Rancho Seco

Final Status Survey Summary Report

July 17, 2008

Reactor Building Tendon Gallery

Survey Unit F8111591

Prepared By: _____ Date: 7.17.2008

FSS Engineer

Reviewed By: _____ Date: 12/8/08

Lead FSS Engineer

Approved By: _____ Date: 2-6-09

Dismantlement Superintendent, Radiological

## FINAL STATUS SURVEY SUMMARY REPORT

### Survey Unit:

F8111591, Reactor Building Tendon Gallery

### Survey Unit Description:

Operating History: The reinforced concrete structure contained the reactor and supporting systems. The building contained four main elevations. Residual radioactive material was known to be present on all levels of the interior of the building. Operating records and the HSA document several events with the potential for a release of radioactivity inside this structure. No events documenting exterior contamination were found.

Site Characterization: Direct measurements were made of each of the interior elevation surfaces as well as the exterior surfaces of the structure. These measurements confirmed the presence of plant-derived radionuclides. Direct measurements on the –27' elevation showed a mean gross activity level of 1,535,383 dpm/100 $cm^2$ and a maximum value of 8,134,000 dpm/100 $cm^2$. Direct measurements on the grade elevation showed a mean gross activity level of 201,670 dpm/100 $cm^2$ and a maximum value of 370,000 dpm/100 $cm^2$. Direct measurements on the +40' elevation showed a mean gross activity level of 51,521 dpm/100 $cm^2$ and a maximum value of 99,150 dpm/100 $cm^2$. Direct measurements on the +60' elevation showed a mean gross activity level of 20,110 dpm/100 $cm^2$ and a maximum value of 46,660 dpm/100 $cm^2$. Direct measurements on the exterior roof showed a mean gross activity level of 1,364 dpm/100 $cm^2$ and a maximum value of 1,571 dpm/100 $cm^2$. Based on the classification procedure (DSIP-0020) and levels of gross activity reported, the interior of the reactor building was determined to be a Class 1 area and the exterior was a Class 3.

HSA Events: HSA Report pg. 63.

### Survey Unit Design Information:

The Survey Unit Design Parameters are presented in Table 1 below. The survey unit and measurement locations are depicted on the maps in Attachment 1. Direct measurement locations were randomly determined and 363 $m^2$ were scanned for approximately 20% coverage. Samples of removable contamination were collected at each direct measurement location. The instrumentation used for the survey along with the MDC values are listed in Tables 2-1 and 2-2 in Attachment 2.

## Table 1. Survey Unit Design Parameters

| Survey Design Parameter | Value | Comment |
|---|---|---|
| **Survey Area:** | F811 | Reactor Building Tendon Gallery |
| **Survey Unit:** | 1591 | Structure Surface |
| **Class:** | 3 | LTP Table 5-4 |
| **SU Area** ($m^2$)**:** | 1817 | |
| **Evaluator:** | Gary Frank | |
| **DCGL** (dpm/100 $cm^2$)**:** | 43000 | Gross Activity DCGL |
| **Area Factor:** | N/A | Class 3 |
| **Design DCGLemc** (dpm/100 $cm^2$)**:** | N/A | Class 3 |
| **LBGR** (dpm/100 $cm^2$)**:** | 21500 | Default = 50% DCGL |
| **Design Sigma** (dpm/100 $cm^2$)**:** | 119 | |
| **Type I Error:** | 0.05 | |
| **Type II Error:** | 0.05 | |
| **Predominant Nuclide:** | Cs-137 | |
| **Sample Area** ($m^2$)**:** | N/A | Class 3 |
| **Scan Area** ($m^2$)**:** | 363 | |
| **Scan Coverage (%):** | 20% | Class 3 |
| $Z_{1-\alpha}$ **:** | 1.645 | |
| $Z_{1-\beta}$ **:** | 1.645 | |
| **Sign P:** | 0.99865 | |
| **Calculated Relative Shift:** | 180.6 | |
| **Relative Shift Used:** | 3 | Uses 3.0 if Relative Shift is >3 |
| **N-Value:** | 11 | |
| **Design N-Value + 20%:** | 14 | NUREG-1575 Table 5-5 |
| **Design Min Samples N:** | 14 | Class 3 |
| **Grid Spacing L:** | N/A | Class 3 |

## Survey Results:

A total of 14 direct measurements were made in F8111591. The results including mean, median, standard deviation and range are shown in Table 2. All direct measurements were less than the DCGL. None of the scan measurements indicated areas of elevated activity. Scan activity ranged from 1863 to 16682 dpm/100 $cm^2$, based on a surveyor efficiency of 0.5 and no background subtracted. Samples for removable surface activity were all less than 10% of the DCGL as shown in Table 3. Removable surface activity samples were counted for alpha activity and none was detected at the MDC shown in Table 2-1 of Attachment 2.

**Table 2. Direct Measurement Results**

| Measurement ID | Gross Activity (dpm/100 $cm^2$) |
|---|---|
| **F8111591-C0001BD** | 1390 |
| **F8111591-C0002BD** | 1447 |
| **F8111591-C0003BD** | 1338 |
| **F8111591-C0004BD** | 1395 |
| **F8111591-C0005BD** | 1406 |
| **F8111591-C0006BD** | 1292 |
| **F8111591-C0007BD** | 1499 |
| **F8111591-C0008BD** | 1494 |
| **F8111591-C0009BD** | 1608 |
| **F8111591-C0010BD** | 1401 |
| **F8111591-C0011BD** | 1758 |
| **F8111591-C0012BD** | 1577 |
| **F8111591-C0013BD** | 1629 |
| **F8111591-C0014BD** | 1634 |
| **Mean:** | 1491 |
| **Median:** | 1471 |
| **Standard Deviation:** | 134 |
| **Range:** | 1292 - 1758 |

## Table 3. Removable Surface Activity Results

| Measurement ID | Surface Beta Activity (dpm/100 $cm^2$) |
|---|---|
| F8111591C0001SM | -4.82 |
| F8111591C0002SM | -4.82 |
| F8111591C0003SM | -3.53 |
| F8111591C0004SM | -2.24 |
| F8111591C0005SM | -3.53 |
| F8111591C0006SM | -3.53 |
| F8111591C0007SM | -2.24 |
| F8111591C0008SM | -3.53 |
| F8111591C0009SM | -2.24 |
| F8111591C0010SM | -2.24 |
| F8111591C0011SM | -0.95 |
| F8111591C0012SM | -4.82 |
| F8111591C0013SM | -2.24 |
| F8111591C0014SM | 2.93 |
| **Mean:** | -2.7 |
| **Median:** | -2.88 |
| **Standard Deviation:** | 2 |
| **Range:** | -4.82 to 2.93 |

## Survey Unit Data Assessment:

The survey design required 14 direct measurements for the Sign Test. The critical value and the results of the Sign Test are presented in Table 4. The sample mean and median values were less than the DCGL. The sample standard deviation was greater than the design standard deviation but both values of sigma resulted in a relative shift greater than three (3), no additional samples were required.

## Table 4. Data Assessment Results

| Survey Results Parameter | Value | Comment |
|---|---|---|
| **Material Background Used** (dpm/100 $cm^2$): | N/A | |
| **Ambient Background Used** (dpm/100 $cm^2$): | N/A | Average Ambient BKG = 0 |
| **Actual Direct Measurements (N):** | 14 | |
| **Median** (dpm/100 $cm^2$): | 1471 | |
| **Mean** (dpm/100 $cm^2$): | 1491 | |
| **Direct Measurement Standard Deviation** (dpm/100 $cm^2$): | 134 | |
| **Total Standard Deviation** (dpm/100 $cm^2$): | 134 | Based on samples and backgrounds. |
| **Maximum** (dpm/100 $cm^2$): | 1758 | |
| **Material Type:** | N/A | Background Subtract Not Applied |
| **Sign Test Final N Value:** | 14 | |
| **S+ Value:** | 14 | |
| **Critical Value:** | 10 | |
| **Sufficient Samples Collected:** | Yes | |
| **Maximum Value < DCGL:** | Yes | |
| **Median Value < DCGL:** | Yes | |
| **Mean Value < DCGL:** | Yes | |
| **Maximum Value < DCGLemc:** | N/A | Class 3 |
| **Total Standard Deviation <= Sigma:** | Investigate | All results <0.5 DCGL |
| **Pass the Sign Test?** | Yes | |
| **Reject the Null Hypothesis?** | Yes | |
| **Does the Survey Unit Pass All Criteria?** | Investigate | Survey Unit Passes |

## Survey Unit Investigations and Results:

No investigations were required for either direct or scan measurements and no investigation results are reported.

## ALARA Statement:

As stated in Chapter 4 of the LTP, as long as the residual activity within the survey unit is less than the DCGL, the ALARA criterion has been met.

## Changes in Initial Survey Unit Assumptions:

The survey unit was designed as a Class 3 structure survey and the sample results are consistent with that classification. The variability of the survey results was greater than the characterization data used for survey design. However, no additional samples were required. No potential areas of elevated activity were detected.

## Conclusion:

The FSS of this survey unit was properly designed as a Class 3 survey based on Table 5-4 of the LTP. The required number of direct measurements was made and the scan coverage met the requirement of Table 5-6 of the LTP. No direct measurements exceeded the DCGL of 43000 dpm/100 $cm^2$ and none of the removable surface activity measurements exceeded 10% of the DCGL. No investigations were required.

The direct measurement data support rejection of the null hypothesis, providing high confidence that the survey unit satisfied the release criteria and that the data quality objectives were met.

It is concluded that survey unit F8111591 meets the release criteria of 10CFR20.1402.

