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MPC&D 06-017

January 25, 2006

U.S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, DC 20555

Docket No. 50-312
Rancho Seco Nuclear Generating Station
License No. DPR-54
**EMBEDDED PIPING SCENARIO AND DCGL DETERMINATION BASIS**

Attention: John Hickman

Attached is a copy of Decommissioning Technical Basis Document DTBD-05-009 "Embedded Piping Scenario and DCGL Determination Basis." This DTBD establishes the embedded piping scenario and the derived concentration guideline levels (DCGLs) that are appropriate for evaluating the internal surfaces of the embedded piping at Rancho Seco.

As they become available, we will submit additional DTBDs in anticipation that the review of these documents will facilitate NRC review and approval of the LTP to be submitted later this year. Members of your staff with questions requiring additional information or clarification may contact Bob Jones at (916) 732-4843.

Sincerely,

Steve Redeker
Manager, Plant Closure and Decommissioning

Attachment

Cc w/ attachment: B.S. Mallett, NRC, Region IV

NMSS01

| Rancho Seco Nuclear Generating Station<br>Decommissioning Technical Basis Document | DTBD–05-009<br>Revision No. 0<br>DPT 05-062<br>RIC 2A.900 |
|---|---|

**Embedded Piping Scenario and DCGL Determination Basis**

PREPARED BY: George Pillsbury — Author — 9/26/05 — Date

REVIEWED BY: John Newsey — Technical Reviewer — 11/15/05 — Date

REVIEWED BY: Michael L. Braun — QA Reviewer — 11/30/05 — Date

APPROVED BY: M W Snyder — Principal Radiological Engineer — 12/10/05 — Date

## 1.0 PURPOSE

The purpose of this Decommissioning Technical Basis Document (DTBD) is to establish the embedded piping scenario and the derived concentration guideline levels (DCGLs) that are appropriate for evaluating the internal surfaces of embedded piping associated with the Rancho Seco Nuclear Generating station (RSNGS).

## 2.0 DISCUSSION

The methodology established in this DTBD is to be used as the basis for determining the disposition of embedded piping systems associated with RSNGS. Because embedded piping is located within concrete structures, the dose contribution is primarily whole body gamma dose to industrial workers within a room or area containing embedded piping. This dose contribution is additive to the whole body dose from contamination on the interior surfaces of the room in which the pipe is embedded.

Although not part of the building occupancy scenario, consideration was also given to the possibility of a future worker removing the pipe from within a wall or floor and being exposed to its residual contamination to ensure the grouting action level was appropriate.

## 3.0 DEFINITIONS

None

## 4.0 TECHNICAL POSITION

Only the gamma dose reaching the worker through the wall or floor must be considered in determining the DCGL. Pipe removal is considered to be a low-probability event which is further mitigated by grouting at a very conservative level of internal contamination.

## 5.0 LIMITATIONS

This DTBD applies only to piping embedded within concrete walls or floors.

## 6.0 TECHNICAL BASES

### 6.1 Scope of Embedded Pipe

Approximately 5360 linear feet of embedded pipe have been identified at RSNGS. The embedded pipe ranges from 0.75 inch I.D. to 18 inch I.D. and is associated with the Turbine Building, Auxiliary Building, Reactor Building, and Fuel Building drains (Attachment 8.1). Embedded pipe is located at depths between 9 to 30 inches beneath the concrete surface, depending on the building.

The basic dose scenario for embedded pipe is one in which the industrial worker receives gamma dose from the residual activity located within the concrete-encased piping in addition to the dose received from the contaminated surfaces of the room.

## 6.2 Embedded Pipe Radionuclides and DCGLs

Embedded pipe is partially shielded and constrained by the encasing concrete which limits the dose to the industrial worker to that arising from the gamma emitters in the nuclide mixture. The impact of nuclides which are not gamma emitters is minimal because the pipe is not easily extracted nor is the interior surface readily accessible through the overlying concrete. A conservative DCGL of 100,000 dpm/100 $cm^2$ has been evaluated and found acceptable for embedded pipe. Microshield runs were used to model the gamma exposure from 100,000 dpm/100 $cm^2$ (4.5E-4 uCi/$cm^2$) in the maximum size pipe in a given building one meter from the surface of the concrete covering the embedded pipe (Attachment 8.2). The amount of the concrete shielding included in the model was based on the thinnest concrete covering above the largest diameter embedded pipe for the given building as determined from site drawings. Results are shown in Table 1 below. The annual dose rates are all less than 1 percent of the 25 mrem/y annual limit.

Table 1. Embedded Pipe Annual Dose Rate By Building

| Building | Turbine Bld | Fuel Bld | Auxiliary Bld | Reactor Bld |
|---|---|---|---|---|
| Max Pipe Size | 8" | 8" | 6" | 18" |
| Concrete Depth | 18" | 30" | 9" | 12" |
| Annual Dose Rate | 0.01 mrem/y | 0.0002 mrem/y | 0.19 mrem/y | 0.12 mrem/y |

A total of 53 samples were collected and analyzed by gamma spectroscopy from various drains, sumps, and trenches in the buildings previously mentioned. The 20 samples found in Attachments 8.3 and 8.6 reflect the different piping systems covered by the 53 samples. In many instances, several samples were collected from one system. As can be seen from the nuclide analyses, the primary contributors to whole body dose are Cs-137 and Co-60 (Attachment 8.3). The Fuel Building pipe sample results indicate the presence of a small portion of non-gamma emitters in the nuclide fraction. (The mean nuclide fractions for Cs-137 and Co-60, as determined by the 20 samples, were 0.802 and 0.161 respectively. The individual building mean fractions were within 2 standard deviations of the overall mean values indicating a consistent nuclide ratio. This compares well with the concrete nuclide fractions of 0.86 and 0.14 for Cs-137 and Co-60 respectively.)

Furthermore, a decision was made to grout embedded pipe when the residual activity exceeded the NRC Screening Levels. Five of the pipe samples were submitted for hard to detect analysis. The sample analyses and subsequent evaluation resulted in DCGL values for grouting based on an adjustment to the NRC Screening Levels for hard to detect nuclides. The mean resulting grout DCGL was 21,040 dpm/100 $cm^2$ based on the gamma-emitting nuclide fractions (Attachment 8.4). This value will be used as an action level for grouting embedded piping.

## 6.3 Embedded Piping Scenario

The embedded piping scenario assumes that the piping remains in place following decommissioning and that the dose to the industrial worker is from direct gamma exposure from the residual activity in the pipe with allowance made for photon attenuation by the wall or floor thickness of concrete remaining over the pipe. Whole body dose from the embedded pipe will be considered additive along with the dose to the industrial worker resulting from residual activity on the walls or floors of the room or area in which the embedded pipe is present. The structure surface DCGL will be reduced by the dose contribution from the embedded piping in order to ensure compliance with the annual dose limit.

The whole body dose rate for pipe contamination at the 100,000 dpm/100 $cm^2$ DCGL has been calculated as described above using Microshield. Dose rates at a distance of 1 m from the wall or floor surface have been determined assuming the minimum thickness of concrete remaining over the largest diameter pipe. Based on 2000 hours per year of exposure, the dose to the industrial worker would be 0.06 mrem/y to 2.02 mrem/y depending on the building if all of the activity is assumed to be Co-60. If the actual nuclide fractions are employed, the annual dose rate ranges from 0.01 mrem/y to 0.19 mrem/y as shown in Table 1. If the assumed indoor exposure time for the industrial worker is considered, the annual dose rates would be further reduced by a factor of two.

The potential for the removal of the embedded pipe and consequent dose to an industrial worker at some time in the future was examined even though this was not part of the building occupancy scenario. The published source of dose factors that came the closest to a pipe cutting and removal scenario was NUREG-1640. Assuming a DCGL of 100,000 dpm/100 $cm^2$ for embedded pipe, results in an annual dose rate of 3.96 mrem/y for Cs-137 and 2.7 mrem/y for Co-60 if the mean dose factors (NUREG-1640, Table 3.24) and scenario for converting pipe into scrap material as outlined in NUREG-1640 are employed. The dose contribution from Cs-137 was principally from the release of contamination and subsequent inhalation by the worker while the dose from Co-60 was mostly the whole body dose from handling the contaminated pipe. In order to preclude the additional dose contribution from embedded pipe, RSNGS plans to grout piping which has residual contamination above the adjusted NRC screening levels (Table 5.19 of NUREG-5512 V3). A conservatively applied, adjusted screening value for embedded pipe is 21,040 dpm/100 $cm^2$ (Attachment 8.4). Using 20,000 dpm/100 $cm^2$ and the NUREG-1640, Table 3.24 values would result in a mean annual dose rate of 1.34 mrem/y (20,000 dpm/220 dpm/pCi/$cm^2$ x 3.8E-2 mrem/y/pCi/$cm^2$ Co+ 20,000 dpm/220 dpm/pCi/$cm^2$ x 1.1E-2 mrem/y/pCi/ $cm^2$ Cs adjusted for a 80:16 Cs to Co

ratio), if the ungrouted piping was removed immediately following decommissioning without any further controls established. Alternatively, if the 20,000 dpm/100 $cm^2$ residual contamination is converted into a specific activity value assuming a contamination layer thickness of 0.1 cm and a density for steel pipe of 7.86 $g/cm^3$, annual dose rates for inhalation and ingestion can be determined using the Building Renovation scenario factors found in NUREG-5512.

