007-BD
B3-012-109-FRFC-008-BD
B3-012-109-FRCW-009-BD
B3-012-109-FRWM-010-BD
B3-012-109-FRRA-011-BD
B3-012-109-FRWW-012-BD
B3-012-109-FRRA-013-BD
B3-012-109-FRFC-014-BD
B3-012-109-FJWM-015-BD
B3-012-109-FQWM-007-BD

The implementation of quality control measures as referenced in LTP, Section 5.9 and LaCrosse*Solutions* LC-QA-PN-001, *Final Status Survey Quality Assurance Project Plan* (QAPP) (Reference 10) includes the collection of a replicate measurement on 5% of the measurements collected in a survey unit, with the locations selected at random. One (1) replicate measurement, B3-012-109-FQWM-007-BD, was selected at random for the QC replicate measurement analysis for the FSS of this survey unit.

LTP Chapter 5, Section 5.6.4.4 and Table 5-15 specifies that for Class 3 structure survey units, surface scans will be performed on a judgmental percentage of the surface area in the survey unit. Typically, surface scans would be performed judgmentally on areas with the greatest potential for contamination. In the absence of any peculiar features identified during the survey unit walkdown that would indicate contamination, and because historical radiological information did not provide sufficient evidence for increased contamination potential, the survey design elected that scanning be performed at random. This allowed for the even distribution of scan surveys around the entire survey unit. For survey unit B3-012-109, 10% scan coverage was selected, which equates to 12.2 m^2. Fourteen (14) scan areas (one [1] 1 m^2 scan area at each random measurement location), covering 14 m^2 of the survey

unit (more than the required minimum), were established. Refer to Attachment 1 for figures and maps depicting the measurement and scan locations in survey unit B3-012-109.

For this Class 3 structure survey unit, the "Investigation Levels" for area scanning and direct measurement results are those levels specified in the LTP, Table 5-16, and are reproduced below in Table 5-2.

Table 5-2 – Investigation Levels

Classification	Scan Investigation Levels	Direct Investigation Levels
Class 3	>Operational DCGL or >MDC_{scan} if MDC_{scan} is greater than Operational DCGL	>50% Operational DCGL

Table 5-3 provides a synopsis of the survey design for survey unit B3-012-109.

Table 5-3 – Synopsis of Survey Design

Feature	Design Criteria	Basis
Survey Unit Surface Area	122 m^2	Building Dimensions
Number of Random Measurements (N)	14	• σ = 473 • UBGR = 3,160 • LBGR = 1,580 • Type I & II error = 0.05 • Δ/σ = 3 (adjusted) • MARSSIM Table 5.5
DCGL/Action Level	3,160 dpm/100 cm^2	Adjusted Gross Operational DCGL (Equation 2)
Direct Investigation Level	>50% Operational DCGL (1,580 dpm/100 cm^2)	LTP, Table 5-16
Scan Investigation Level	>Operational DCGL or >MDC_{scan}	LTP, Table 5-16
Scan Areal Coverage	14 m^2 or ~10% areal coverage 15 m^2 (with 1 judgmental grid) or ~13%	LTP, Table 5-15 Actual Scan Coverage
Judgmental Measurements	1	Per Survey Design
QC	1 replicate measurement selected at random location	LTP, Section 5.9

6. SURVEY IMPLEMENTATION

For survey unit B3-012-109, compliance with the unrestricted release criteria was demonstrated through a combination of surface scanning and surface static measurements with a Ludlum Model 44-116 beta/gamma detector.

An FSS Supervisor performed a visual inspection and walk-down of the survey unit during the Unconditional Release Survey (URS) that was performed prior to FSS. The purpose of the walk-down was to assess the physical condition of the survey unit, evaluate access points and travel paths, and identify potentially hazardous conditions. At the time of FSS, the interior of the building was dry, and the exterior (in areas not subject to random surveys) was sparsely covered (nearest to the ground) with ice. The grounds around the building were muddy and partially covered in snow, making travel paths a safety concern. No conditions prohibited the proper collection of static and scan measurements.

FSS field activities were conducted under the FSS Sample Plan, which included DQOs, survey design, detailed FSS instructions, job safety analysis, and related procedures for reference. FSS field activities were projected to take four (4) working days to complete. Daily briefings were conducted to discuss the expectations for job performance and to review safety aspects of the job. A "Field Log" was used to document field activities and other information pertaining to the performance of the FSS. FSS field activities commenced on February 13, 2019 and were concluded on February 14, 2019.

A total of fifteen (15) different scan areas (fourteen [14] random and one [1] judgmental), constituting an area coverage of 15 m^2, were scanned using a Ludlum 2350-1 paired with a Ludlum Model 44-116 detector (125 cm^2 detector area). The background was established as the average of five (5) 1-minute static measurements, while maintaining the detector waist high with the detector face pointed away from the surface of interest. In survey unit B3-012-109, background ranged from 182 cpm up to 193 cpm.