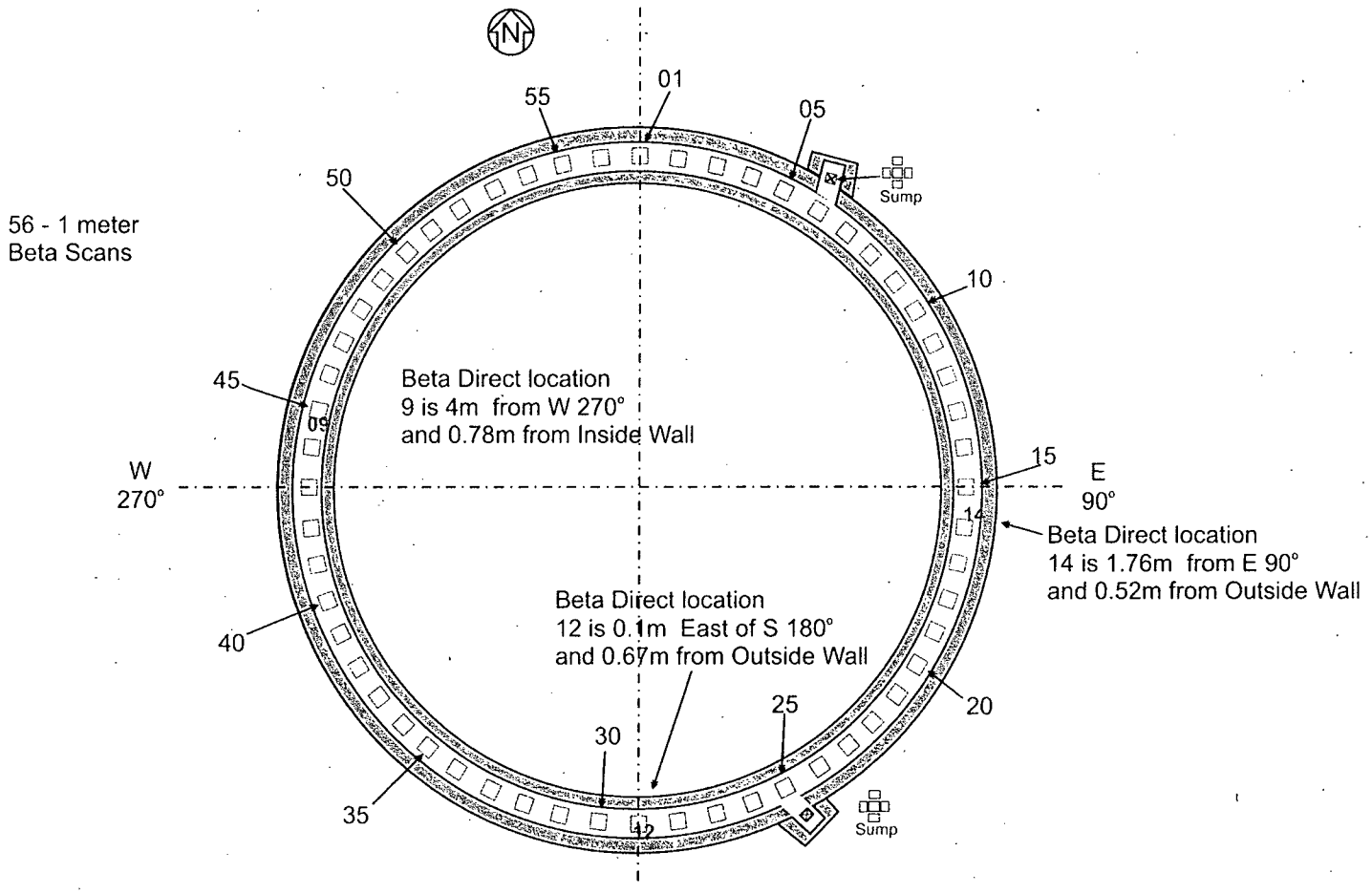
Attachment 1

Maps

July 17, 2008

Survey Unit F8111591

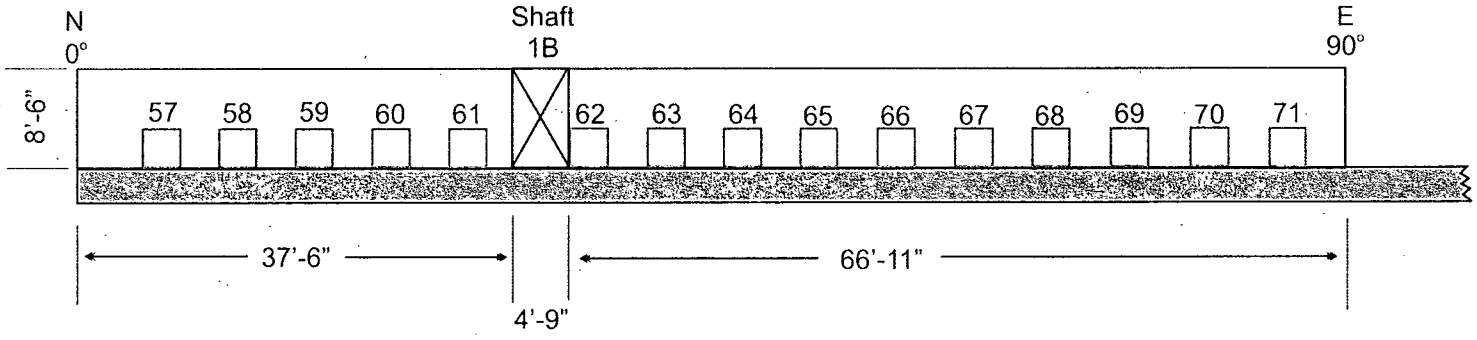
Tendon Gallery Floor Beta Scans/Beta Directs

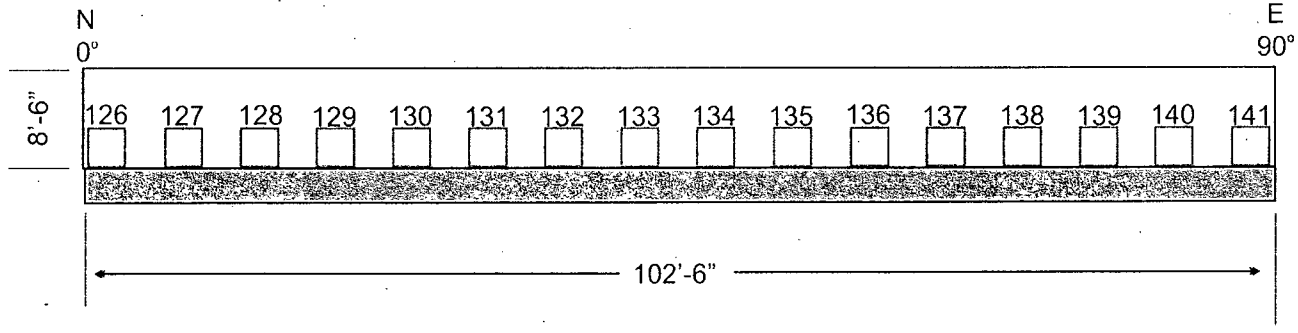



Tendon Gallery Floor -48' Elev
2440.0 ft²
226.7m²

F8111591 - M1

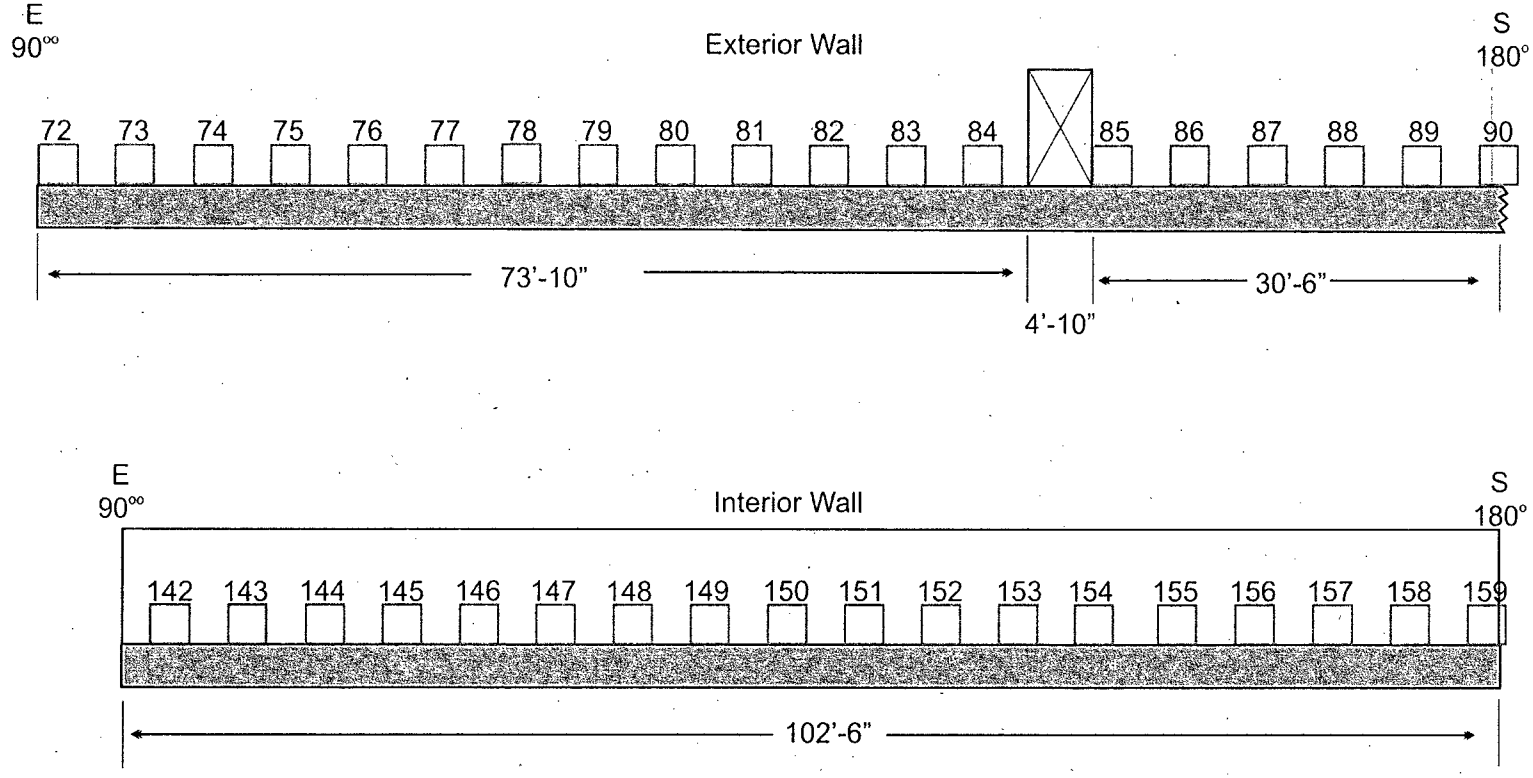
Tendon Gallery Section 1
0° North to 90° East
Beta Scans