Pipe activity = 20,000 dpm/100 $cm^2$ x $cm^3$/7.86 g x pCi/2.22 dpm x $cm^2$/0.1 $cm^3$

= 114.6 pCi/g

Inhalation dose rate = 114.6 pCi/g x 9.5E-6 mrem/y per pCi/g Co-60

= 1.09E-3 mrem/y Co-60 (Cs-137 at 6.7E-5 mrem/y = 7.7E-5 mrem/y)

for a 80:16 Cs to Co ratio, the total dose rate would be 2.36E-4 mrem/y.

Ingestion dose rate = 114.6 pCi/g x 5.0E-5 mrem/y per pCi/g Co-60

= 0.006 mrem/y Co-60 (Cs-137 at 1.2E-4 mrem/y = 0.014 mrem/y)

for a 80:16 Cs to Co ratio, the total dose rate would be 0.012 mrem/y.

The combined internal annual dose rate for pipe removal would be 0.012 mrem/y.

These two methods of dose analysis place bounds on pipe removal activities of 0.012 mrem/y to 1.34 mrem/y or 0.05% and 5.4% of the annual dose limit.

Given the plans for the site following decommissioning, such an exposure scenario (removal of un-grouted embedded pipe) has a very low probability of occurrence along with a very low potential annual dose rate.

## 6.4 Embedded Pipe Area Factors

Area Factors will vary with the internal diameter (I.D.) of the pipe being surveyed. In order to calculate specific area factors, determine the limiting length of pipe in the room or area being surveyed. Calculate the interior surface area for the given pipe I.D. Enter the specific physical dimensions into Microshield using the Cylinder Surface, External Dose Point Geometry. Perform subsequent calculations while reducing the pipe length for each run until the dose rates bound the hot spot area of interest. Divide the dose rate for the initial pipe size by the dose rate for the reduced lengths of pipe. The resulting ratios are the area factors for the given pipe size.

## 7.0 REFERENCES

7.1 NUREG-1640, Radiological Assessments for Clearance of Equipment and Materials from Nuclear Facilities.

7.2 NUREG/CR-5512 V1, Residual Radioactive Contamination From Decommissioning.

7.3 NUREG/CR-5512 V3, Residual Radioactive Contamination From Decommissioning.

## 8.0 ATTACHMENTS

8.1 Embedded Pipe Inventory

8.2 Microshield Results For Embedded Piping

8.3 Nuclide Fraction For Embedded Pipe

8.4 Adjusted Screening Value DCGLs For Embedded Pipe

## 9.0 RESPONSIBLE INDIVIDUAL

George D. Pillsbury

**Attachment 8.1**
**Page 1**

## Embedded Piping Inventory (linear feet)

| Size (inches) | Turbine Bld | Auxiliary Bld | Reactor Bld | Fuel Bld | Total |
|---|---|---|---|---|---|
| 0.75 | - | - | - | 20 | 20 |
| 1 | - | 45 | - | 266 | 311 |
| 2 | 405 | 1264 | 352 | 267 | 2288 |
| 2.5 | - | - | - | 182 | 182 |
| 3 | 59 | 50 | - | 39 | 148 |
| 4 | 1164 | 513 | 53 | - | 1730 |
| 6 | 202 | 178 | 44 | - | 424 |
| 8 | 72 | - | - | 53 | 125 |
| 16 | - | - | - | 5 | 5 |
| 18 | - | - | 121 | - | 121 |
| Total | 1902 | 2050 | 570 | 832 | 5354 |

### Turbine Building

| Size (inches) | Below Grade | Grade | +40 | Total |
|---|---|---|---|---|
| 2 | 59 | 346 | - | 405 |
| 3 | - | 59 | - | 59 |
| 4 | 536 | 560 | 68 | 1164 |
| 6 | 32 | 170 | - | 202 |
| 8 | 27 | 45 | - | 72 |

### Auxiliary Building

| Size (inches) | -47 | -20 | Grade | Total |
|---|---|---|---|---|
| 1 | - | 45 | - | 45 |
| 2 | 86 | 1044 | 134 | 1264 |
| 3 | - | 50 | - | 50 |
| 4 | 44 | 464 | 5 | 513 |
| 6 | 71 | 107 | - | 178 |

**Attachment 8.1**
**Page 2 (Continued)**

**Reactor Building**

| Size (inches) | -26 | +40 | Total |
|---|---|---|---|
| 2 | 180 | 172 | 352* |
| 4 | 53 | - | 53 |
| 6 | 44 | - | 44 |
| 18 | 121 | - | 121 |

* Removal of Reactor Building interior concrete will eliminate 2" pipe.

**Fuel Building**

| Size (inches) | Grade | Vertical | +40 | Total |
|---|---|---|---|---|
| 0.75 | - | - | 20 | 20 |
| 1 | 224 | 42 | - | 266 |
| 2 | - | - | 267 | 267 |
| 2.5 | - | 31 | 151 | 182 |
| 3 | - | 29 | 10 | 39 |
| 8 | - | 53 | - | 53 |
| 16 | - | 5** | - | 5 |

**This is a 5 foot throughwall pipe penetration.

## Attachment 8.2

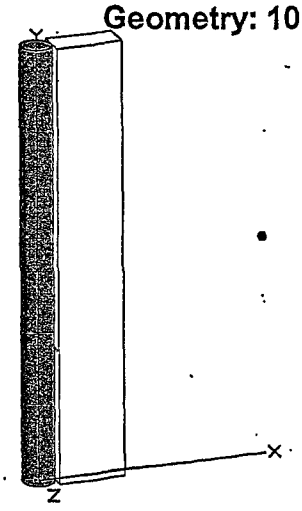
## Microshield Results For Embedded Pipe

**MicroShield v5.05 (5.05-00488)**
**Sacramento Municipal Utility District**

Page : 1
DOS File : EMBD_D2.MS5
Run Date: November 7, 2005
Run Time: 2:50:07 PM
Duration : 00:00:00

File Ref: _____
Date: _____
By: _____
Checked: _____

**Case Title: 8" Embedded Pipe**
**Description: Turbine Bld 18" Concrete**
**Geometry: 10 - Cylinder Surface - External Dose Point**




**Source Dimensions**

| | | |
|---|---|---|
| Height | 305.0 cm | 10 ft 0.1 in |
| Radius | 10.0 cm | 3.9 in |

**Dose Points**

| | X | Y | Z |
|---|---|---|---|
| # 1 | 156.52 cm | 152.5 cm | 0 cm |
| | 5 ft 1.6 in | 5 ft 0.0 in | 0.0 in |

**Shields**

| Shield Name | Dimension | Material | Density |
|---|---|---|---|
| Cyl. Core | 10.0 cm² | Air | 0.00122 |
| Transition | | Air | 0.00122 |
| Shield 2 | 45.72 cm | Concrete | 2.4 |
| Air Gap | | Air | 0.00122 |
| Wall Clad | .8 cm | Iron | 7.86 |

**Source Input**
**Grouping Method : Actual Photon Energies**

| Nuclide | curies | becquerels | µCi/cm² | Bq/cm² |
|---|---|---|---|---|
| Ba-137m | 6.9181e-006 | 2.5597e+005 | 3.6100e-004 | 1.3357e+001 |
| Co-60 | 1.3875e-006 | 5.1336e+004 | 7.2400e-005 | 2.6788e+000 |
| Cs-137 | 6.9181e-006 | 2.5597e+005 | 3.6100e-004 | 1.3357e+001 |

**Buildup**
**The material reference is : Shield 2**

**Integration Parameters**

| | |
|---|---|
| Y Direction (axial) | 20 |
| Circumferential | 20 |

**Results**

| Energy MeV | Activity photons/sec | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.0318 | 5.299e+03 | 5.575e-71 | 8.312e-30 | 4.644e-73 | 6.924e-32 |
| 0.0322 | 9.777e+03 | 1.050e-68 | 1.594e-29 | 8.451e-71 | 1.283e-31 |
| 0.0364 | 3.558e+03 | 6.983e-52 | 8.881e-30 | 3.968e-54 | 5.046e-32 |

Page : 2
DOS File : EMBD_D2.MS5
Run Date: November 7, 2005
Run Time: 2:50:07 PM
Duration : 00:00:00