All designated scan areas were scanned using a Ludlum 2350-1 paired with a Model 44-116 beta/gamma detector operated in the rate-meter mode and using audio response. The probe was positioned as close to the surface as possible and was moved at a scan speed of approximately one (1) detector width per second. Scan MDC was sufficient to detect residual radioactivity at the action level of 1,580 dpm/100cm^2 (50% of Adjusted Gross Operational DCGL). Complete scan results are provided in Attachment 2.

The fourteen (14) random static measurement locations were marked based on the dimensions provided on the survey map. One (1) judgmental measurement location was selected and marked as per the sample plan. Using the Ludlum 2350-1 paired with a Model 44-116 detector, a 1-minute static measurement was acquired at each designated random and judgmental survey location.

The implementation of survey specific QC measures included the collection of one (1) replicate static measurement (B3-012-109-FQWM-007-BD) for QC analysis.

7. SURVEY RESULTS

All areas identified in the FSS plan were scanned for elevated radiation levels. No alarms were produced during the scanning of survey unit B3-012-109. Table 7-1 provides an overview of the scan results. Complete scan results are provided in Attachment 2.

Table 7-1 – Synopsis of Scan Results

Scan Area	Highest Logged Reading (cpm)	Action Level(1) (cpm)	# of Scan Alarms	Investigation Measurements
1	264	403	0	0
2	266	403	0	0
3	191	403	0	0
4	292	403	0	0
5	360	403	0	0
6	257	403	0	0
7	215	403	0	0
8	251	403	0	0
9	272	403	0	0
10	293	403	0	0
11	354	387	0	0
12	275	403	0	0
13	251	387	0	0
14	261	403	0	0
15	221	403	0	0
7 QC	231	387	0	0

(1) Action Level based on the average background plus MDCR$_{Surveyor}$. $MDCR_{Surveyor} = (1.38\sqrt{Background\left(\frac{1}{60}\right)}60)/\sqrt{0.5}$.

Background was subtracted from all measurements, then were converted from cpm to dpm/100 cm^2 (net cpm divided by detector efficiency) for direct comparison to the Adjusted Gross DCGLs. Table 7-2 below presents the detector efficiencies used for conversions. A summary of the results for the fourteen (14) random static measurements, one (1) judgmental static measurement, and one (1) QC static measurement is provided in Table 7-3. The basic statistics for the random measurement population are summarized in Table 7-4.

Table 7-2 – Detector Efficiencies

44-116 Detector #	Efficiency (c/d)
PR 357439	0.2381
PR 357009	0.2047

Table 7-3 – Summary of Random, Judgmental, and QC Static Measurements

Measurement ID	Gross Activity (dpm/100 cm^2)	Fraction of Adjusted Gross OpDCGL
B3-012-109-FRWW-001-BD	0	0.0000
B3-012-109-FRWM-002-BD	0	0.0000
B3-012-109-FRWM-003-BD	0	0.0000
B3-012-109-FRCW-004-BD	34	0.0106
B3-012-109-FRFC-005-BD	118	0.0372
B3-012-109-FRWM-006-BD	8	0.0027
B3-012-109-FRWM-007-BD	0	0.0000
B3-012-109-FRFC-008-BD	25	0.0080
B3-012-109-FRCW-009-BD	0	0.0000
B3-012-109-FRWM-010-BD	0	0.0000
B3-012-109-FRRA-011-BD	156	0.0495
B3-012-109-FRWW-012-BD	0	0.0000
B3-012-109-FRRA-013-BD	215	0.0680
B3-012-109-FRFC-014-BD	42	0.0133
B3-012-109-FJWM-015-BD	0	0.0000
B3-012-109-FQWM-007-BD	0	0.0000

Table 7-4 – Basic Statistical Properties of Random Measurement Population

Mean (dpm/100cm^2)	Median (dpm/100cm^2)	Max (dpm/100cm^2)	Min (dpm/100cm^2)	Std. Dev. (dpm/100cm^2)	Adjusted Gross BcDCGL (dpm/100cm^2)	Mean Adjusted Gross BcDCGL Fraction	Dose
43	0	215	0	66	19751	0.0022	0.0541

The mean activity from random static measurements was divided by the Adjusted Gross Base Case DCGL to derive a mean fraction. The mean fraction was then multiplied by twenty-five (25) mrem/yr to calculate the dose attributed to the survey unit. For survey unit B3-012-109, the calculated dose from residual activity is 0.0541 mrem/yr.

8. QUALITY CONTROL

The implementation of survey specific QC measures included the collection of one (1) replicate static measurement (B3-012-109-FQWM-007-BD) for QC analysis. The acceptance criterion for replicate static measurements is that the same conclusion is reached for each measurement. The acceptance criterion is satisfied if the replicate measurement is within 20% of the standard measurement. In cases where the replicate measurement is not within 20% of the standard measurement, but both measurements are below the Operational DCGL as well as the static MDC, there is an acceptable agreement. The QC replicate measurement fell within the 20% criteria, and there is an acceptable agreement between standard and replicate results. Refer to Attachment 4 for QC analysis results.