F8111591 - M2A

# Tendon Gallery Section 2
## 90° East to 180° South
## Beta Scans

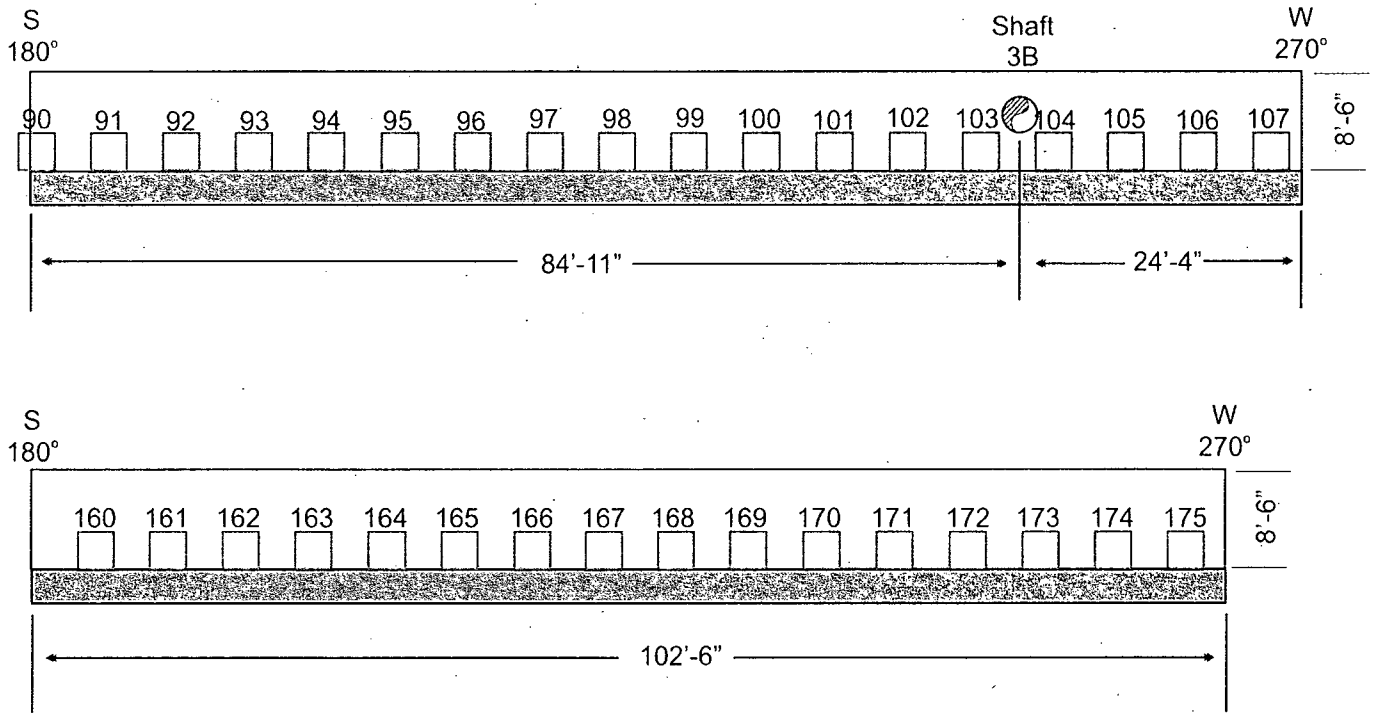






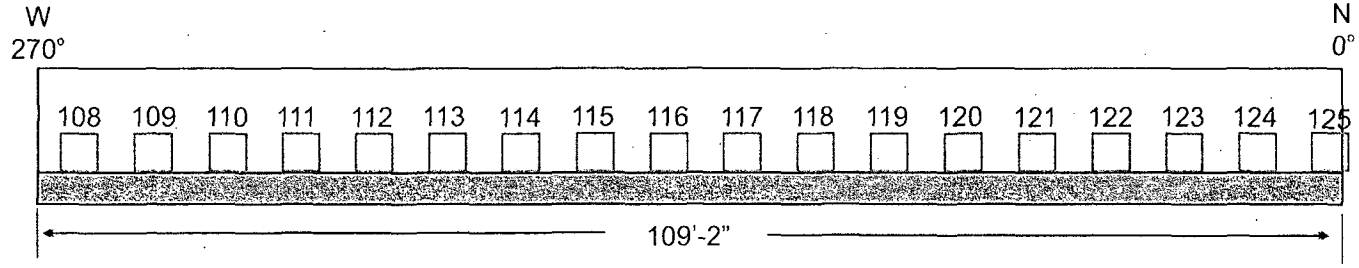
F8111591 - M2B

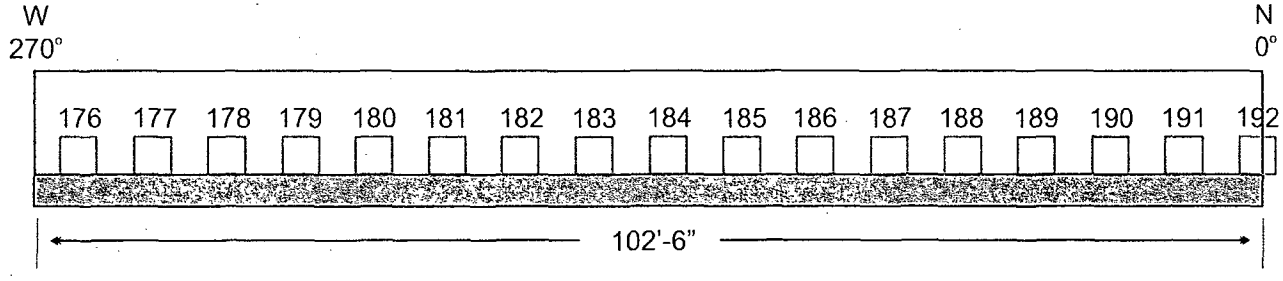
Tendon Gallery Section 3
South 180° to West 270°
Beta Scans




F8111591 - M2C

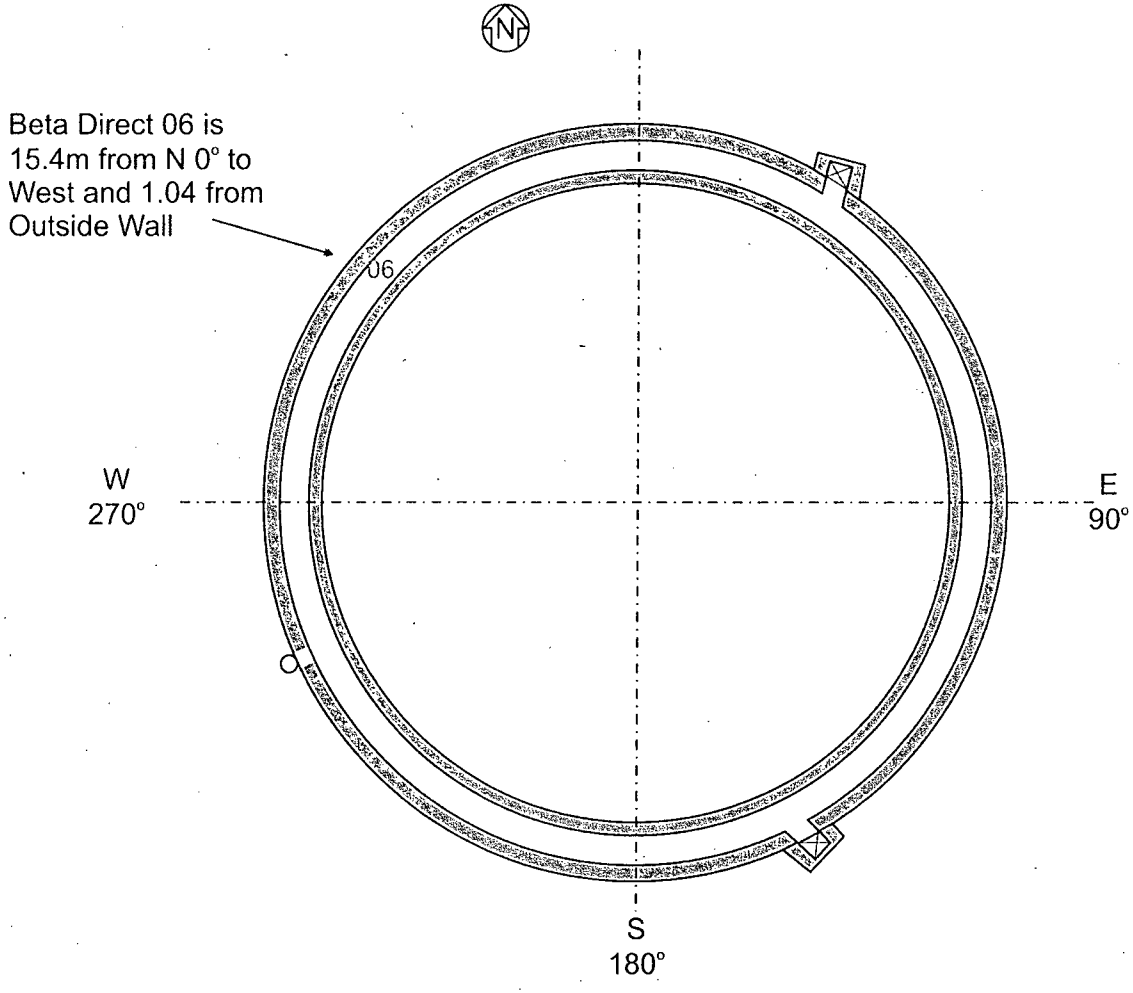
Tendon Gallery Section 4
West 270° to North 0°
Beta Scans