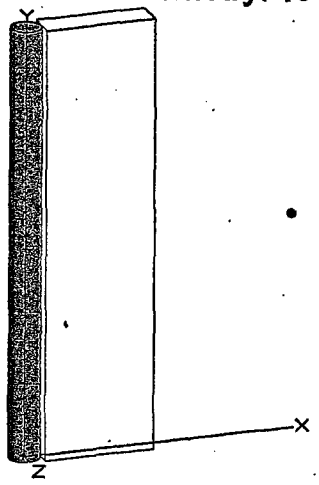
| Energy MeV | Activity photons/sec | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.6616 | 2.303e+05 | 1.895e-05 | 5.237e-04 | 3.675e-08 | 1.015e-06 |
| 0.6938 | 8.374e+00 | 8.858e-10 | 2.283e-08 | 1.710e-12 | 4.408e-11 |
| 1.1732 | 5.134e+04 | 7.541e-05 | 9.165e-04 | 1.348e-07 | 1.638e-06 |
| 1.3325 | 5.134e+04 | 1.362e-04 | 1.402e-03 | 2.363e-07 | 2.433e-06 |
| TOTALS: | 3.516e+05 | 2.305e-04 | 2.842e-03 | 4.078e-07 | 5.086e-06 |

**MicroShield v5.05 (5.05-00488)**
**Sacramento Municipal Uitility District**

Page : 1
DOS File : EMBD_D2.MS5
Run Date: November 7, 2005
Run Time: 2:52:25 PM
Duration : 00:00:01

File Ref: _____
Date: _____
By: _____
Checked: _____

**Case Title: 8" Embedded Pipe**
**Description: Fuel Bld 30" Concrete**
**Geometry: 10 - Cylinder Surface - External Dose Point**




**Source Dimensions**

| | | |
|---|---|---|
| Height | 305.0 cm | 10 ft 0.1 in |
| Radius | 10.0 cm | 3.9 in |

**Dose Points**

| | X | Y | Z |
|---|---|---|---|
| # 1 | 187 cm | 152.5 cm | 0 cm |
| | 6 ft 1.6 in | 5 ft 0.0 in | 0.0 in |

**Shields**

| Shield Name | Dimension | Material | Density |
|---|---|---|---|
| Cyl. Core | 10.0 cm² | Air | 0.00122 |
| Transition | | Air | 0.00122 |
| Shield 2 | 76.2 cm | Concrete | 2.4 |
| Air Gap | | Air | 0.00122 |
| Wall Clad | .8 cm | Iron | 7.86 |

**Source Input**
**Grouping Method : Actual Photon Energies**

| Nuclide | curies | becquerels | µCi/cm² | Bq/cm² |
|---|---|---|---|---|
| Ba-137m | 6.9181e-006 | 2.5597e+005 | 3.6100e-004 | 1.3357e+001 |
| Co-60 | 1.3875e-006 | 5.1336e+004 | 7.2400e-005 | 2.6788e+000 |
| Cs-137 | 6.9181e-006 | 2.5597e+005 | 3.6100e-004 | 1.3357e+001 |

**Buildup**
**The material reference is : Shield 2**

**Integration Parameters**

| | |
|---|---|
| Y Direction (axial) | 20 |
| Circumferential | 20 |

**Results**

| Energy MeV | Activity photons/sec | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.0318 | 5.299e+03 | 2.567e-102 | 6.159e-30 | 2.138e-104 | 5.130e-32 |
| 0.0322 | 9.777e+03 | 4.011e-99 | 1.181e-29 | 3.228e-101 | 9.503e-32 |
| 0.0364 | 3.558e+03 | 1.937e-74 | 6.581e-30 | 1.101e-76 | 3.739e-32 |

Page : 2
DOS File : EMBD_D2.MS5
Run Date: November 7, 2005
Run Time: 2:52:25 PM
Duration : 00:00:01

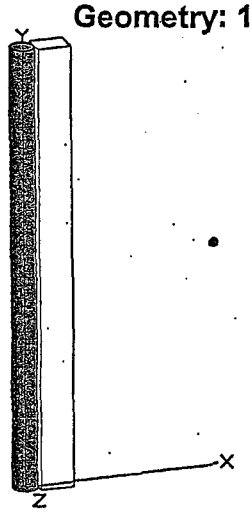
| Energy MeV | Activity photons/sec | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.6616 | 2.303e+05 | 4.468e-08 | 2.663e-06 | 8.662e-11 | 5.162e-09 |
| 0.6938 | 8.374e+00 | 2.355e-12 | 1.290e-10 | 4.546e-15 | 2.491e-13 |
| 1.1732 | 5.134e+04 | 6.918e-07 | 1.543e-05 | 1.236e-09 | 2.758e-08 |
| 1.3325 | 5.134e+04 | 1.640e-06 | 2.991e-05 | 2.845e-09 | 5.188e-08 |
| TOTALS: | 3.516e+05 | 2.376e-06 | 4.800e-05 | 4.168e-09 | 8.462e-08 |

**MicroShield v5.05 (5.05-00488)**
**Sacramento Municipal Utility District**

Page : 1
DOS File : EMBD_D2.MS5
Run Date : November 7, 2005
Run Time : 2:53:47 PM
Duration : 00:00:01

File Ref: _____
Date: _____
By: _____
Checked: _____

**Case Title: 6" Embedded Pipe**
**Description: Auxiliary Bld 9" Concrete**
**Geometry: 10 - Cylinder Surface - External Dose Point**




**Source Dimensions**

| | | |
|---|---|---|
| Height | 305.0 cm | 10 ft 0.1 in |
| Radius | 7.62 cm | 3.0 in |

**Dose Points**

| | X | Y | Z |
|---|---|---|---|
| # 1 | 131.18 cm | 152.5 cm | 0 cm |
| | 4 ft 3.6 in | 5 ft 0.0 in | 0.0 in |

**Shields**

| Shield Name | Dimension | Material | Density |
|---|---|---|---|
| Cyl. Core | 7.62 cm² | Air | 0.00122 |
| Transition | | Air | 0.00122 |
| Shield 2 | 22.86 cm | Concrete | 2.4 |
| Air Gap | | Air | 0.00122 |
| Wall Clad | .7 cm | Iron | 7.86 |

**Source Input**
**Grouping Method : Actual Photon Energies**

| Nuclide | curies | becquerels | µCi/cm² | Bq/cm² |
|---|---|---|---|---|
| Ba-137m | 5.2716e-006 | 1.9505e+005 | 3.6100e-004 | 1.3357e+001 |
| Co-60 | 1.0572e-006 | 3.9118e+004 | 7.2400e-005 | 2.6788e+000 |
| Cs-137 | 5.2716e-006 | 1.9505e+005 | 3.6100e-004 | 1.3357e+001 |

**Buildup**
**The material reference is : Shield 2**

**Integration Parameters**

| | |
|---|---|
| Y Direction (axial) | 20 |
| Circumferential | 20 |

**Results**

| Energy MeV | Activity photons/sec | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.0318 | 4.038e+03 | 3.340e-45 | 8.413e-30 | 2.782e-47 | 7.008e-32 |
| 0.0322 | 7.450e+03 | 1.079e-43 | 1.613e-29 | 8.681e-46 | 1.298e-31 |
| 0.0364 | 2.711e+03 | 1.985e-33 | 8.989e-30 | 1.128e-35 | 5.107e-32 |

Page : 2
DOS File : EMBD_D2.MS5
Run Date: November 7, 2005
Run Time: 2:53:47 PM
Duration : 00:00:01

| Energy MeV | Activity photons/sec | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.6616 | 1.755e+05 | 1.718e-03 | 1.924e-02 | 3.330e-06 | 3.730e-05 |
| 0.6938 | 6.381e+00 | 7.318e-08 | 7.769e-07 | 1.413e-10 | 1.500e-09 |
| 1.1732 | 3.912e+04 | 2.394e-03 | 1.435e-02 | 4.278e-06 | 2.564e-05 |
| 1.3325 | 3.912e+04 | 3.502e-03 | 1.850e-02 | 6.076e-06 | 3.209e-05 |
| TOTALS: | 2.679e+05 | 7.613e-03 | 5.209e-02 | 1.368e-05 | 9.503e-05 |

**MicroShield v5.05 (5.05-00488)**
**Sacramento Municipal Uitility District**

Page : 1
DOS File : EMBD_D2.MS5
Run Date: November 7, 2005
Run Time: 2:55:23 PM
Duration : 00:00:01