9. INVESTIGATIONS AND RESULTS

No investigations were performed during the performance or analyses of the survey.

10. REMEDIATION AND RESULTS

No radiological remedial action as described by MARSSIM Section 5.4 was performed in this survey unit prior to or as a result of the FSS. Chapter 4 of the LTP determined that remediation beyond that required to meet the release criteria is unnecessary and that the remaining residual radioactivity in above grade buildings was ALARA.

11. CHANGES FROM THE FINAL STATUS SURVEY PLAN

There were no addendums to the FSS plan.

12. DATA QUALITY ASSESSMENT (DQA)

The DQO sample design and data were reviewed in accordance with LC-FS-PR-008, *Final Status Survey Data Assessment* (Reference 11) for completeness and consistency. Documentation was complete and legible. Scan surveys and the collection of static measurements were consistent with the DQOs and were sufficient to ensure that the survey unit was properly designated as Class 3. The survey design had adequate power as indicated by the Retrospective Power Curve (see Attachment 5).

The measurement results indicated that all measurements were less than 50% of the Adjusted Gross Operational DCGL.

Although MARSSIM states that the Sign test need not be performed in the instance that no measurements exceed the DCGL, the test was conducted to demonstrate coherence to the statistical principles of the DQO process. The Sign test was performed on the data and compared to the original assumptions of the DQOs. The evaluation of the Sign test results clearly demonstrates that the survey unit passes the unrestricted release criteria, thus, the null hypothesis is rejected.

The preliminary data review consisted of calculating basic statistical quantities (e.g., mean, median, standard deviation). The mean and median values of the data were well below the Adjusted Gross Operational DCGL. Also, the retrospective power curve shows that a sufficient number of measurements were collected to achieve the desired power. Therefore, the survey unit meets the unrestricted release criteria with adequate power as required by the DQOs.

The survey unit data is presented graphically through a frequency plot and quantile plot. All graphical presentations are provided in Attachment 5.

13. ANOMALIES

No anomalies were observed during the performance or analyses of the survey.

14. CONCLUSION

Survey unit B3-012-109 has met the DQOs of the FSS plan. The ALARA criteria as specified in Chapter 4 of the LTP were achieved.

The sample data passed the Sign test. The null hypothesis was rejected. The Retrospective Power Curve showed that adequate power was achieved. The survey unit is properly classified as Class 3. Therefore, in accordance with the LTP, Section 5.11, the survey unit meets the release criteria.

The dose contribution from survey unit B3-012-109 is 0.0541 mrem/yr TEDE, based on the mean activity of measurements used for non-parametric statistical sampling.

Survey unit B3-012-109 is acceptable for unrestricted release.

15. REFERENCES

1. LC-FS-PR-009, Final Status Survey Data Reporting
2. *La Crosse Boiling Water Reactor License Termination Plan*
3. LC-FS-PR-015, *Final Status Surveys for Structures*

4. LC-FS-PR-002, *Final Status Survey Package Development*
5. NUREG-1575, Revision 1, *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM)
6. *La Crosse Boiling Water Reactor Historical Site Assessment*
7. RS-TD-313196-001, *Radionuclides of Concern During LACBWR Decommissioning*
8. NUREG-1757, Volume 2, Revision 1, *Consolidated Decommissioning Guidance – Characterization, Survey, and Determination of Radiological Criteria, Final Report*
9. LC-FS-TSD-002, *Operational Derived Concentration Guideline Levels for Final Status Survey*
10. LC-QA-PN-001, *Final Status Survey Quality Assurance Project Plan*
11. LC-FS-PR-008, *Final Status Survey Data Assessment*