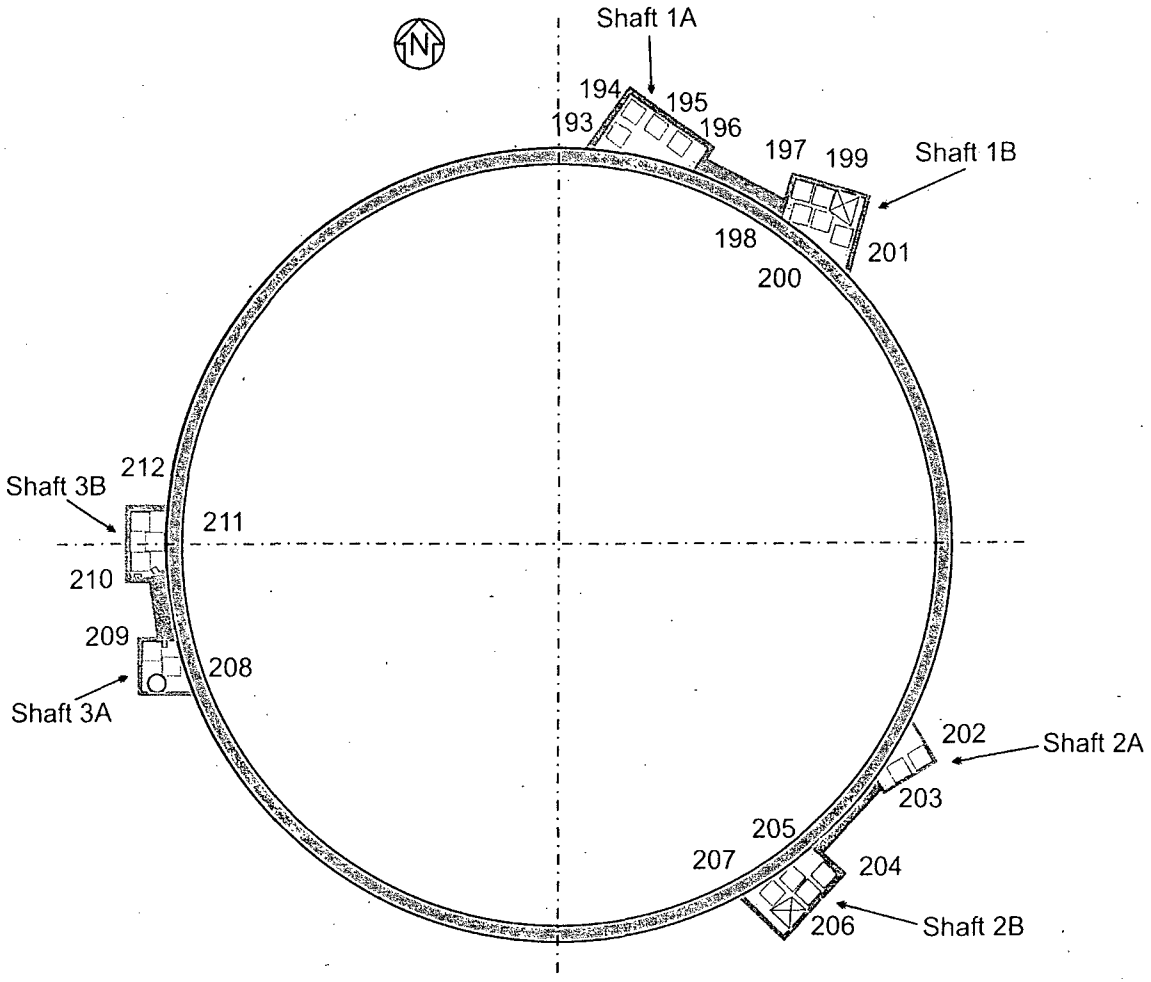

F811159 - M2D

F8111591 Tendon Gallery Ceiling
Beta Directs



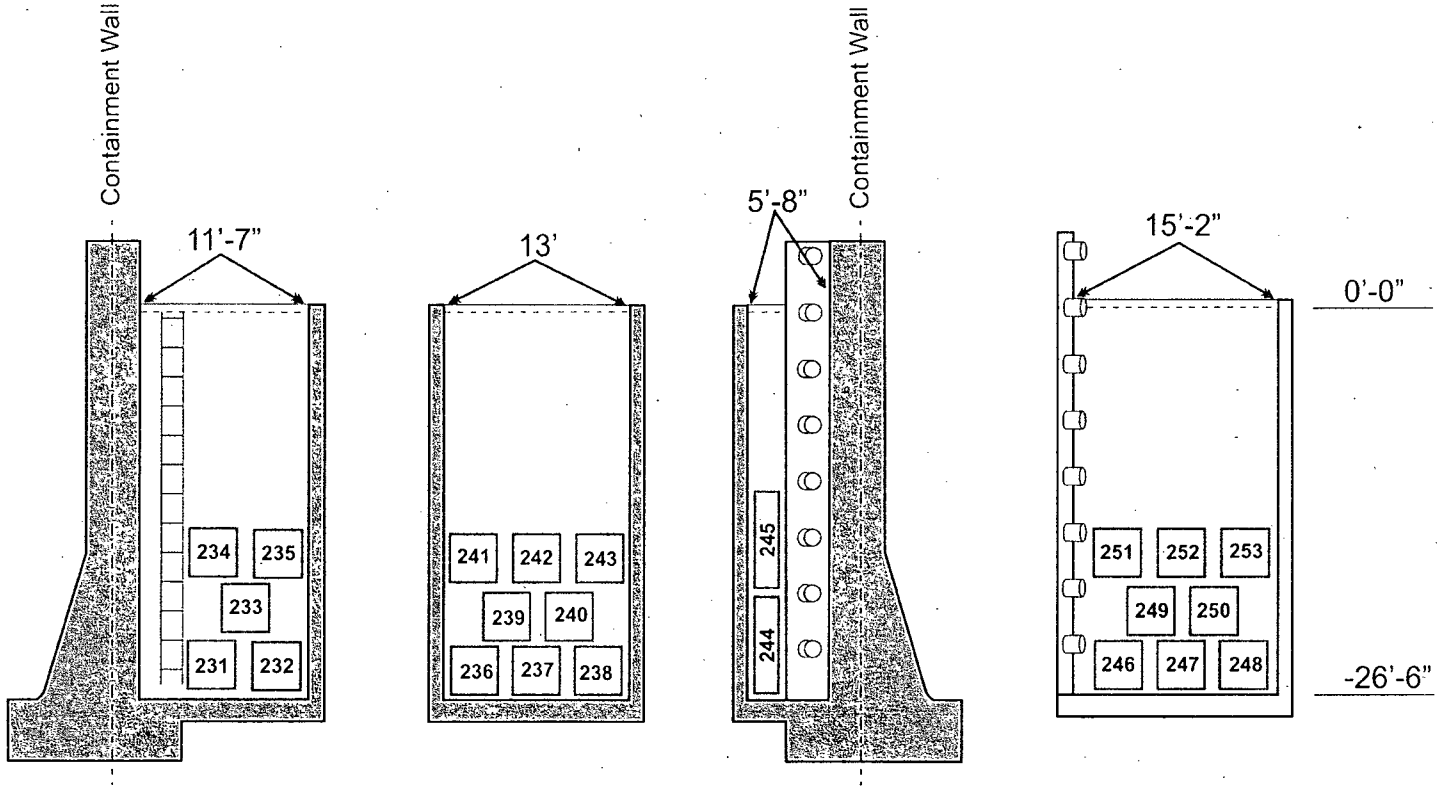

Tendon Gallery Reflected Ceiling -48' Elev
2402.0 ft$^2$
223.2m$^2$

F8111591 - M3



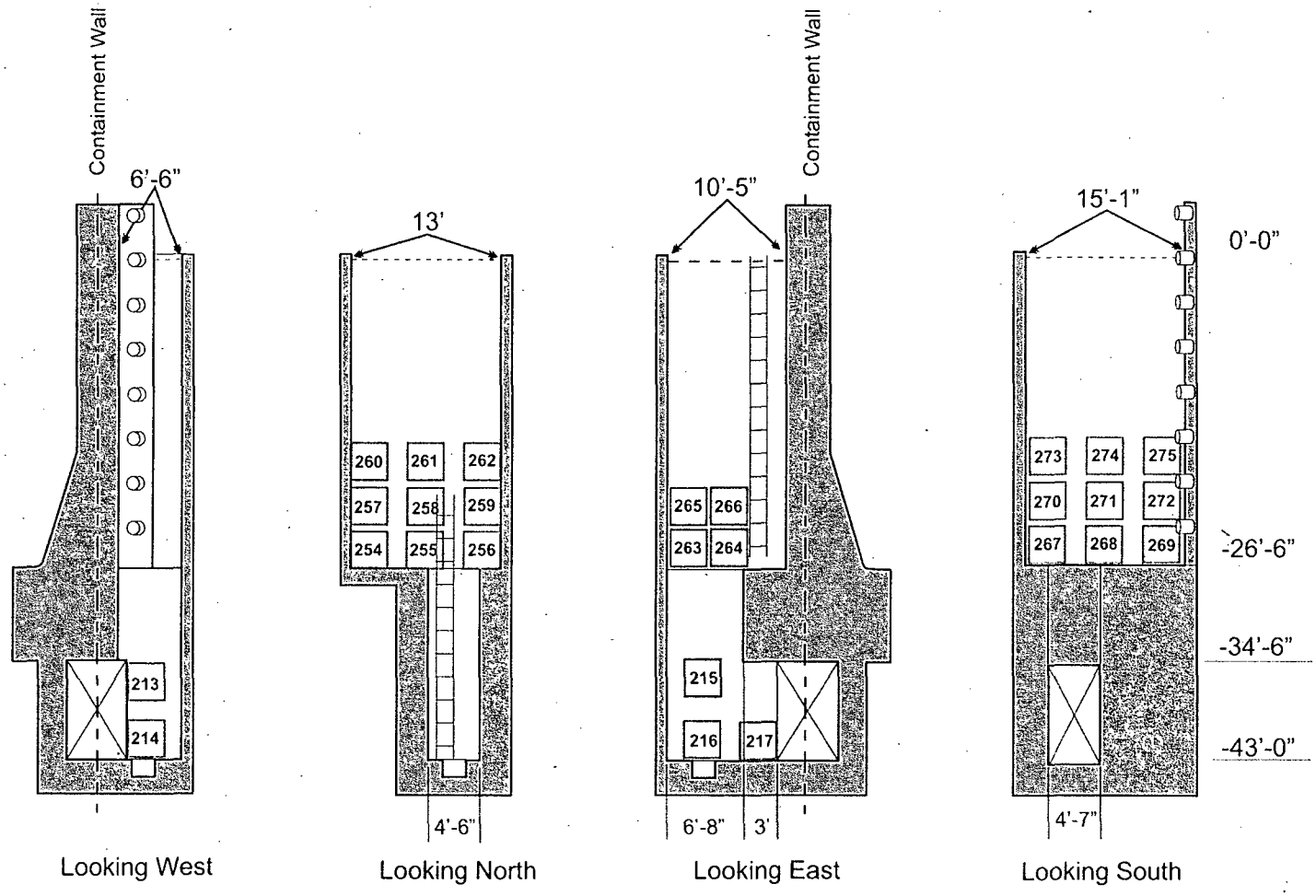

Tendon Gallery Access Shaft Floor Beta Grating Scans
-26'6"' Elev
491.0 $ft^2$
45.6$m^2$