File Ref: _____
Date: _____
By: _____
Checked: _____

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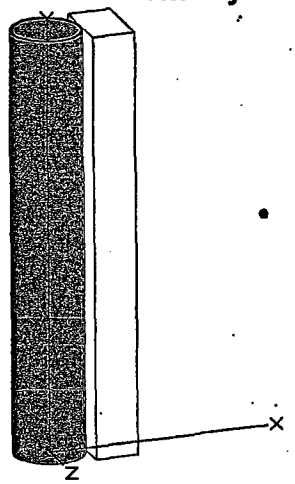
**Description: Reactor Bld 12" Concrete**
**Geometry: 10 - Cylinder Surface - External Dose Point**




**Source Dimensions**

| | | |
|---|---|---|
| Height | 305.0 cm | 10 ft 0.1 in |
| Radius | 22.86 cm | 9.0 in |

**Dose Points**

| | X | Y | Z |
|---|---|---|---|
| # 1 | 154.26 cm | 152.5 cm | 0 cm |
| | 5 ft 0.7 in | 5 ft 0.0 in | 0.0 in |

**Shields**

| Shield Name | Dimension | Material | Density |
|---|---|---|---|
| Cyl. Core | 22.86 cm² | Air | 0.00122 |
| Transition | | Air | 0.00122 |
| Shield 2 | 30.0 cm | Concrete | 2.4 |
| Air Gap | | Air | 0.00122 |
| Wall Clad | 1.4 cm | Iron | 7.86 |

**Source Input**
**Grouping Method : Actual Photon Energies**

| Nuclide | curies | becquerels | µCi/cm² | Bq/cm² |
|---|---|---|---|---|
| Ba-137m | 1.5815e-005 | 5.8515e+005 | 3.6100e-004 | 1.3357e+001 |
| Co-60 | 3.1717e-006 | 1.1735e+005 | 7.2400e-005 | 2.6788e+000 |
| Cs-137 | 1.5815e-005 | 5.8515e+005 | 3.6100e-004 | 1.3357e+001 |

**Buildup**
**The material reference is : Shield 2**

**Integration Parameters**

| | |
|---|---|
| Y Direction (axial) | 20 |
| Circumferential | 20 |

**Results**

| Energy MeV | Activity photons/sec | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.0318 | 1.211e+04 | 1.956e-68 | 1.966e-29 | 1.629e-70 | 1.638e-31 |
| 0.0322 | 2.235e+04 | 3.555e-66 | 3.770e-29 | 2.861e-68 | 3.034e-31 |
| 0.0364 | 8.134e+03 | 1.914e-49 | 2.101e-29 | 1.087e-51 | 1.194e-31 |

Page : 2
DOS File : EMBD_D2.MS5
Run Date: November 7, 2005
Run Time: 2:55:23 PM
Duration : 00:00:01

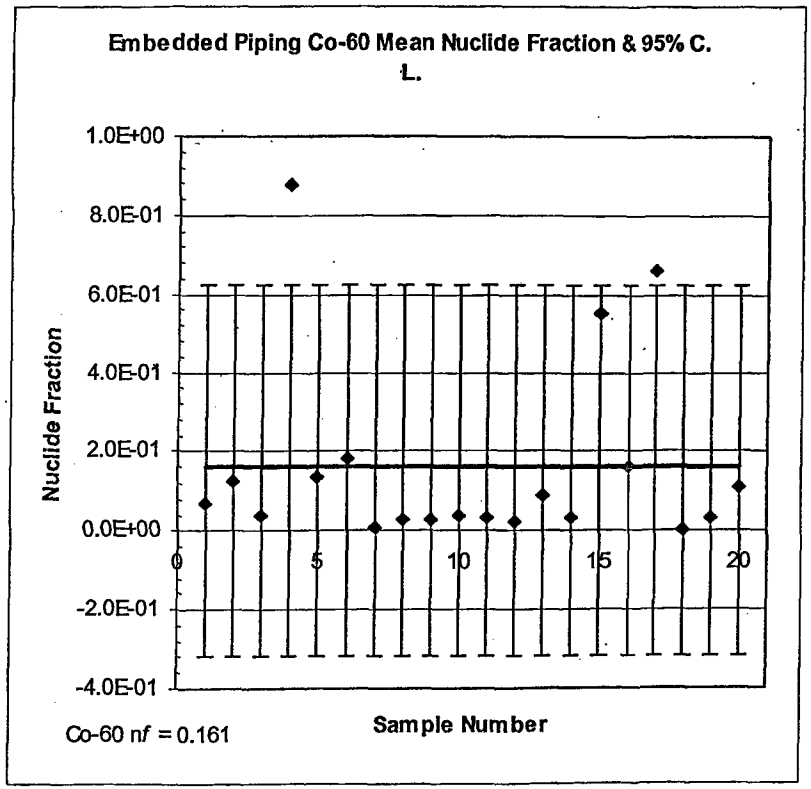
| Energy MeV | Activity photons/sec | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.6616 | 5.265e+05 | 5.581e-04 | 9.591e-03 | 1.082e-06 | 1.859e-05 |
| 0.6938 | 1.914e+01 | 2.473e-08 | 3.998e-07 | 4.775e-11 | 7.719e-10 |
| 1.1732 | 1.174e+05 | 1.214e-03 | 1.022e-02 | 2.170e-06 | 1.827e-05 |
| 1.3325 | 1.174e+05 | 1.942e-03 | 1.415e-02 | 3.369e-06 | 2.454e-05 |
| TOTALS: | 8.038e+05 | 3.714e-03 | 3.396e-02 | 6.621e-06 | 6.141e-05 |

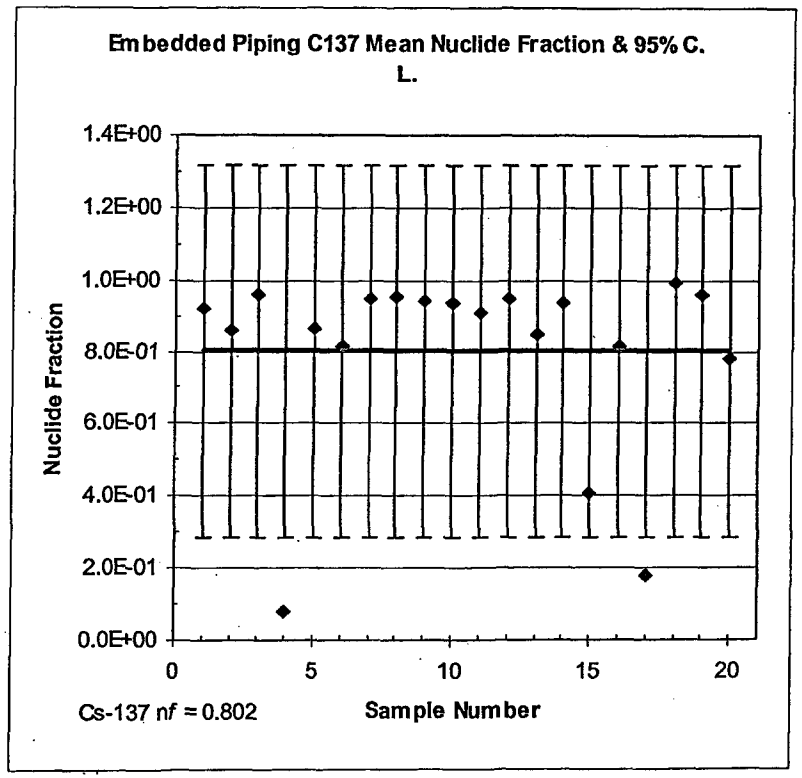
## Attachment 8.3 Gamma Nuclide Fraction For Embedded Piping

| Nuclide | Turbine Air Air Drier #6 Normalized nf | Turbine Drain Sump Normalized nf | Aux Acid Drains #1 Normalized nf | SFP 16" DHS Normalized nf | Aux Drain Common #3 to -26 sump Normalized nf | Aux Drain Common #3 to -47 sump Normalized nf | SFP #3 Leak Chase #6 Normalized nf | SFP Leak Chase #3 Normalized nf | SFP Leak Chase #1 Normalized nf | SFP Leak Chase #2 Normalized nf | SFP Leak Chase #4 Normalized nf |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Co-60 | 6.916E-02 | 1.255E-01 | 3.691E-02 | 8.757E-01 | 1.346E-01 | 1.839E-01 | 6.304E-03 | 2.628E-02 | 2.822E-02 | 3.498E-02 | 3.191E-02 |
| Nb-94 | 1.202E-03 | 1.926E-03 | 3.512E-04 | 1.828E-02 | 1.333E-03 | 5.336E-04 | < 1.060E-03 | < 9.061E-04 | < 1.431E-03 | < 1.241E-03 | < 2.078E-03 |
| Ag-108m | 2.777E-03 | 3.420E-03 | 4.086E-04 | < 7.336E-03 | 7.234E-04 | 2.299E-04 | 3.205E-02 | 1.124E-02 | 1.537E-02 | 1.705E-02 | 4.427E-02 |
| Sb-125 | 3.453E-03 | 4.246E-03 | < 2.937E-04 | < 6.313E-03 | 2.646E-04 | 2.990E-04 | < 6.225E-03 | < 3.955E-03 | < 5.487E-03 | 4.513E-03 | 6.308E-03 |
| Cs-134 | 5.712E-04 | < 8.833E-04 | 4.318E-04 | < 2.082E-03 | 4.579E-04 | 2.499E-04 | < 9.345E-04 | < 5.941E-04 | < 8.893E-04 | < 7.088E-04 | < 1.016E-03 |
| Cs-137 | 9.182E-01 | 8.574E-01 | 9.613E-01 | 7.584E-02 | 8.618E-01 | 8.116E-01 | 9.480E-01 | 9.537E-01 | 9.433E-01 | 9.367E-01 | 9.075E-01 |
| Eu-154 | 2.388E-03 | < 3.545E-03 | < 1.538E-04 | < 4.490E-03 | 6.972E-04 | 2.821E-03 | < 3.113E-03 | < 1.892E-03 | < 2.793E-03 | < 2.445E-03 | < 3.155E-03 |
| Eu-155 | < 2.293E-03 | < 3.128E-03 | < 1.458E-04 | < 9.934E-03 | 1.303E-04 | 3.657E-04 | < 2.357E-03 | < 1.422E-03 | < 2.478E-03 | < 2.406E-03 | < 3.808E-03 |
| | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 |
| Co-60 mean | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.412E-01 |
| Cs-137 mean | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.341E-01 |