16. ATTACHMENTS

Attachment 1 – Figures and Maps

Attachment 2 – Scan Data

Attachment 3 – Sign Test

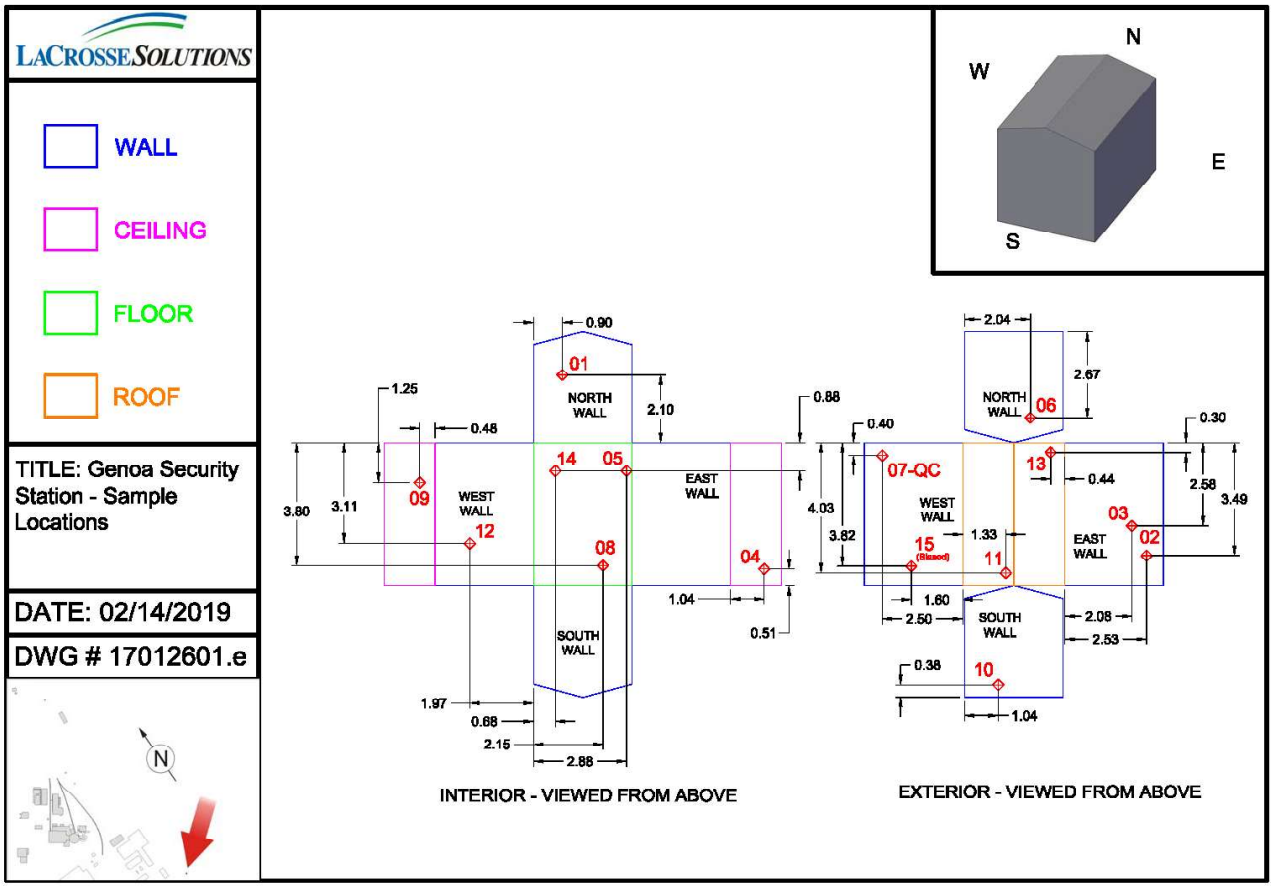
Attachment 4 – Quality Control Assessment

Attachment 5 – Graphical Presentations

Attachment 6 – Ludlum 2350-1 Download Reports

ATTACHMENT 1
FIGURES AND MAPS

Figure 16-1 – Survey Unit B3-012-109 Random and Judgmental Measurement Locations Map



ATTACHMENT 2
SCAN DATA

Table 16-1 – Survey Unit B3-012-109 Complete Scan Data

Detector Type	Detector ID	M2350-1 ID	Location	Scan Logged Result (cpm)	Avg Background (cpm)	Action Level(1) (cpm)	Scan Alarms
44-116	357439	325261	1	264	193	403	0
44-116	357439	325261	2	266	193	403	0
44-116	357439	325261	3	191	193	403	0
44-116	357439	325261	4	292	193	403	0
44-116	357439	325261	5	360	193	403	0
44-116	357439	325261	6	257	193	403	0
44-116	357439	325261	7	215	193	403	0
44-116	357439	325261	8	251	193	403	0
44-116	357439	325261	9	272	193	403	0
44-116	357439	325261	10	293	193	403	0
44-116	357009	325246	11	354	182	387	0
44-116	357439	325261	12	275	193	403	0
44-116	357009	325246	13	251	193	387	0
44-116	357439	325261	14	261	193	403	0
44-116	357439	325261	15	221	193	403	0
44-116	357009	325246	7 QC	231	182	387	0

(1) Action Level based on the average background plus $MDCR_{Surveyor}$. $MDCR_{Surveyor} = (1.38\sqrt{Background\left(\frac{1}{60}\right)}60)/\sqrt{0.5}$