F8111591 - M4



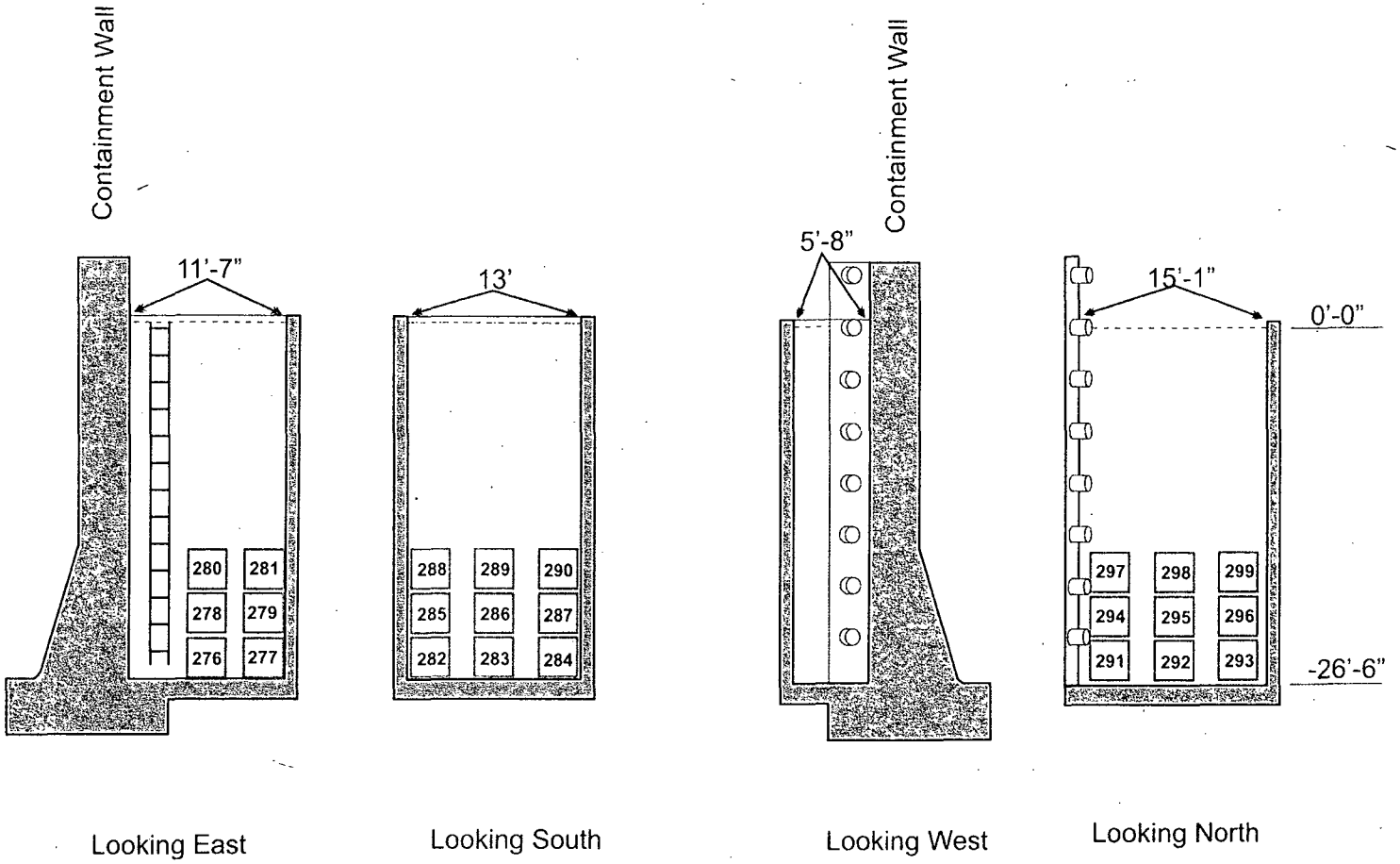

Shaft 1A Beta Scans
1226 $ft^2$
113.9 $m^2$

F8111591 - M5



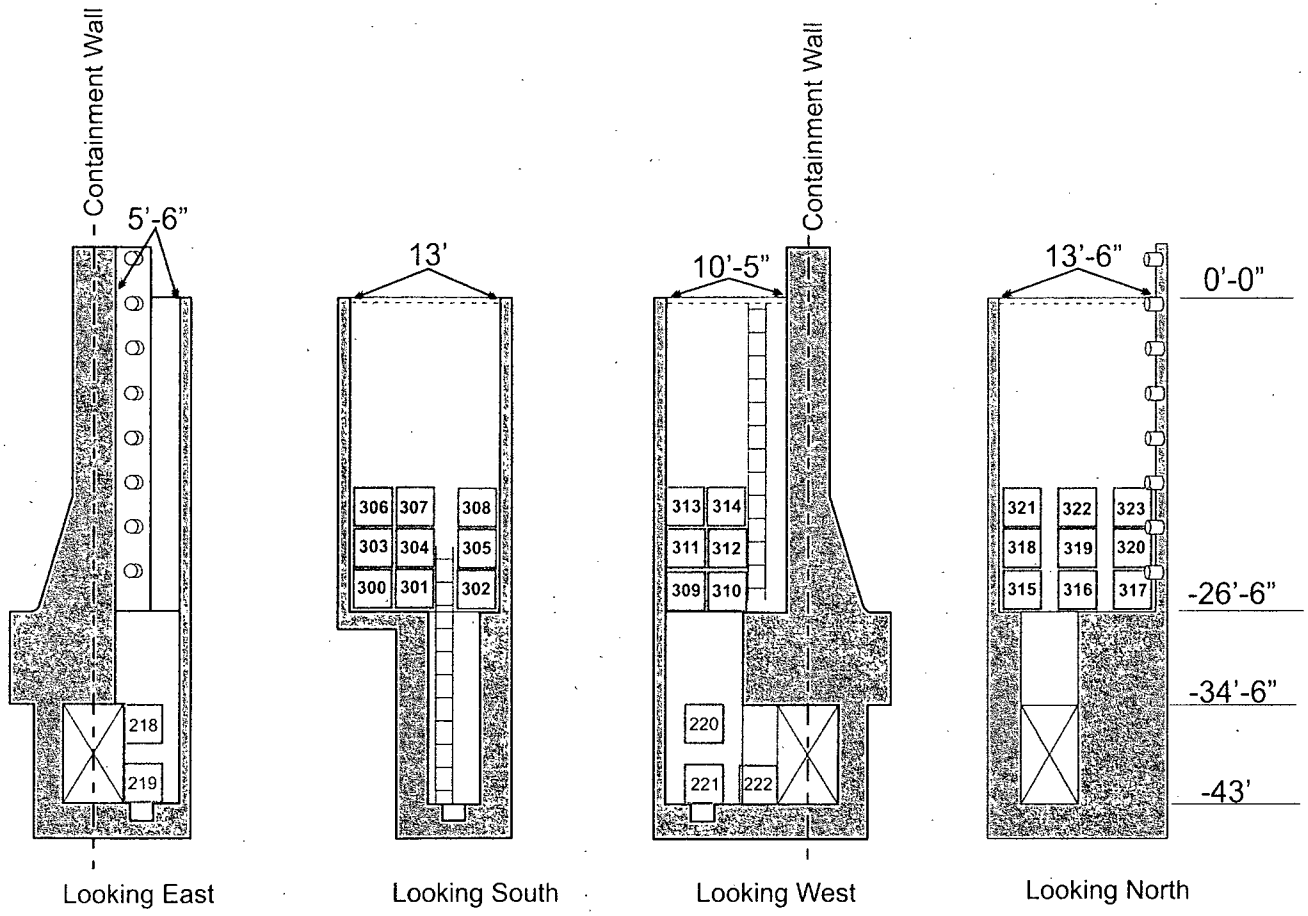

Shaft 1B Beta Scans
1513 $ft^2$
140.6 $m^2$

F8111591 - M6



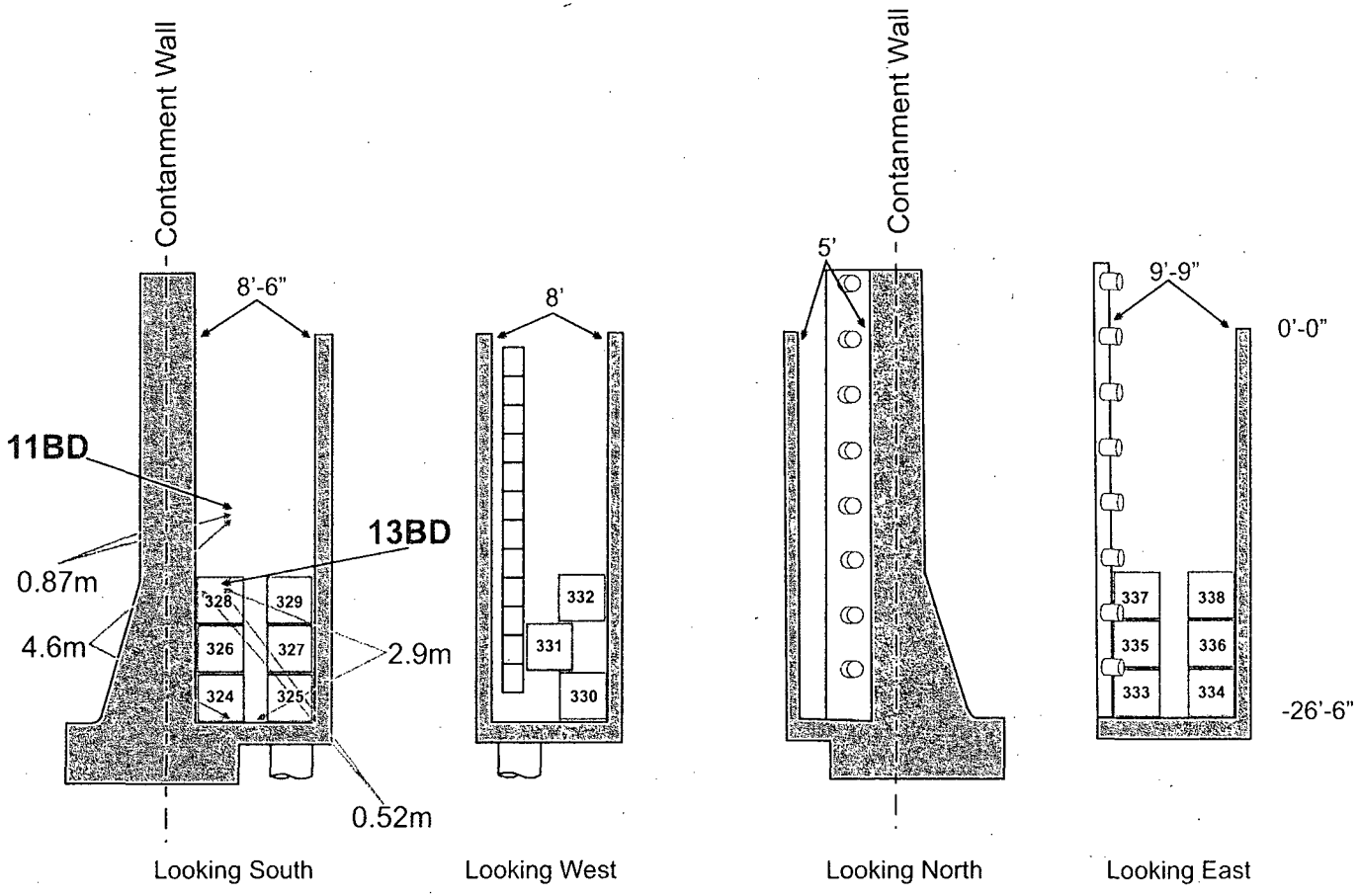

Shaft 2A Beta Scans
1214 $ft^2$
112.8 $m^2$

F8111591 - M7



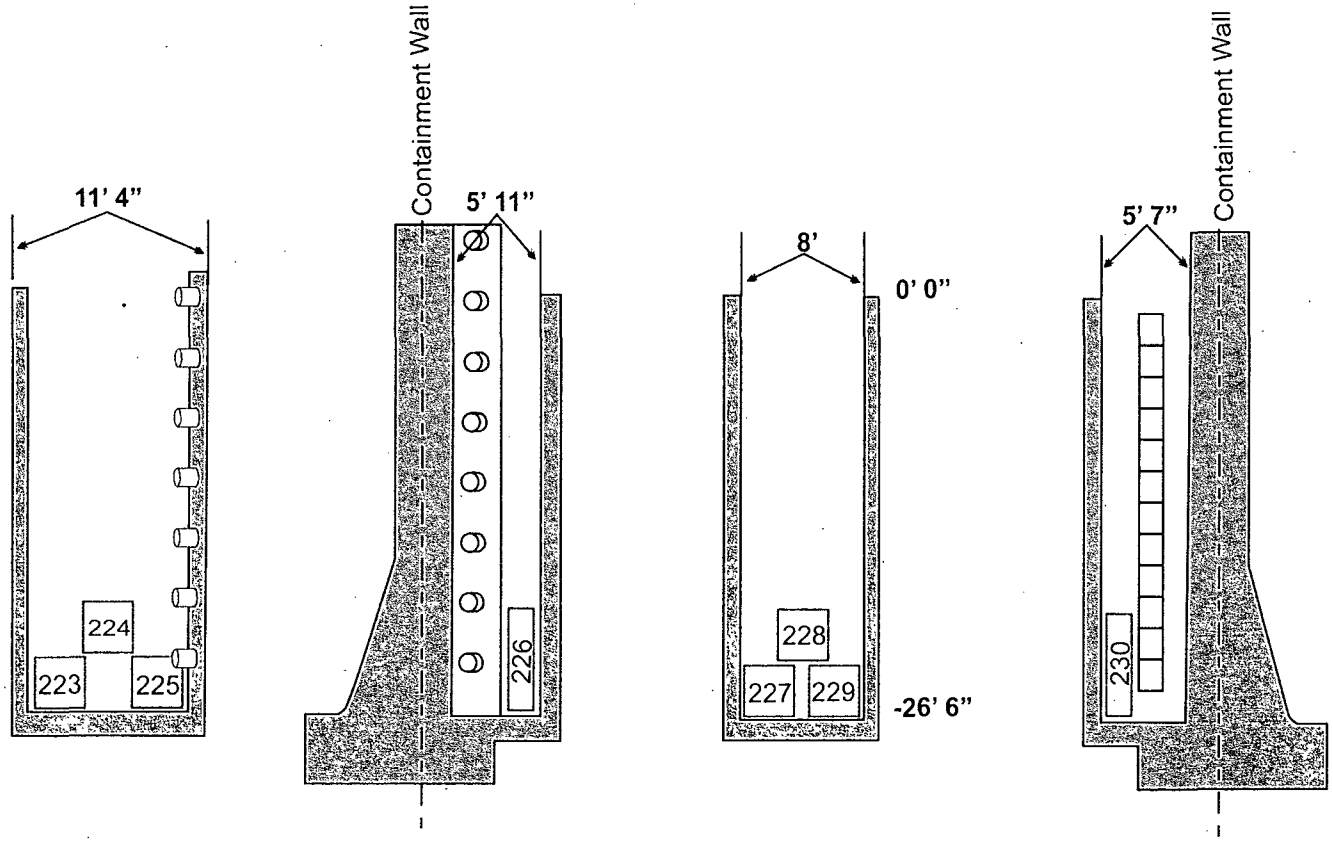

Shaft 2B ISOCS/Beta Scans
1481.0 $ft^2$
137.6$m^2$

F8111591 - M8




Shaft 3A Beta Scans/Beta Direct
843 $ft^2$
78.3$m^2$

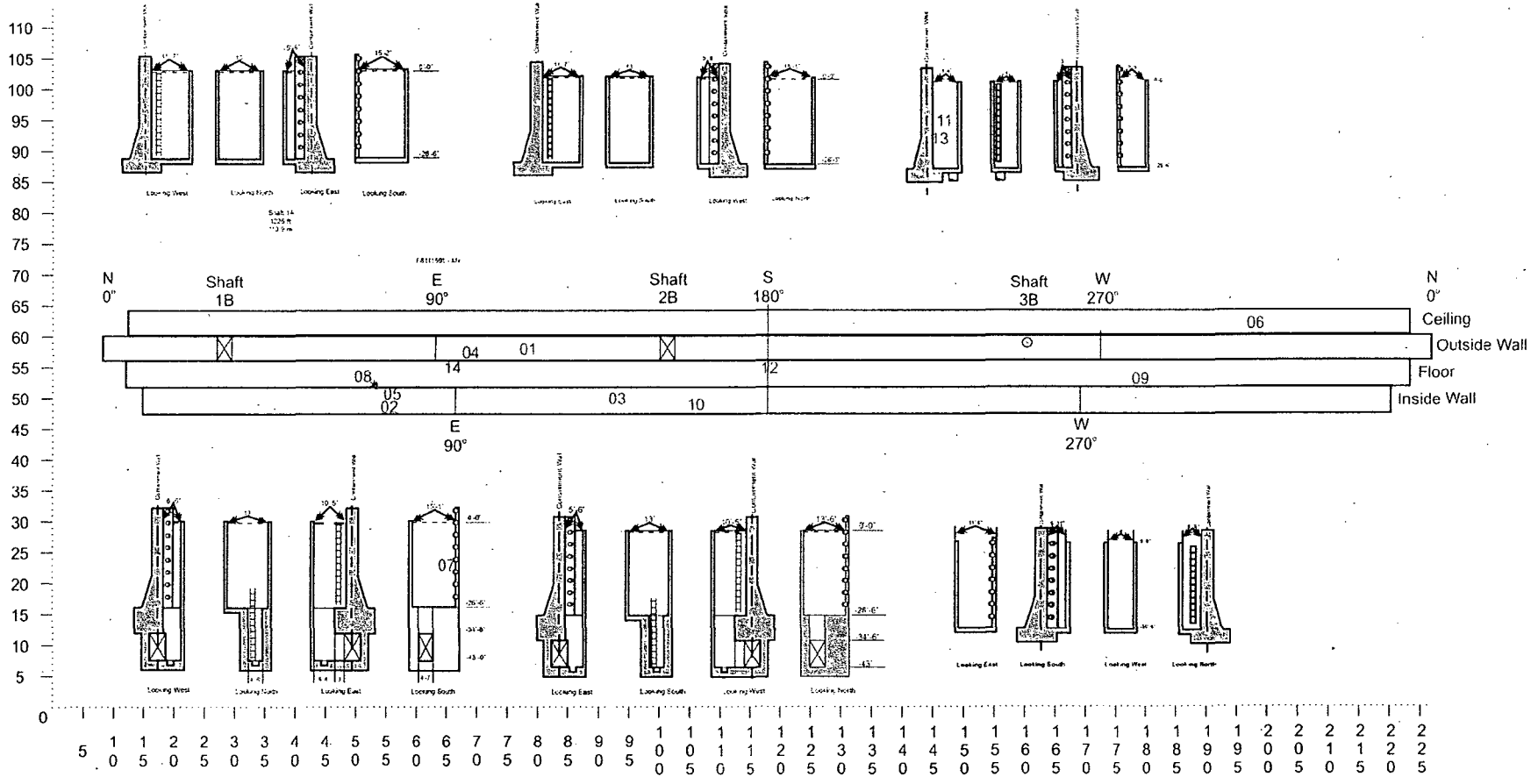
F8111591 - M9




**Shaft 3B Beta Scans**
**832.0 ft²**
**77.3m²**

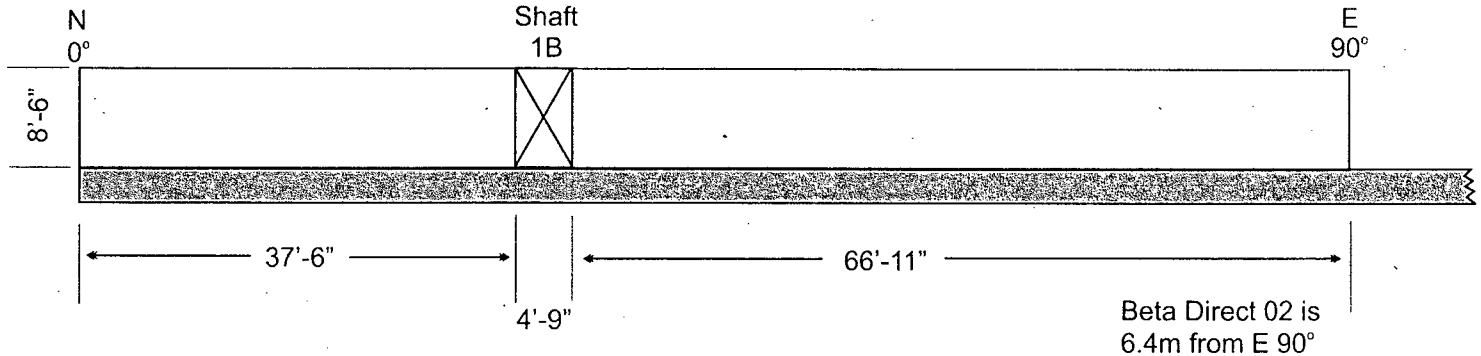
F8111591 - M10

# F8111591 Tendon Gallery Beta Direct

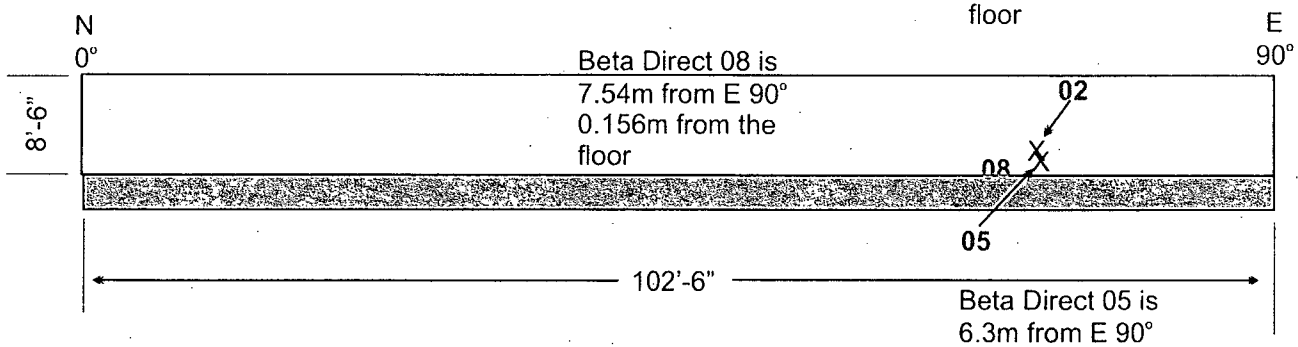



F8111591 - M11

Tendon Gallery Section 1
0° North to 90° East
Beta Direct




Beta Direct 02 is
6.4m from E 90°
0.63m from the
floor

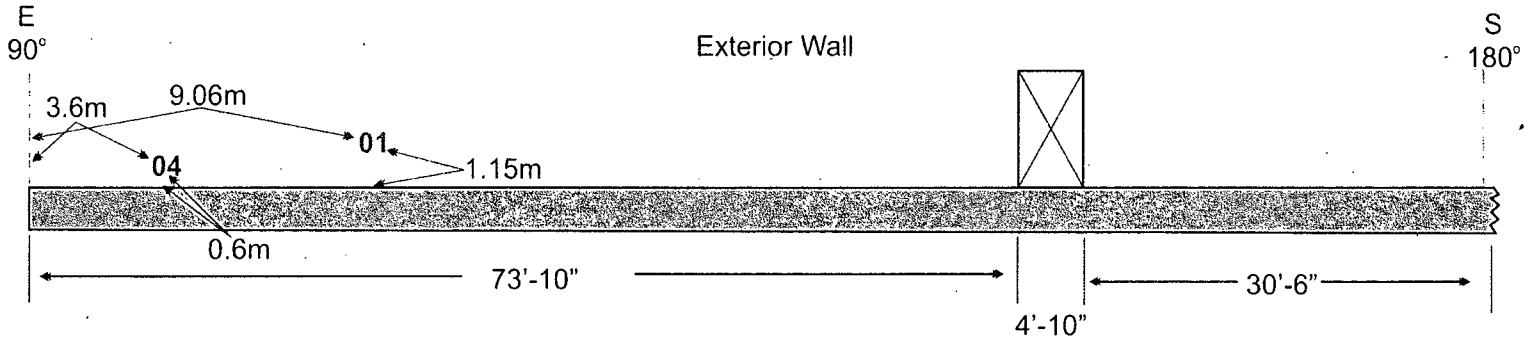