| Nuclide | SFP Leak Chase #7 Normalized nf | SFP Leak Chase #5 Normalized nf | SFP Leak Chase #8 Normalized nf | SFP 8" Cooler Pipe Normalized nf | SFP 3" Skimmer Pipe Normalized nf | SFP 2.5" Nozzle Return Normalized nf | 7' NE B sump SD8110351 SC01A Normalized nf | 9' E B Sump SD8110351 SC01A Normalized nf | S +40 EL SF8990420 PM01 Normalized nf | Mean | Standard Deviation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Co-60 | 2.335E-02 | 8.803E-02 | 3.213E-02 | 5.547E-01 | 1.632E-01 | 6.596E-01 | 1.188E-03 | 3.191E-02 | 1.115E-01 | 1.610E-01 | 2.426E-01 |
| Nb-94 | < 1.483E-03 | < 6.893E-03 | < 1.532E-03 | 1.592E-02 | 1.096E-02 | < 1.965E-02 | < 2.002E-04 | < 4.189E-04 | < 1.172E-02 | 4.955E-03 | 6.526E-03 |
| Ag-108m | 1.945E-02 | 2.274E-02 | 1.623E-02 | 7.891E-03 | 3.329E-03 | 7.389E-02 | < 2.456E-04 | < 5.735E-03 | 1.384E-02 | 1.491E-02 | 1.804E-02 |
| Sb-125 | < 7.352E-04 | < 1.370E-02 | < 6.110E-03 | < 4.424E-03 | 3.764E-03 | < 1.880E-02 | < 1.383E-03 | < 1.029E-03 | < 3.051E-02 | 6.091E-03 | 7.325E-03 |
| Cs-134 | < 1.240E-03 | < 2.180E-03 | < 9.643E-04 | < 1.237E-03 | 9.786E-04 | < 5.970E-03 | 2.536E-04 | 2.084E-04 | < 6.450E-04 | 1.125E-03 | 1.257E-03 |
| Cs-137 | 9.462E-01 | 8.481E-01 | 9.369E-01 | 4.074E-01 | 8.151E-01 | 1.775E-01 | 9.942E-01 | 9.590E-01 | 7.828E-01 | 8.021E-01 | 2.631E-01 |
| Eu-154 | < 3.665E-03 | < 6.736E-03 | < 2.956E-03 | < 2.749E-03 | 9.402E-04 | < 1.261E-02 | < 2.300E-03 | < 1.208E-03 | < 1.816E-02 | 3.941E-03 | 4.259E-03 |
| Eu-155 | < 3.895E-03 | < 1.163E-02 | < 3.125E-03 | < 5.663E-03 | < 1.764E-03 | < 3.195E-02 | < 2.542E-04 | < 4.928E-04 | < 3.077E-02 | 5.901E-03 | 9.219E-03 |
| | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | 1.000E+00 | |
| Co-60 mean | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | 1.610E-01 | | |
| Cs-137 mean | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | 8.021E-01 | | |

## Attachment 8.3 Gamma Nuclide Fraction For Embedded Piping



# Attachment 8.4
# Adjusted Screening Value DCGLs

**GEL results for Turbine Air Driers #6** 1

| 7/1/2008 Nuclide | | SB8990070 PM02 Normalized nf | NRC Screening Level DCGL dpm/100cm² | nf/DCGL | % Dose | Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 6.916E-02 | 7.050E+03 | 9.810E-06 | 2.262E+01 | 6.916E-02 |
| Nb-94 | < | 1.202E-03 | 8.290E+03 | 1.449E-07 | 3.342E-01 | 1.202E-03 |
| Ag-108m | < | 2.777E-03 | 1.020E+04 | 2.723E-07 | 6.279E-01 | 2.777E-03 |
| Sb-125 | < | 3.453E-03 | 4.430E+04 | 7.794E-08 | 1.797E-01 | 3.453E-03 |
| Cs-134 | < | 5.712E-04 | 1.270E+04 | 4.498E-08 | 1.037E-01 | 5.712E-04 |
| Cs-137 | | 9.182E-01 | 2.800E+04 | 3.279E-05 | 7.562E+01 | 9.182E-01 |
| Eu-154 | < | 2.388E-03 | 1.150E+04 | 2.076E-07 | 4.789E-01 | 2.388E-03 |
| Eu-155 | < | 2.293E-03 | 1.570E+05 | 1.460E-08 | 3.368E-02 | 2.293E-03 |
| | | 1.000E+00 | | 4.336E-05 | 1.000E+02 | 1.00e+00 |
| | | | DCGL Total | **2.306E+04** | | |

**GEL results for Turbine Drain Sump #5** 2

| 7/1/2008 Nuclide | | SB8990070 PM01 Normalized nf | NRC Screening Level DCGL dpm/100cm² | nf/DCGL | % Dose | Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 1.255E-01 | 7.050E+03 | 1.780E-05 | 3.597E+01 | 1.255E-01 |
| Nb-94 | | 1.926E-03 | 8.290E+03 | 2.323E-07 | 4.695E-01 | 1.926E-03 |
| Ag-108m | | 3.420E-03 | 1.020E+04 | 3.353E-07 | 6.776E-01 | 3.420E-03 |
| Sb-125 | | 4.246E-03 | 4.430E+04 | 9.585E-08 | 1.937E-01 | 4.246E-03 |
| Cs-134 | < | 8.833E-04 | 1.270E+04 | 6.955E-08 | 1.406E-01 | 8.833E-04 |
| Cs-137 | < | 8.574E-01 | 2.800E+04 | 3.062E-05 | 6.188E+01 | 8.574E-01 |
| Eu-154 | < | 3.545E-03 | 1.150E+04 | 3.083E-07 | 6.230E-01 | 3.545E-03 |
| Eu-155 | < | 3.128E-03 | 1.570E+05 | 1.993E-08 | 4.027E-02 | 3.128E-03 |
| | | 1.000E+00 | | 4.948E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | **2.021E+04** | | |

**GEL results for Aux Acid Drains #1** 3

| 7/1/2008 Nuclide | | SE8990420 PM01A Normalized nf | NRC Screening Level DCGL dpm/100cm² | nf/DCGL | % Dose | Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 3.691E-02 | 7.050E+03 | 5.235E-06 | 1.319E+01 | 3.691E-02 |
| Nb-94 | | 3.512E-04 | 8.290E+03 | 4.237E-08 | 1.067E-01 | 3.512E-04 |
| Ag-108m | | 4.086E-04 | 1.020E+04 | 4.006E-08 | 1.009E-01 | 4.086E-04 |
| Sb-125 | < | 2.937E-04 | 4.430E+04 | 6.630E-09 | 1.670E-02 | 2.937E-04 |
| Cs-134 | | 4.318E-04 | 1.270E+04 | 3.400E-08 | 8.563E-02 | 4.318E-04 |
| Cs-137 | | 9.613E-01 | 2.800E+04 | 3.433E-05 | 8.647E+01 | 9.613E-01 |
| Eu-154 | < | 1.538E-04 | 1.150E+04 | 1.337E-08 | 3.368E-02 | 1.538E-04 |
| Eu-155 | < | 1.458E-04 | 1.570E+05 | 9.285E-10 | 2.338E-03 | 1.458E-04 |
| | | 1.000E+00 | | 3.971E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | **2.519E+04** | | |