ATTACHMENT 3
SIGN TEST

Table 16-2 – Survey Unit B3-012-109 Sign Test

#	SOF (Ws)	1-Ws	Sign
1	0.0000	1.00	+1
2	0.0000	1.00	+1
3	0.0000	1.00	+1
4	0.0106	0.99	+1
5	0.0372	0.96	+1
6	0.0027	1.00	+1
7	0.0000	1.00	+1
8	0.0080	0.99	+1
9	0.0000	1.00	+1
10	0.0000	1.00	+1
11	0.0495	0.95	+1
12	0.0000	1.00	+1
13	0.0680	0.93	+1
14	0.0133	0.99	+1

Number of positive differences (S+) 14

Critical Value 10

Survey Unit Meets the Acceptance Criteria

ATTACHMENT 4
QUALITY CONTROL ASSESSMENT

Table 16-3 – Survey Unit B3-012-109 QC Assessment

Standard	Activity (dpm/100cm^2)	-20%	+20%	Comparison	Activity (dpm/100cm^2)	Within 20%
B3-012-109-FRWM-007-BD	0	0	0	B3-012-109-FQWM-007-BD	0	Y

ATTACHMENT 5
GRAPHICAL PRESENTATIONS

Figure 16-2 - Quantile Plot for Gross Activity

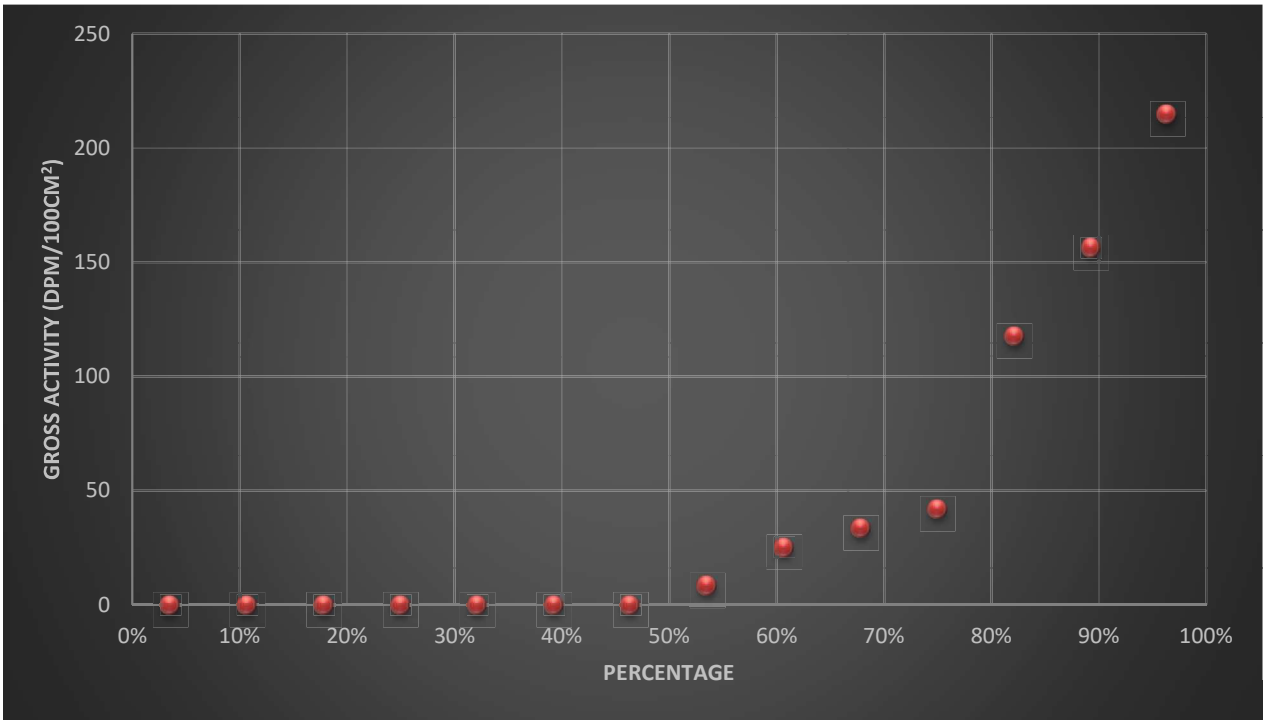


Figure 16-3 - Histogram for Gross Activity

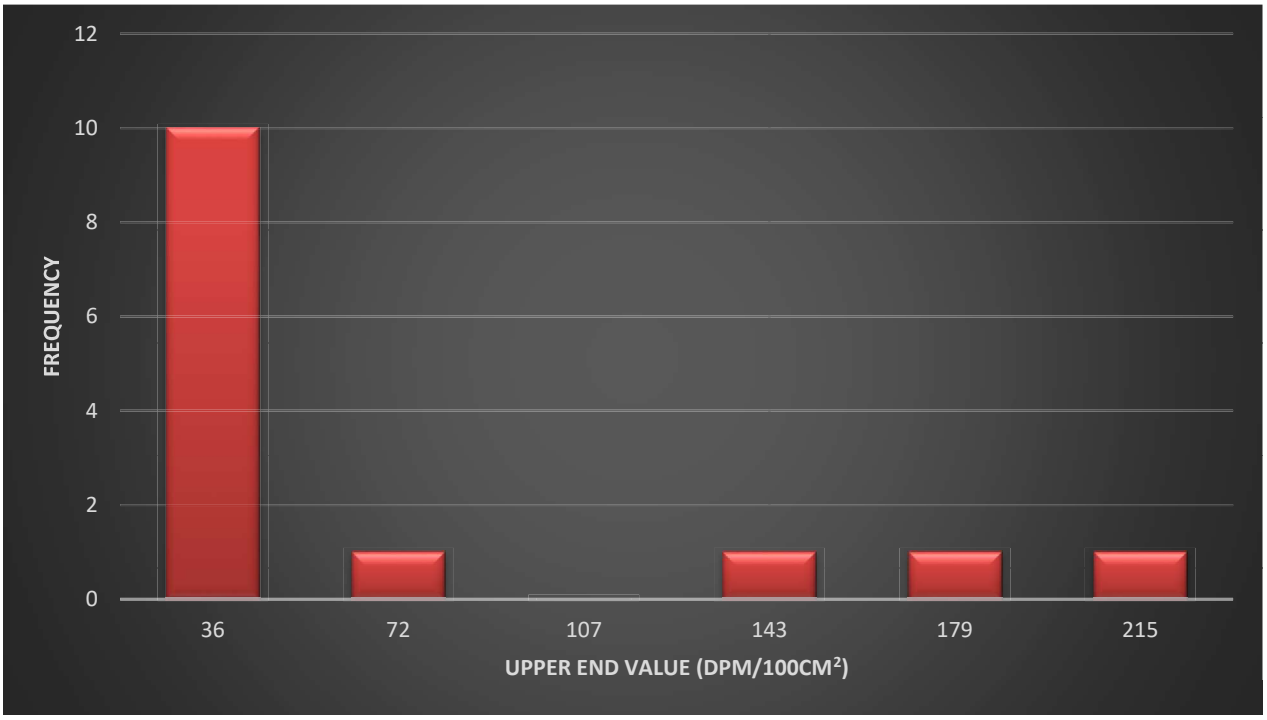
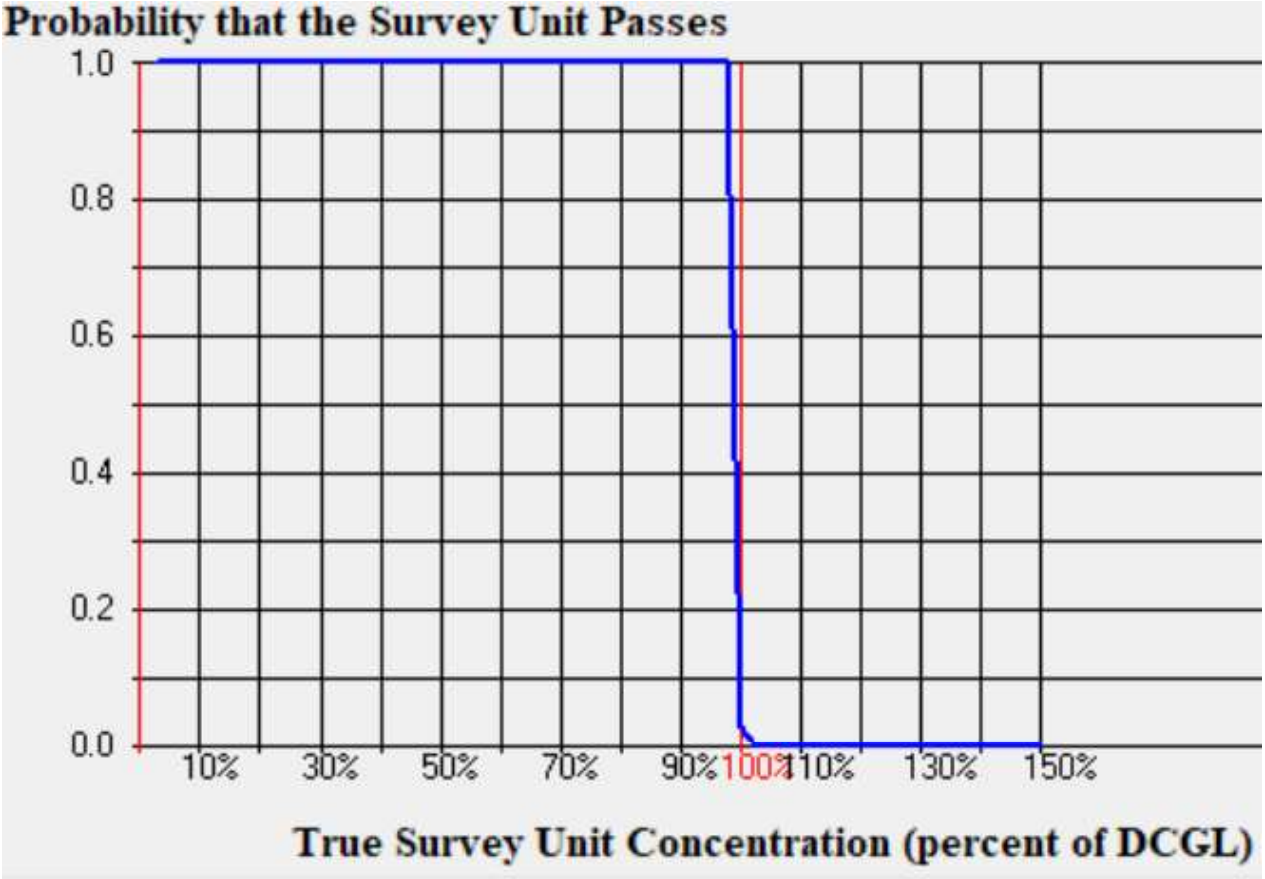