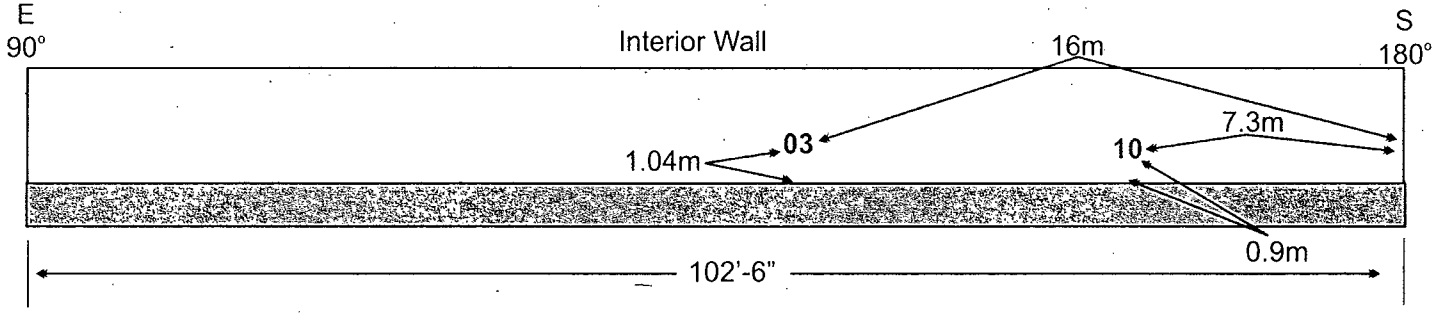

Beta Direct 08 is
7.54m from E 90°
0.156m from the
floor

Beta Direct 05 is
6.3m from E 90°
0.36m from the
floor

F8111591 - M12A

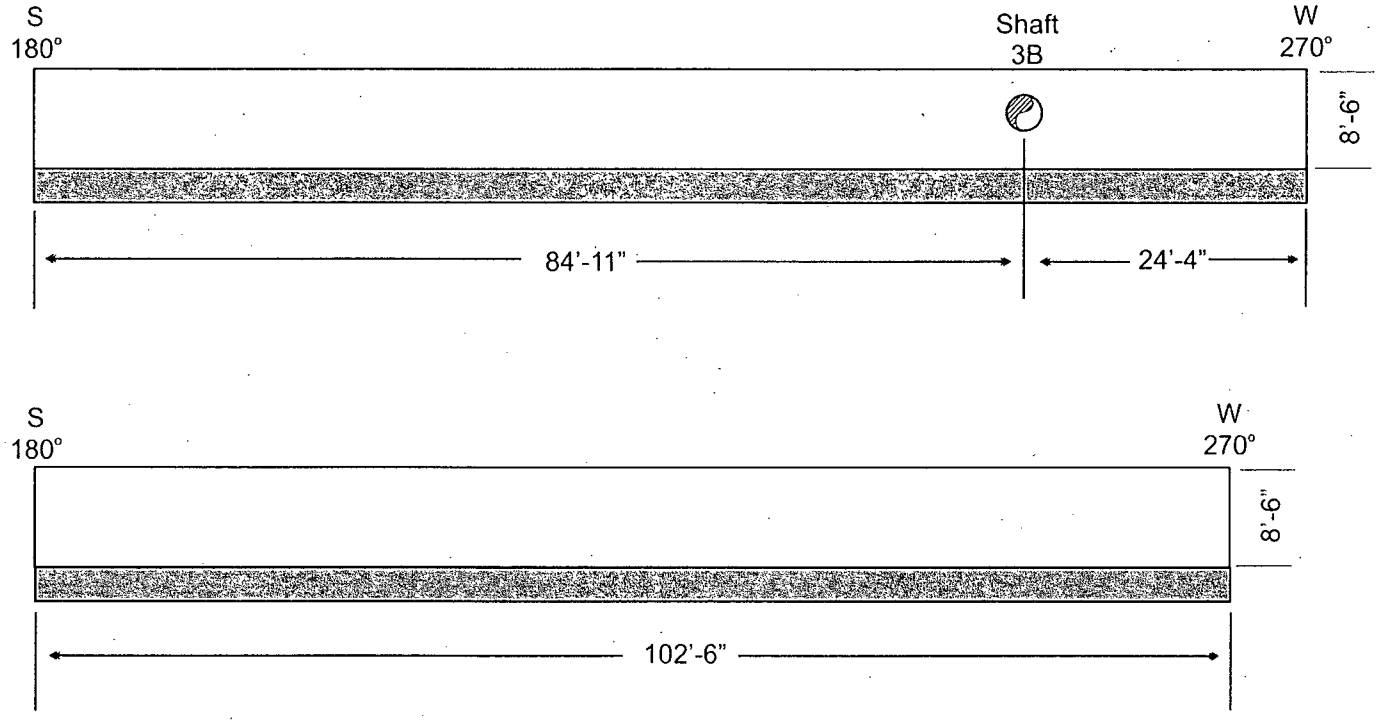
Tendon Gallery Section 2
90° East to 180° South
Beta Directs



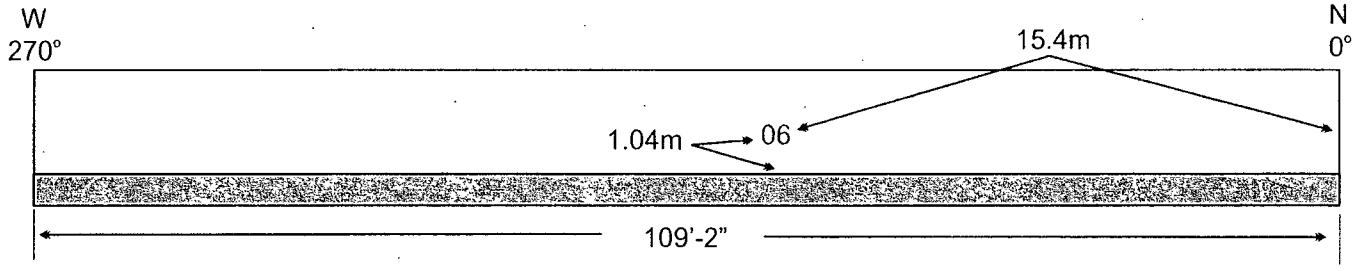

F8111591 - M12B

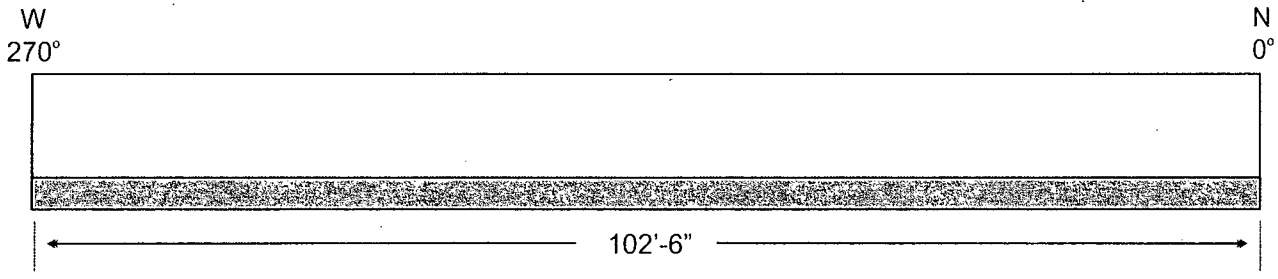
Tendon Gallery Section 3
South 180° to West 270°
Beta Directs




F8111591 - M12C

Tendon Gallery Section 4
West 270° to North 0°
Beta Directs

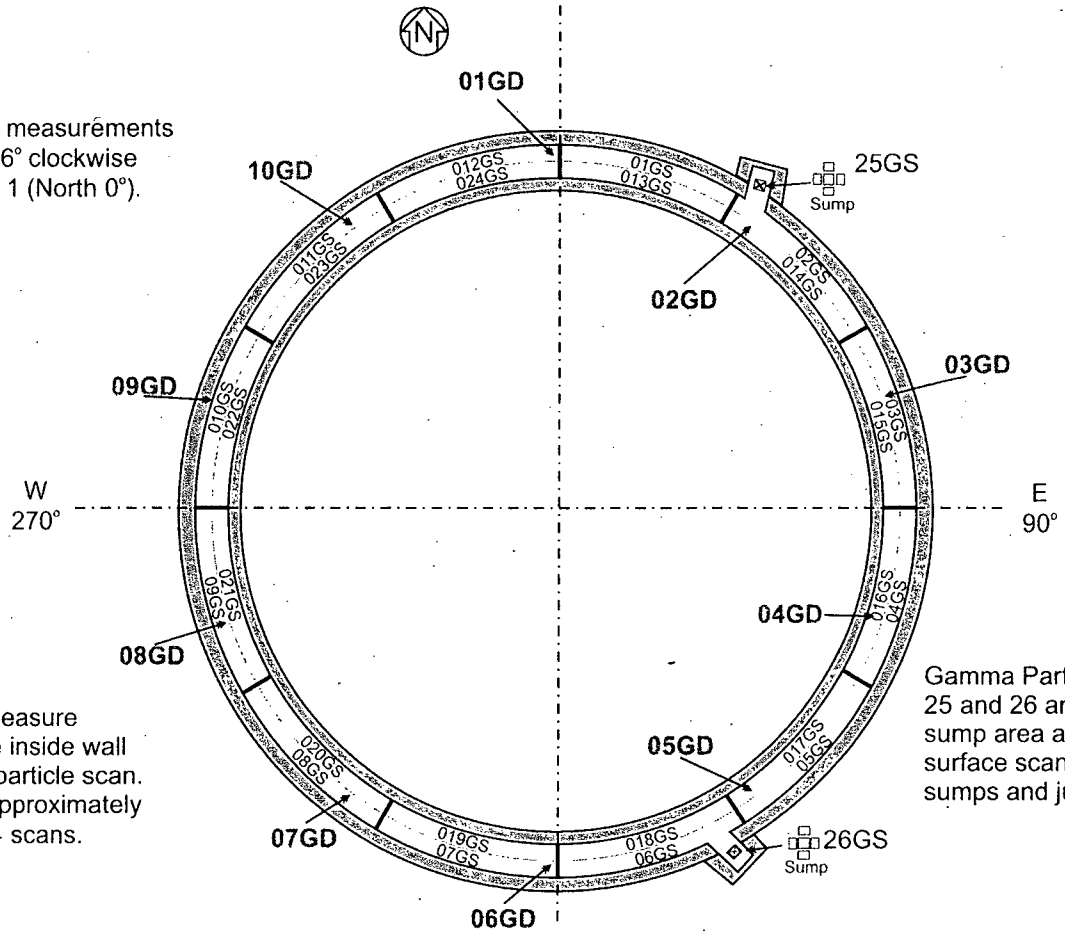



F811159 - M12D

Tendon Gallery Floor Gamma Particle Scans

Gamma background measurements are obtained every 36° clockwise starting with location 1 (North 0°).




Starting at N 0° measure 10.4m around the inside wall for each gamma particle scan. This equates to approximately 30° resulting in 24 scans.