**Results for SFP 16" DHS Piping** 4

| 7/1/5008 Nuclide | | SA899010 PM01 Normalized nf | NRC Screening Level DCGL dpm/100cm2 | nf/DCGL | % Dose | Observable Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 8.757E-01 | 7.050E+03 | 1.242E-04 | 9.479E+01 | 8.757E-01 |
| Nb-94 | | 1.828E-02 | 8.290E+03 | 2.205E-06 | 1.682E+00 | 1.828E-02 |
| Ag-108m | < | 7.336E-03 | 1.020E+04 | 7.192E-07 | 5.488E-01 | 7.336E-03 |
| Sb-125 | < | 6.313E-03 | 4.430E+04 | 1.425E-07 | 1.087E-01 | 6.313E-03 |
| Cs-134 | < | 2.082E-03 | 1.270E+04 | 1.640E-07 | 1.251E-01 | 2.082E-03 |
| Cs-137 | | 7.584E-02 | 2.800E+04 | 2.708E-06 | 2.067E+00 | 7.584E-02 |
| Eu-154 | < | 4.490E-03 | 4.430E+04 | 1.013E-07 | 7.734E-02 | 4.490E-03 |
| Eu-155 | < | 9.934E-03 | 1.270E+04 | 7.822E-07 | 5.969E-01 | 9.934E-03 |
| | | | | 1.310E-04 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | **7.631E+03** | | |

GEL results for Aux Drain #3; Common to -26 Sump 5

| 7/1/5008 Nuclide | | SE8990420 PM03 Normalized nf | NRC Screening Level DCGL dpm/100cm² | nf/DCGL | % Dose | Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 1.346E-01 | 7.050E+03 | 1.909E-05 | 3.802E+01 | 1.346E-01 |
| Nb-94 | | 1.333E-03 | 8.290E+03 | 1.608E-07 | 3.202E-01 | 1.333E-03 |
| Ag-108m | | 7.234E-04 | 1.020E+04 | 7.092E-08 | 1.413E-01 | 7.234E-04 |
| Sb-125 | | 2.646E-04 | 4.430E+04 | 5.972E-09 | 1.190E-02 | 2.646E-04 |
| Cs-134 | | 4.579E-04 | 1.270E+04 | 3.605E-08 | 7.182E-02 | 4.579E-04 |
| Cs-137 | | 8.618E-01 | 2.800E+04 | 3.078E-05 | 6.131E+01 | 8.618E-01 |
| Eu-154 | | 6.972E-04 | 1.150E+04 | 6.063E-08 | 1.208E-01 | 6.972E-04 |
| Eu-155 | < | 1.303E-04 | 1.570E+05 | 8.296E-10 | 1.653E-03 | 1.303E-04 |
| | | 1.000E+00 | | 5.020E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 1.992E+04 | | |

GEL results for Aux Drain #2; Common to -47 Sumps 6

| 7/1/2008 Nuclide | | SE8990420 PM02A Normalized nf | NRC Screening Level DCGL dpm/100cm² | nf/DCGL | % Dose | Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 1.839E-01 | 7.050E+03 | 2.608E-05 | 4.705E+01 | 1.839E-01 |
| Nb-94 | | 5.336E-04 | 8.290E+03 | 6.437E-08 | 1.161E-01 | 5.336E-04 |
| Ag-108m | < | 2.299E-04 | 1.020E+04 | 2.254E-08 | 4.066E-02 | 2.299E-04 |
| Sb-125 | < | 2.990E-04 | 4.430E+04 | 6.750E-09 | 1.218E-02 | 2.990E-04 |
| Cs-134 | | 2.499E-04 | 1.270E+04 | 1.967E-08 | 3.550E-02 | 2.499E-04 |
| Cs-137 | | 8.116E-01 | 2.800E+04 | 2.899E-05 | 5.229E+01 | 8.116E-01 |
| Eu-154 | | 2.821E-03 | 1.150E+04 | 2.453E-07 | 4.425E-01 | 2.821E-03 |
| Eu-155 | | 3.657E-04 | 1.570E+05 | 2.329E-09 | 4.202E-03 | 3.657E-04 |
| | | 1.000E+00 | | 5.543E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 1.804E+04 | | |

SFP #3 Leak Chase #6 7

| 7/1/2008 Nuclide | | SB8990440 PM01 Normalized nf | NRC Screening Level DCGL dpm/100cm2 | nf/DCGL | % Dose | Observable Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 6.304E-03 | 7.050E+03 | 8.942E-07 | 2.323E+00 | 6.304E-03 |
| Nb-94 | < | 1.060E-03 | 8.290E+03 | 1.279E-07 | 3.323E-01 | 1.060E-03 |
| Ag-108m | | 3.205E-02 | 1.020E+04 | 3.142E-06 | 8.163E+00 | 3.205E-02 |
| Sb-125 | < | 6.225E-03 | 4.430E+04 | 1.405E-07 | 3.651E-01 | 6.225E-03 |
| Cs-134 | < | 9.345E-04 | 1.270E+04 | 7.359E-08 | 1.912E-01 | 9.345E-04 |
| Cs-137 | | 9.480E-01 | 2.800E+04 | 3.386E-05 | 8.796E+01 | 9.480E-01 |
| Eu-154 | < | 3.113E-03 | 4.430E+04 | 7.027E-08 | 1.826E-01 | 3.113E-03 |
| Eu-155 | < | 2.357E-03 | 1.270E+04 | 1.856E-07 | 4.821E-01 | 2.357E-03 |
| | | | | 3.849E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 2.598E+04 | | |

SFP Leak Chase #3 8

| 7/1/2008 Nuclide | | SB8990440 PM02 Normalized nf | NRC Screening Level DCGL dpm/100cm2 | nf/DCGL | % Dose | Observable Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 2.628E-02 | 7.050E+03 | 3.727E-06 | 9.486E+00 | 2.628E-02 |
| Nb-94 | < | 9.061E-04 | 8.290E+03 | 1.093E-07 | 2.782E-01 | 9.061E-04 |
| Ag-108m | | 1.124E-02 | 1.020E+04 | 1.102E-06 | 2.805E+00 | 1.124E-02 |
| Sb-125 | < | 3.955E-03 | 4.430E+04 | 8.927E-08 | 2.272E-01 | 3.955E-03 |
| Cs-134 | < | 5.941E-04 | 1.270E+04 | 4.678E-08 | 1.191E-01 | 5.941E-04 |
| Cs-137 | | 9.537E-01 | 2.800E+04 | 3.406E-05 | 8.669E+01 | 9.537E-01 |
| Eu-154 | < | 1.892E-03 | 4.430E+04 | 4.270E-08 | 1.087E-01 | 1.892E-03 |
| Eu-155 | < | 1.422E-03 | 1.270E+04 | 1.120E-07 | 2.850E-01 | 1.422E-03 |
| | | | | 3.929E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 2.545E+04 | | |

**SFP Leak Chase #1** 9

| 7/1/2008 Nuclide | | SB8990440 PM03 Normalized nf | NRC Screening Level DCGL dpm/100cm2 | nf/DCGL | % Dose | Observable Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 2.822E-02 | 7.050E+03 | 4.003E-06 | 1.005E+01 | 2.822E-02 |
| Nb-94 | < | 1.431E-03 | 8.290E+03 | 1.726E-07 | 4.334E-01 | 1.431E-03 |
| Ag-108m | | 1.537E-02 | 1.020E+04 | 1.507E-06 | 3.783E+00 | 1.537E-02 |
| Sb-125 | < | 5.487E-03 | 4.430E+04 | 1.239E-07 | 3.110E-01 | 5.487E-03 |
| Cs-134 | < | 8.893E-04 | 1.270E+04 | 7.003E-08 | 1.758E-01 | 8.893E-04 |
| Cs-137 | | 9.433E-01 | 2.800E+04 | 3.369E-05 | 8.460E+01 | 9.433E-01 |
| Eu-154 | < | 2.793E-03 | 4.430E+04 | 6.304E-08 | 1.583E-01 | 2.793E-03 |
| Eu-155 | < | 2.478E-03 | 1.270E+04 | 1.951E-07 | 4.900E-01 | 2.478E-03 |
| | | | | 3.982E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 2.511E+04 | | |

**SFP #2 Leak Chase** 10

| 7/1/2008 Nuclide | | SB8990440 PM04 Normalized nf | NRC Screening Level DCGL dpm/100cm2 | nf/DCGL | % Dose | Observable Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 3.498E-02 | 7.050E+03 | 4.961E-06 | 1.221E+01 | 3.498E-02 |
| Nb-94 | < | 1.241E-03 | 8.290E+03 | 1.497E-07 | 3.683E-01 | 1.241E-03 |
| Ag-108m | | 1.705E-02 | 1.020E+04 | 1.672E-06 | 4.114E+00 | 1.705E-02 |
| Sb-125 | | 4.513E-03 | 4.430E+04 | 1.019E-07 | 2.507E-01 | 4.513E-03 |
| Cs-134 | < | 7.088E-04 | 1.270E+04 | 5.581E-08 | 1.373E-01 | 7.088E-04 |
| Cs-137 | | 9.367E-01 | 2.800E+04 | 3.345E-05 | 8.232E+01 | 9.367E-01 |
| Eu-154 | < | 2.445E-03 | 4.430E+04 | 5.520E-08 | 1.358E-01 | 2.445E-03 |
| Eu-155 | < | 2.406E-03 | 1.270E+04 | 1.895E-07 | 4.662E-01 | 2.406E-03 |
| | | | | 4.064E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 2.461E+04 | | |

**SFP Leak Chase #4** 11

| 7/1/2008 Nuclide | | SB8990440 PM05 Normalized nf | NRC Screening Level DCGL dpm/100cm2 | nf/DCGL | % Dose | Observable Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 3.191E-02 | 7.050E+03 | 4.526E-06 | 1.075E+01 | 3.191E-02 |
| Nb-94 | < | 2.078E-03 | 8.290E+03 | 2.507E-07 | 5.951E-01 | 2.078E-03 |
| Ag-108m | | 4.427E-02 | 1.020E+04 | 4.340E-06 | 1.030E+01 | 4.427E-02 |
| Sb-125 | < | 6.308E-03 | 4.430E+04 | 1.424E-07 | 3.380E-01 | 6.308E-03 |
| Cs-134 | < | 1.016E-03 | 1.270E+04 | 7.999E-08 | 1.899E-01 | 1.016E-03 |
| Cs-137 | | 9.075E-01 | 2.800E+04 | 3.241E-05 | 7.695E+01 | 9.075E-01 |
| Eu-154 | < | 3.155E-03 | 4.430E+04 | 7.123E-08 | 1.691E-01 | 3.155E-03 |
| Eu-155 | < | 3.808E-03 | 1.270E+04 | 2.998E-07 | 7.119E-01 | 3.808E-03 |
| | | | | 4.212E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 2.374E+04 | | |

**SFP Leak Chase #7** 12

| 7/1/2008 Nuclide | | SB8990440 PM06 Normalized nf | NRC Screening Level DCGL dpm/100cm2 | nf/DCGL | % Dose | Observable Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 2.335E-02 | 7.050E+03 | 3.312E-06 | 8.343E+00 | 2.335E-02 |
| Nb-94 | < | 1.483E-03 | 8.290E+03 | 1.789E-07 | 4.507E-01 | 1.483E-03 |
| Ag-108m | | 1.945E-02 | 1.020E+04 | 1.907E-06 | 4.805E+00 | 1.945E-02 |
| Sb-125 | < | 7.352E-04 | 4.430E+04 | 1.660E-08 | 4.181E-02 | 7.352E-04 |
| Cs-134 | < | 1.240E-03 | 1.270E+04 | 9.762E-08 | 2.459E-01 | 1.240E-03 |
| Cs-137 | | 9.462E-01 | 2.800E+04 | 3.379E-05 | 8.513E+01 | 9.462E-01 |
| Eu-154 | < | 3.665E-03 | 4.430E+04 | 8.273E-08 | 2.084E-01 | 3.665E-03 |
| Eu-155 | < | 3.895E-03 | 1.270E+04 | 3.067E-07 | 7.727E-01 | 3.895E-03 |
| | | | | 3.969E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 2.519E+04 | | |

**SFP Leak Chase #5** 13

| 7/1/2008 Nuclide | | SB8990440 PM08 Normalized nf | NRC Screening Level DCGL dpm/100cm2 | nf/DCGL | % Dose | Observable Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 8.803E-02 | 7.050E+03 | 1.249E-05 | 2.635E+01 | 8.803E-02 |
| Nb-94 | < | 6.893E-03 | 8.290E+03 | 8.314E-07 | 1.755E+00 | 6.893E-03 |
| Ag-108m | | 2.274E-02 | 1.020E+04 | 2.229E-06 | 4.705E+00 | 2.274E-02 |
| Sb-125 | < | 1.370E-02 | 4.430E+04 | 3.093E-07 | 6.527E-01 | 1.370E-02 |
| Cs-134 | < | 2.180E-03 | 1.270E+04 | 1.717E-07 | 3.623E-01 | 2.180E-03 |
| Cs-137 | | 8.481E-01 | 2.800E+04 | 3.029E-05 | 6.392E+01 | 8.481E-01 |
| Eu-154 | < | 6.736E-03 | 4.430E+04 | 1.520E-07 | 3.209E-01 | 6.736E-03 |
| Eu-155 | < | 1.163E-02 | 1.270E+04 | 9.161E-07 | 1.933E+00 | 1.163E-02 |
| | | | | 4.739E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 2.110E+04 | | |

**SFP Leak Chase #8** 14

| 7/1/2008 Nuclide | | SB8990440 PM07 Normalized nf | NRC Screening Level DCGL dpm/100cm2 | nf/DCGL | % Dose | Observable Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 3.213E-02 | 7.050E+03 | 4.558E-06 | 1.130E+01 | 3.213E-02 |
| Nb-94 | < | 1.532E-03 | 8.290E+03 | 1.848E-07 | 4.582E-01 | 1.532E-03 |
| Ag-108m | | 1.623E-02 | 1.020E+04 | 1.591E-06 | 3.946E+00 | 1.623E-02 |
| Sb-125 | < | 6.110E-03 | 4.430E+04 | 1.379E-07 | 3.420E-01 | 6.110E-03 |
| Cs-134 | < | 9.643E-04 | 1.270E+04 | 7.593E-08 | 1.883E-01 | 9.643E-04 |
| Cs-137 | | 9.369E-01 | 2.800E+04 | 3.346E-05 | 8.299E+01 | 9.369E-01 |
| Eu-154 | < | 2.956E-03 | 4.430E+04 | 6.673E-08 | 1.655E-01 | 2.956E-03 |
| Eu-155 | < | 3.125E-03 | 1.270E+04 | 2.461E-07 | 6.103E-01 | 3.125E-03 |
| | | | | 4.032E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 2.480E+04 | | |

**SFP Cooler 8" Pipe** 15

| 7/1/2008 Nuclide | | SA8990440 PM01 Normalized nf | NRC Screening Level DCGL dpm/100cm2 | nf/DCGL | % Dose | Observable Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 5.547E-01 | 7.050E+03 | 7.869E-05 | 8.143E+01 | 5.547E-01 |
| Nb-94 | | 1.592E-02 | 8.290E+03 | 1.920E-06 | 1.987E+00 | 1.592E-02 |
| Ag-108m | | 7.891E-03 | 1.020E+04 | 7.736E-07 | 8.006E-01 | 7.891E-03 |
| Sb-125 | < | 4.424E-03 | 4.430E+04 | 9.987E-08 | 1.034E-01 | 4.424E-03 |
| Cs-134 | < | 1.237E-03 | 1.270E+04 | 9.737E-08 | 1.008E-01 | 1.237E-03 |
| Cs-137 | | 4.074E-01 | 2.800E+04 | 1.455E-05 | 1.506E+01 | 4.074E-01 |
| Eu-154 | < | 2.749E-03 | 4.430E+04 | 6.206E-08 | 6.422E-02 | 2.749E-03 |
| Eu-155 | < | 5.663E-03 | 1.270E+04 | 4.459E-07 | 4.614E-01 | 5.663E-03 |
| | | | | 9.663E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 1.035E+04 | | |

**SFP Skimmer 3" Pipe** 16

| 7/1/2008 Nuclide | | SA8990440 PM02 Normalized nf | NRC Screening Level DCGL dpm/100cm2 | nf/DCGL | % Dose | Observable Beta f |
|---|---|---|---|---|---|---|
| Co-60 | | 1.632E-01 | 7.050E+03 | 2.315E-05 | 4.268E+01 | 1.632E-01 |
| Nb-94 | | 1.096E-02 | 8.290E+03 | 1.322E-06 | 2.437E+00 | 1.096E-02 |
| Ag-108m | | 3.329E-03 | 1.020E+04 | 3.263E-07 | 6.018E-01 | 3.329E-03 |
| Sb-125 | | 3.764E-03 | 4.430E+04 | 8.497E-08 | 1.567E-01 | 3.764E-03 |
| Cs-134 | | 9.786E-04 | 1.270E+04 | 7.706E-08 | 1.421E-01 | 9.786E-04 |
| Cs-137 | | 8.151E-01 | 2.800E+04 | 2.911E-05 | 5.368E+01 | 8.151E-01 |
| Eu-154 | | 9.402E-04 | 4.430E+04 | 2.122E-08 | 3.914E-02 | 9.402E-04 |
| Eu-155 | < | 1.764E-03 | 1.270E+04 | 1.389E-07 | 2.562E-01 | 1.764E-03 |
| | | | | 5.423E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 1.844E+04 | | |

SFP Nozzle Return 2.5" Pipe 17

| 7/1/2008 | | SA8990440 PM03 Normalized | NRC Screening Level DCGL | | | Observable |
|---|---|---|---|---|---|---|
| Nuclide | | nf | dpm/100cm2 | nf/DCGL | % Dose | Beta f |
| Co-60 | | 6.596E-01 | 7.050E+03 | 9.357E-05 | 8.265E+01 | 6.596E-01 |
| Nb-94 | < | 1.965E-02 | 8.290E+03 | 2.371E-06 | 2.094E+00 | 1.965E-02 |
| Ag-108m | | 7.389E-02 | 1.020E+04 | 7.244E-06 | 6.398E+00 | 7.389E-02 |
| Sb-125 | < | 1.880E-02 | 4.430E+04 | 4.244E-07 | 3.749E-01 | 1.880E-02 |
| Cs-134 | < | 5.970E-03 | 1.270E+04 | 4.701E-07 | 4.152E-01 | 5.970E-03 |
| Cs-137 | | 1.775E-01 | 2.800E+04 | 6.339E-06 | 5.599E+00 | 1.775E-01 |
| Eu-154 | < | 1.261E-02 | 4.430E+04 | 2.846E-07 | 2.514E-01 | 1.261E-02 |
| Eu-155 | < | 3.195E-02 | 1.270E+04 | 2.516E-06 | 2.222E+00 | 3.195E-02 |
| | | | | 1.132E-04 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 8.833E+03 | | |

Rx Trench 7' NE B Sump 18

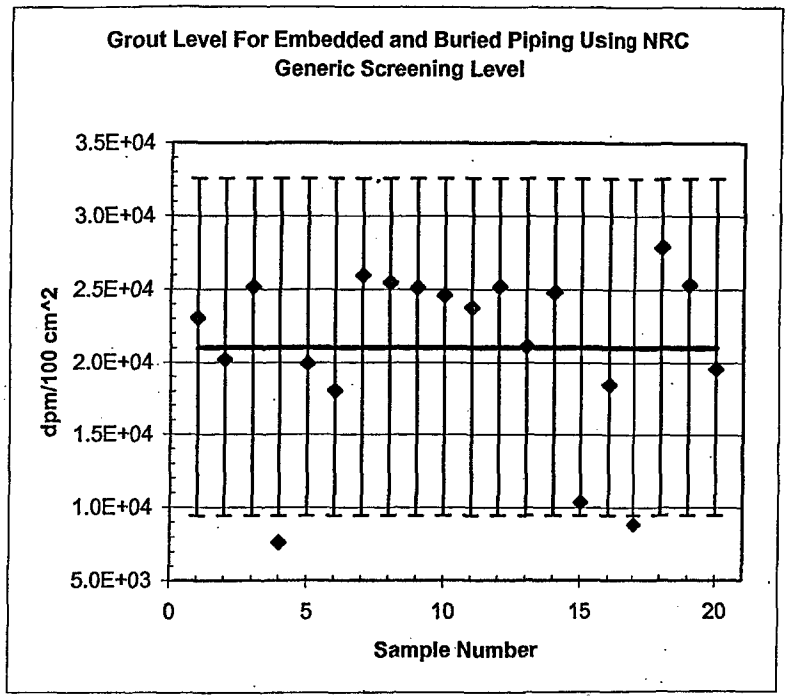
| 7/1/2008 | | SA8110351 SC01A Normalized | NRC Screening Level DCGL | | | Observable |
|---|---|---|---|---|---|---|
| Nuclide | | nf | dpm/100cm2 | nf/DCGL | % Dose | Beta f |
| Co-60 | | 1.188E-03 | 7.050E+03 | 1.685E-07 | 4.701E-01 | 1.188E-03 |
| Nb-94 | < | 2.002E-04 | 8.290E+03 | 2.415E-08 | 6.736E-02 | 2.002E-04 |
| Ag-108m | < | 2.456E-04 | 1.020E+04 | 2.408E-08 | 6.718E-02 | 2.456E-04 |
| Sb-125 | < | 1.383E-03 | 4.430E+04 | 3.123E-08 | 8.711E-02 | 1.383E-03 |
| Cs-134 | | 2.536E-04 | 1.270E+04 | 1.997E-08 | 5.571E-02 | 2.536E-04 |
| Cs-137 | | 9.942E-01 | 2.800E+04 | 3.551E-05 | 9.905E+01 | 9.942E-01 |
| Eu-154 | < | 2.300E-03 | 4.430E+04 | 5.192E-08 | 1.448E-01 | 2.300E-03 |
| Eu-155 | < | 2.542E-04 | 1.270E+04 | 2.001E-08 | 5.583E-02 | 2.542E-04 |
| | | | | 3.585E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 2.790E+04 | | |

Rx Trench 9' E B Sump 19

| 7/1/2008 | | SD8110351 SC01A Normalized | NRC Screening Level DCGL | | | Observable |
|---|---|---|---|---|---|---|
| Nuclide | | nf | dpm/100cm2 | nf/DCGL | % Dose | Beta f |
| Co-60 | | 3.191E-02 | 7.050E+03 | 4.527E-06 | 1.146E+01 | 3.191E-02 |
| Nb-94 | | 4.189E-04 | 8.290E+03 | 5.053E-08 | 1.279E-01 | 4.189E-04 |
| Ag-108m | | 5.735E-03 | 1.020E+04 | 5.622E-07 | 1.424E+00 | 5.735E-03 |
| Sb-125 | | 1.029E-03 | 4.430E+04 | 2.322E-08 | 5.880E-02 | 1.029E-03 |
| Cs-134 | | 2.084E-04 | 1.270E+04 | 1.641E-08 | 4.156E-02 | 2.084E-04 |
| Cs-137 | | 9.590E-01 | 2.800E+04 | 3.425E-05 | 8.672E+01 | 9.590E-01 |
| Eu-154 | | 1.208E-03 | 4.430E+04 | 2.728E-08 | 6.907E-02 | 1.208E-03 |
| Eu-155 | | 4.928E-04 | 1.270E+04 | 3.880E-08 | 9.824E-02 | 4.928E-04 |
| | | | | 3.950E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 2.532E+04 | | |

SFP 2" Drain +40 EL. 20

| | | NRC Screening | | | | |
|---|---|---|---|---|---|---|
| | | Normalized | Level DCGL | | | Observable |
| Nuclide | | nf | dpm/100cm2 | nf/DCGL | % Dose | Beta f |
| Co-60 | | 1.099E-01 | 7.050E+03 | 1.559E-05 | 3.049E+01 | 1.099E-01 |
| Nb-94 | < | 1.181E-02 | 8.290E+03 | 1.425E-06 | 2.788E+00 | 1.181E-02 |
| Ag-108m | < | 1.394E-02 | 1.020E+04 | 1.367E-06 | 2.675E+00 | 1.394E-02 |
| Sb-125 | < | 2.944E-02 | 4.430E+04 | 6.645E-07 | 1.300E+00 | 2.944E-02 |
| Cs-134 | < | 6.129E-04 | 1.270E+04 | 4.826E-08 | 9.442E-02 | 6.129E-04 |
| Cs-137 | | 7.860E-01 | 2.800E+04 | 2.807E-05 | 5.492E+01 | 7.860E-01 |
| Eu-154 | < | 3.060E-02 | 1.270E+04 | 2.409E-06 | 4.714E+00 | 3.060E-02 |
| Eu-155 | < | 1.770E-02 | 1.150E+04 | 1.539E-06 | 3.011E+00 | 1.770E-02 |
| | | 1.000E+00 | | 5.111E-05 | 1.000E+02 | 1.000E+00 |
| | | | DCGL Total | 1.957E+04 | | |




**Grout Level Using NRC Generic Screening Level**

| Location Code | NRC Screening cpm/100 cm$^2$ |
|---|---|
| 1 | 2.306E+04 |
| 2 | 2.021E+04 |
| 3 | 2.519E+04 |
| 4 | 7.631E+03 |
| 5 | 1.992E+04 |
| 6 | 1.804E+04 |
| 7 | 2.598E+04 |
| 8 | 2.545E+04 |
| 9 | 2.511E+04 |
| 10 | 2.461E+04 |
| 11 | 2.374E+04 |
| 12 | 2.519E+04 |
| 13 | 2.110E+04 |
| 14 | 2.480E+04 |
| 15 | 1.035E+04 |
| 16 | 1.844E+04 |
| 17 | 8.833E+03 |
| 18 | 2.790E+04 |
| 19 | 2.532E+04 |
| 20 | 1.957E+04 |
| mean | 2.102E+04 |
| Standard Deviation | 5.900E+03 |
| 1.96σ | 1.156E+04 |
| lcl | 9.458E+03 |
| ucl | 3.259E+04 |