Figure 16-4 - Retrospective Power Curve for Survey Unit B3-012-109



ATTACHMENT 6
LUDLUM 2350-1 DOWNLOAD REPORTS

B3-012-109

Probe Model	Serial Number	Sample Number	Survey Unit - Grid	Location	D=Direct S=Scan	BKG	Source Check	Date / Time	Detector Setup	Logged Reading	Units (cpm)	Count Time	Logging Mode(min)	Alarm=1 No Alarm=0	Inst Serial Number	Tech Name
44-116	357009	0	B3109		BD	PRBKG		2/14/2019 7:03	2	178	c	60	1	0	325246	SB
44-116	357009	1	B3109		BD		PRCHK	2/14/2019 7:06	2	2475	c	60	1	1	325246	SB
44-116	357009	2	B3109	FLDBK	BD			2/14/2019 9:00	2	177	c	60	1	0	325246	SB
44-116	357009	3	B3109	FLDBK	BD			2/14/2019 9:01	2	181	c	60	1	0	325246	SB
44-116	357009	4	B3109	FLDBK	BD			2/14/2019 9:03	2	184	c	60	1	0	325246	SB
44-116	357009	5	B3109	FLDBK	BD			2/14/2019 9:04	2	186	c	60	1	0	325246	SB
44-116	357009	6	B3109	FLDBK	BD			2/14/2019 9:05	2	184	c	60	1	0	325246	SB
44-116	357009	7	B3109	11	BS			2/14/2019 9:37	2	354	c	0	0	0	325246	SB
44-116	357009	8	B3109	11	BD			2/14/2019 9:39	2	214	c	60	1	0	325246	SB
44-116	357009	9	B3109	13	BS			2/14/2019 10:04	2	251	c	0	0	0	325246	SB
44-116	357009	10	B3109	13	BD			2/14/2019 10:07	2	226	c	60	1	0	325246	SB
44-116	357009	13	B3109		BD	PSBKG		2/14/2019 12:08	2	211	c	60	1	0	325246	SB
44-116	357009	14	B3109		BD		PSCHK	2/14/2019 12:12	2	2507	c	60	1	1	325246	SB

Reviewed By: WB

 2/14/19 SAB

Survey # 2019-~~0055~~ 0054

B3-012-109

Probe Model	Serial Number	Sample Number	Survey Unit - Grid	Location	D=Direct S=Scan	BKG	Source Check	Date / Time	Detector Setup	Logged Reading	Units (cpm)	Count Time	Logging Mode(min)	Alarm=1 No Alarm=0	Inst Serial Number	Tech Name
44-116	357009	0	B3109		BD	PRBKG		2/14/2019 7:03	2	178	c	60	1	0	325246	SB
44-116	357009	1	B3109		BD		PRCHK	2/14/2019 7:06	2	2475	c	60	1	1	325246	SB
44-116	357009	2	B3109	FLDBK	BD			2/14/2019 9:00	2	177	c	60	1	0	325246	SB
44-116	357009	3	B3109	FLDBK	BD			2/14/2019 9:01	2	181	c	60	1	0	325246	SB
44-116	357009	4	B3109	FLDBK	BD			2/14/2019 9:03	2	184	c	60	1	0	325246	SB
44-116	357009	5	B3109	FLDBK	BD			2/14/2019 9:04	2	186	c	60	1	0	325246	SB
44-116	357009	6	B3109	FLDBK	BD			2/14/2019 9:05	2	184	c	60	1	0	325246	SB
44-116	357009	11	B3109	QC07	BS			2/14/2019 10:17	2	231	c	0	0	0	325246	SB
44-116	357009	12	B3109	QC07	BD			2/14/2019 10:19	2	147	c	60	1	0	325246	SB
44-116	357009	13	B3109		BD	PSBKG		2/14/2019 12:08	2	211	c	60	1	0	325246	SB
44-116	357009	14	B3109		BD		PSCHK	2/14/2019 12:12	2	2507	c	60	1	1	325246	SB