Gamma Particle Scans 25 and 26 are performed in the sump area and will include surface scan and scan of the sumps and junctures.

Tendon Gallery Floor -48' Elev
2440.0 ft²
226.7m²

F8111591 - M13

**Attachment 2**

**Instrumentation**

**July 17, 2008**

**Survey Unit F8111591**

## Table 2-1. Survey Unit Instrumentation

| Instrument Model; Serial No. | Detector Model; Serial No. | MDC Static (dpm/100 cm²) | MDC Scan (dpm/100 cm²) |
|---|---|---|---|
| M2350; 203482 | 44-10; 211672 | N/A | 5.2pCi/g |
| M2350; 203482 | 43-68B; 178510 | 433 | 1033 |
| M2350; 149789 | 43-68B; 161415 | 433 | 1033 |
| M2350; 175834 | 43-68B; 148634 | 433 | 1033 |
| M2350; 193715 | 43-68B; 148630 | 433 | 1033 |
| Tennelec; 0401171 | N/A | 6 dpm α, 12 dpm β | N/A |

## Table 2-2. Investigation Criteria and DCGL

| Parameter | Value (dpm/100 cm²) |
|---|---|
| Investigation Criteria - Direct | 21500 |
| Investigation Criteria – Scan | 43000 |
| $DCGL_W$ | 43000 |
| $DCGL_{EMC}$ | N/A |

**Attachment 3**

**Investigation**

**July 17, 2008**

**Survey Unit F8111591**

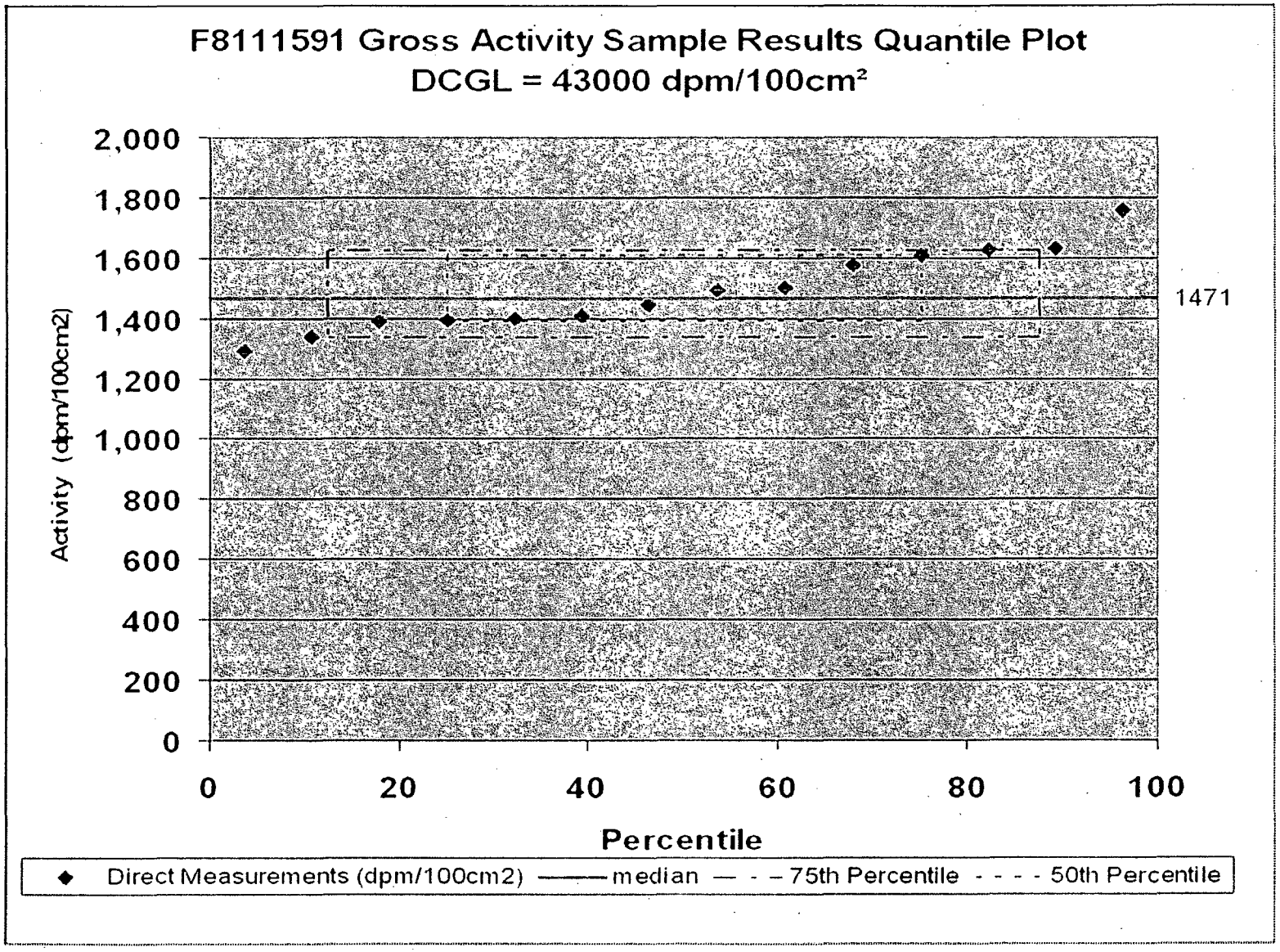
**(none required)**

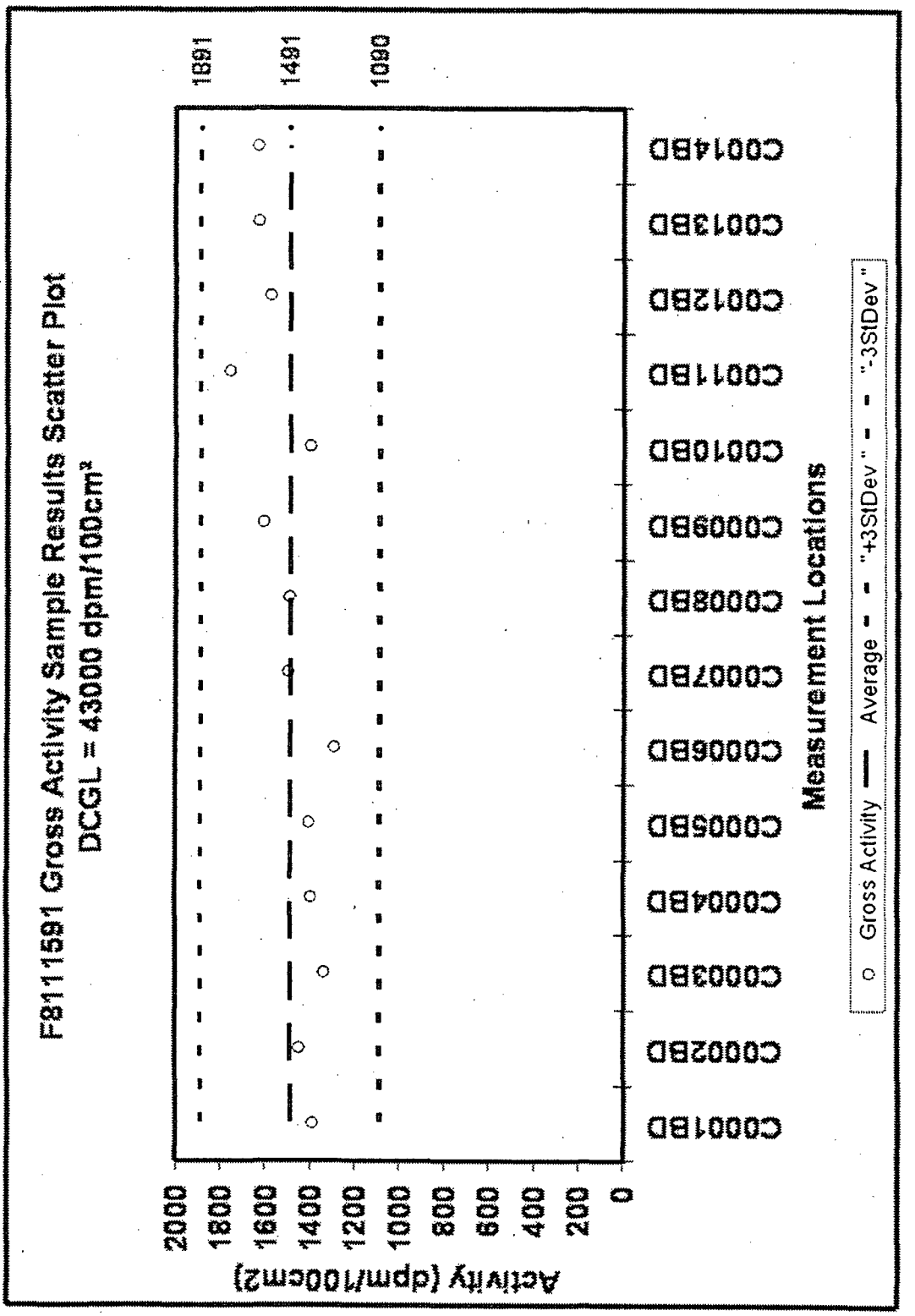
Attachment 4

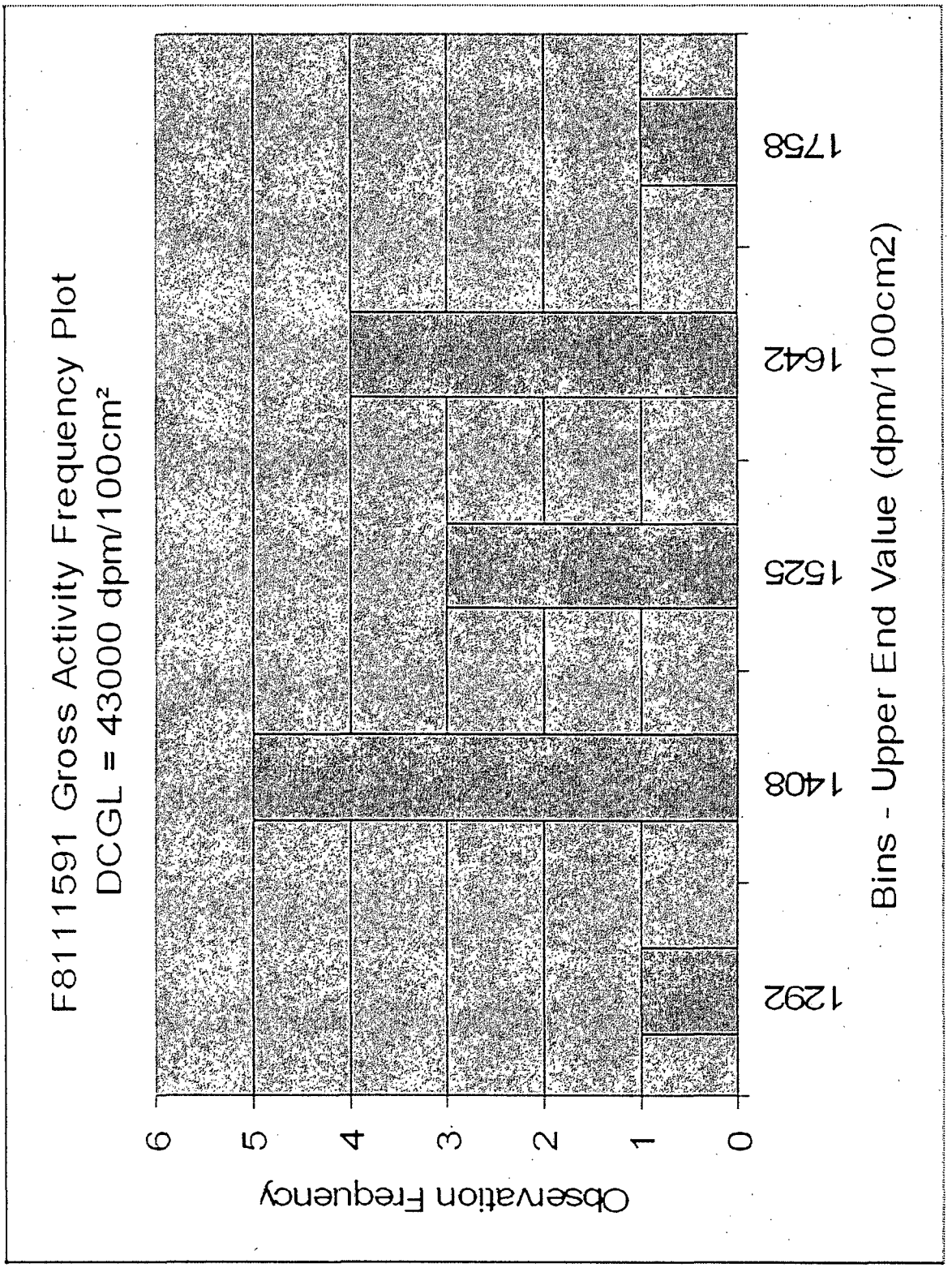
Data Assessment

July 17, 2008

Survey Unit F8111591


F8111591 Gross Activity Sample Results Quantile Plot
DCGL = 43000 dpm/100cm²
Activity (dpm/100cm2)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1471
0
20
40
60
80
100
Percentile
Direct Measurements (dpm/100cm2)
median
75th Percentile
50th Percentile


F8111591 Gross Activity Sample Results Scatter Plot
DCGL = 43000 dpm/100cm²
Activity (dpm/100cm2)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1891
1491
1090
C00014BD
C00013BD
C00012BD
C00011BD
C00010BD
C00009BD
C00008BD
C00007BD
C00006BD
C00005BD
C00004BD
C00003BD
C00002BD
C00001BD
Measurement Locations
Gross Activity
Average
"+3StDev"
"-3StDev"


F8111591 Gross Activity Frequency Plot
DCGL = 43000 dpm/100cm²
Observation Frequency
0
1
2
3
4
5
6
1292
1408
1525
1642
1758
Bins - Upper End Value (dpm/100cm2)