Reviewed By: WB

Survey # 2019-0055

Probe Model	Serial Number	Sample Number	Survey Unit - Grid	Location	D=Direct S=Scan	BKG	Source Check	Date / Time	Detector Setup	Logged Reading	Units (cpm)	Count Time	Logging Mode(min)	Alarm=1 No Alarm=0	Inst Serial Number	Tech Name
44-116	357439	0			BD	PRBKG		2/13/2019 13:15	1	225	c	60	1	0	325261	WDC
44-116	357439	1			BD		PRCHK	2/13/2019 13:26	1	2563	c	60	1	1	325261	WDC
44-116	357439	2	B3109	FLDBK	BD			2/13/2019 13:45	1	187	c	60	1	0	325261	WDC
44-116	357439	3	B3109	FLDBK	BD			2/13/2019 13:48	1	217	c	60	1	0	325261	WDC
44-116	357439	4	B3109	FLDBK	BD			2/13/2019 13:49	1	184	c	60	1	0	325261	WDC
44-116	357439	5	B3109	FLDBK	BD			2/13/2019 13:50	1	186	c	60	1	0	325261	WDC
44-116	357439	6	B3109	FLDBK	BD			2/13/2019 13:51	1	190	c	60	1	0	325261	WDC
44-116	357439	7	B3109	10	BS			2/13/2019 13:57	1	293	c	0	0	0	325261	WDC
44-116	357439	8	B3109	10	BD			2/13/2019 13:59	1	142	c	60	1	0	325261	WDC
44-116	357439	9	B3109	2	BS			2/13/2019 14:01	1	266	c	0	0	0	325261	WDC
44-116	357439	10	B3109	2	BD			2/13/2019 14:03	1	130	c	60	1	0	325261	WDC
44-116	357439	11	B3109	3	BS			2/13/2019 14:05	1	191	c	0	0	0	325261	WDC
44-116	357439	12	B3109	3	BD			2/13/2019 14:07	1	160	c	60	1	0	325261	WDC
44-116	357439	13	B3109	15	BS			2/13/2019 14:11	1	221	c	0	0	0	325261	WDC
44-116	357439	14	B3109	15	BD			2/13/2019 14:12	1	160	c	60	1	0	325261	WDC
44-116	357439	15	B3109	7	BS			2/13/2019 14:14	1	215	c	0	0	0	325261	WDC
44-116	357439	16	B3109	7	BD			2/13/2019 14:17	1	148	c	60	1	0	325261	WDC
44-116	357439	17	B3109	6	BS			2/13/2019 14:20	1	257	c	0	0	0	325261	WDC
44-116	357439	18	B3109	6	BD			2/13/2019 14:22	1	195	c	60	1	0	325261	WDC
44-116	357439	19	B3109	8	BS			2/13/2019 14:49	1	251	c	0	0	0	325261	WDC
44-116	357439	20	B3109	8	BD			2/13/2019 14:50	1	199	c	60	1	0	325261	WDC
44-116	357439	21	B3109	12	BS			2/13/2019 14:54	1	275	c	0	0	0	325261	WDC
44-116	357439	22	B3109	12	BD			2/13/2019 14:55	1	156	c	60	1	0	325261	WDC
44-116	357439	23	B3109	14	BS			2/13/2019 14:59	1	261	c	0	0	0	325261	WDC
44-116	357439	24	B3109	14	BD			2/13/2019 15:00	1	203	c	60	1	0	325261	WDC
44-116	357439	25	B3109	5	BS			2/13/2019 15:03	1	360	c	0	0	0	325261	WDC
44-116	357439	26	B3109	5	BD			2/13/2019 15:04	1	221	c	60	1	0	325261	WDC
44-116	357439	27	B3109	1	BS			2/13/2019 15:08	1	264	c	0	0	0	325261	WDC
44-116	357439	28	B3109	1	BD			2/13/2019 15:10	1	130	c	60	1	0	325261	WDC
44-116	357439	29	B3109	9	BS			2/13/2019 15:22	1	272	c	0	0	0	325261	WDC
44-116	357439	30	B3109	9	BD			2/13/2019 15:24	1	191	c	60	1	0	325261	WDC
44-116	357439	31	B3109	4	BS			2/13/2019 15:29	1	292	c	0	0	0	325261	WDC
44-116	357439	32	B3109	4	BD			2/13/2019 15:31	1	201	c	60	1	0	325261	WDC
44-116	357439	33			BD	PSBKG		2/13/2019 15:48	1	239	c	60	1	0	325261	WDC
44-116	357439	34			BD		PSCHK	2/13/2019 15:58	1	2623	c	60	1	1	325261	WDC

Reviewed By: