DUANE ARNOLD ENERGY CENTER

BASELINE ASSESSMENT OF THE RISK OF RADIOLOGICAL IMPACTS TO GROUNDWATER

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August 30th, 2006

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INTRODUCTION

This document describes baseline assessments performed to provide a snapshot of the groundwater conditions that exist at the site. The following baseline assessments were performed:

- A tritium baseline to determine the current radiological condition for site groundwater/surface water.
- A review of site geology/hydrology to establish site surface and groundwater characteristics.
- A review of the plant 10 CFR 50.75(g) documentation to identify historic radiological conditions (i.e. past leaks or spills) with the potential to impact groundwater.

TRITIUM BASELINE

Ground Water

- All on-site and near-site groundwater wells have been identified. Where applicable, sampling and analyses for radioactivity was performed. See Appendix A1.
- The common header to site production wells has been sampled for tritium over the entire life of the plant.
    - No tritium has been identified in any of these samples.
    - The same is true of samples taken from wells on adjoining property.
- 3 shallow and 3 intermediate depth wells were drilled in summer of 2006. Low levels of tritium were identified in water from two of the shallow wells. The source of the tritium is washout of gaseous effluents into rain water.

Surface Water

- All on-site surface water bodies have been identified. Where applicable, sampling and analyses for radioactivity was performed. See Appendix A2.
- Starting in 2004, low levels of tritium were identified in liquid discharge from the sewage treatment plant. This occurred only during summer months. The source of tritium has been attributed to recapture of tritiated water vapor in plant gaseous effluents by building air conditioning units. The identification occurred in the course of the performance of the REMP program. The releases were recorded in the annual REMP report AND the annual Rad Material Release report. Offsite dose for the releases were also calculated.
- Starting in 2005, tritium was identified in a batch release from the site transformer pit. The source of tritium has been attributed to recapture of tritiated water vapor in plant gaseous effluents condensing on the main plant air intake cooling coil. The release was described in the Annual Rad. Material Release Report. An offsite dose calculation was performed.
- Starting in 2006, tritium was identified in rainwater collecting in the Condensate Storage Tank Retention Pit. The source of the tritium is washout of gaseous effluents

into rain water. The release will be described in the Annual Rad. Material Release Report. Offsite dose calculation was performed.

- Batch releases from the Transformer Pit, the CST Pit and the Neutralizing Tank are being fully incorporated into the Conditions and Surveillance section of the Offsite Dose Assessment Manual and the Effluents Controls Program.
- Frequency of analysis for tritium in surface water was increased in the REMP program. Before 2006, quarterly analyses were performed from composited monthly samples. In 2006, the REMP program was modified to allow for monthly sampling AND analysis for tritium in surface water.
- A report containing the results of the tritium baseline sampling/analyses will be submitted to the JCT Attorney[1].

GEOLOGY - HYDROLOGY BASELINE

- The UFSAR description of the geologic and hydrologic characteristics of the site was reviewed. :
    - The UFSAR describes two aquifers. An upper water table aquifer separated from a lower artesian type aquifer. The two aquifers are separated by a impervious clay rich material
    - The flow gradient in the shallower ground water aquifer is towards the southeast.
    - Artesian pressure in the deeper aquifer will result in an upward transfer of water into the shallower aquifer. It is noted that this condition may be reversed by the extended operation of deep production wells.
- As part of this assessment, three pairs of monitoring wells were drilled onsite. Each pair consisted of a (relatively) shallow well and an intermediate depth well.
- Analysis of the water levels from the monitoring wells by a hydrological consultant indicates that shallow groundwater (the "A" monitoring wells) flow is to the south-west, and intermediate depth groundwater (the "B" monitoring wells) flow is to the northeast. It is believed that the intermediate depth wells may be influenced by the DAEC water supply well ("D" well) north of the plant.
- The hydrological consultant recommends two additional wells be installed, a shallow one to the southwest, and a deep one to the northeast. Site staff is currently considering this plan.
- In the initial round of sampling, low concentrations of tritium were identified in two of the three shallow wells. Considering the presence of tritium in site rainwater, this is not unexpected.

[1] ~~This Report should be marked "Proprietary and Confidential, For Internal Use Only, Do Not Copy or Distribute"~~

HISTORICAL RELEASES BASELINE

- The site's 10 CFR 50.75(g) documentation for past leaks or spills was reviewed. The spills are described in attachment A3.
- There is no bulk or un-containerized radioactive materials managed outdoors at the site.
- The only storage tanks containing radioactive liquids outside of the plant power block are the Condensate Storage Tanks. These two tanks are surrounded by a concrete Berm and there is no history of leaks from the tanks to the environment.
- 10 individuals with work histories of greater than 20 years were interviewed about their knowledge of the history of radioactive spills at the plant. As a result of those interviews an additional event was added to the site 50.75(g) file.
- The DAEC REMP Program encompasses samples points from both off-site AND on-site locations. Additional on-site data of interest from the Sites REMP Program is included in attachment A4.

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APPENDIX A1

WATER WELLS

Water Well Inventory List

Facility : Duane Arnold Energy Center Person(s) Providing Data : Jerald Hogan/Steve Funk

Well ID Number	Type (1)	Depth (ft.)	Location (GPS)	In Service?	Sampled for RAM?	If OOS Returnable?	Up or Down stream
#1 (B)	DW		N42 05 889 W91 46 848	No 1970-1991	Yes	No	Up
#2 (A)	DW	138	N42 06 117 W91 07 077	No 1970-2002	Yes	No	Up
#3 (C)	DW	122	N42 05 763 W91 46 876	No 1975-1997	Yes	No	Up
#4 (D)	DW	285	N42 06 198 W91 46 418	Yes 1980-	Yes	N/A	Up
#5 (B)	DW	375	N42 05 885 W91 46 843	Yes 1991-	Yes	N/A	Up
#6 (C)	DW	375	N42 05 768 W91 46 880	Yes 1997-	Yes	N/A	Up
#7 (A)	DW	380	N42 06 113 W91 47 010	Yes 2002-	Yes	N/A	Up
MW-01A	MW	19.5	N42 06 930 W91 46 610	Yes 2006-	Yes	N/A	Down
MW-01B	MW	62.5	N42 05 934 W91 06 614	Yes 2006-	Yes	N/A	Down
MW-02A	MW	12.5	N42 05 989 W91 46 458	Yes 2006-	Yes	N/A	Down
MW-02B	MW	92	N42 05 987 W91 46 458	Yes 2006-	Yes	N/A	Down
MW-03A	MW	29	N42 06 101 W91 46 760	Yes 2006-	Yes	N/A	Up
MW-03B	MW	67	N42 06 100 W91 46 761	Yes 2006-	Yes	N/A	Up

(1) Drinking Water (DW) Monitoring Well (MW) Piezometer (PW) Service/Dewatering/Inductrial Use Water (SW) Reclamation/Recovery/Remediation (R)

Water Well Data Sheet

Well Number: #1 (B) Old Type Of Well : Drinking water

Location (GPS, if possible): N42 05 889 W91 46 848

Screened Interval : _____

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: No (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: Upstream

If Well NOT In-Service can it be returned to service? No (Yes / No)

Effort required returning to service: The well is plugged

Water Sampled For Radioactivity? Yes, while it was in operation between1970 and 1991

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Water Well Data Sheet

Well Number: #2 (A) Old Type Of Well : Drinking water

Location (GPS, if possible): N42 06 117 W91 07 077

Screened Interval : _____

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: No (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: Upstream

If Well NOT In-Service can it be returned to service? No (Yes / No)

Effort required returning to service: The well is plugged

Water Sampled For Radioactivity? Yes, while it was in operation between1970 and 2002

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Water Well Data Sheet

Well Number: #3 (C) Old Type Of Well : Drinking water

Location (GPS, if possible): N42 05 763 W91 46 876

Screened Interval : _____

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: No (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: Upstream

If Well NOT In-Service can it be returned to service? No (Yes / No)

Effort required returning to service: The well is plugged

Water Sampled For Radioactivity? Yes, while it was in operation between1975 and 1997

Water Well Data Sheet

Well Number: #4 (D) Type Of Well : Drinking water

Location (GPS, if possible): N42 06 198 W91 46 418

Screened Interval : 16" casing, to 120', well depth 285'

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: No (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: Upstream

If Well NOT In-Service can it be returned to service? N/A (Yes / No)

Effort required returning to service:

Water Sampled For Radioactivity? Yes, the common well header is sampled quarterly.

See attached REMP sample history, 2000 thru 2005.

Water Well Data Sheet

Well Number: #5 (B) Type Of Well : Drinking water

Location (GPS, if possible): N42 05 885 W91 46 843

Screened Interval : 16" casing, casing depth 125', well depth 375'

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: No (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: Upstream

If Well NOT In-Service can it be returned to service? N/A (Yes / No)

Effort required returning to service:

Water Sampled For Radioactivity? Yes, the common well header is sampled quarterly.

See attached REMP sample history, 2000 thru 2005.

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Water Well Data Sheet

Well Number: #6 (C) Type Of Well : Drinking water

Location (GPS, if possible): N42 05 768 W91 46 880

Screened Interval : 16" casing to 125', well depth 375'

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: No (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: Upstream

If Well NOT In-Service can it be returned to service? N/A (Yes / No)

Effort required returning to service:

Water Sampled For Radioactivity? Yes, the common well header is sampled quarterly.

See attached REMP sample history, 2000 thru 2005.

Water Well Data Sheet

Well Number: #7 (A) Type Of Well : Drinking water

Location (GPS, if possible): N42 06 113 W91 47 010

Screened Interval : 16" casing to 92', well depth 380'

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: No (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: Upstream

If Well NOT In-Service can it be returned to service? N/A (Yes / No)

Effort required returning to service:

Water Sampled For Radioactivity? Yes, the common well header is sampled quarterly.

See attached REMP sample history, 2000 thru 2005.

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Water Well Data Sheet

Well Number: MW-02A Type Of Well : Monitoring well

Location (GPS, if possible): N42 05 989 W91 46 458

Screened Interval : 2" casing, well depth 12.5'-- screened 7 to 12

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: _____ (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: downstream

If Well NOT In-Service can it be returned to service? N/A (Yes / No)

Effort required returning to service: _____

Water Sampled For Radioactivity? Yes

See the attached initial sample results.

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Water Well Data Sheet

Well Number: MW-02B Type Of Well : Monitoring well

Location (GPS, if possible): N42 05 987 W91 46 458

Screened Interval : 2" casing, well depth 92'-- screened 82 to 92

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: _____ (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: downstream

If Well NOT In-Service can it be returned to service? N/A (Yes / No)

Effort required returning to service: _____

Water Sampled For Radioactivity? Yes

See the attached initial sample results.

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Water Well Data Sheet

Well Number: MW-03A Type Of Well : Monitoring well

Location (GPS, if possible): N42 06 101 W91 46 760

Screened Interval : 2" casing, well depth 29'-- screened 19 to 29

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: _____ (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: upstream

If Well NOT In-Service can it be returned to service? N/A (Yes / No)

Effort required returning to service: _____

Water Sampled For Radioactivity? Yes

See the attached initial sample results.

Water Well Data Sheet

Well Number: MW-03B Type Of Well : Monitoring well

Location (GPS, if possible): N42 06 100 W91 46 761

Screened Interval : 2" casing, well depth 67'-- screened 57 to 67

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: _____ (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: upstream

If Well NOT In-Service can it be returned to service? N/A (Yes / No)

Effort required returning to service: _____

Water Sampled For Radioactivity? Yes

See the attached initial sample results.

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Water Well Data Sheet

Well Number: MW-01A Type Of Well : Monitoring well

Location (GPS, if possible): N42 06 930 W91 46 610

Screened Interval : 2" casing, well depth 19.5'-- screened 12.5 to 19.5

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: _____ (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: downstream

If Well NOT In-Service can it be returned to service? N/A (Yes / No)

Effort required returning to service: _____

Water Sampled For Radioactivity? Yes

See the attached initial sample results.

Water Well Data Sheet

Well Number: MW-01B Type Of Well : Monitoring well

Location (GPS, if possible): N42 05 934 W91 06 614

Screened Interval : 2" casing, well depth 62.5'-- screened 52 to 62

Reason for installation : Drinking water and service water for plant equipment

Is well completion on Form (e.g., Fla Form 0124) Available: _____ (Yes / No)

Is well "upstream" or "downstream"
of Power Block & Associated Tanks: downstream

If Well NOT In-Service can it be returned to service? N/A (Yes / No)

Effort required returning to service: _____

Water Sampled For Radioactivity? Yes

See the attached initial sample results.

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Ground Water Analysis Results
REMP Program

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Table 16. Well water samples, analyses for gross beta and tritium.
Collection: Quarterly
Units: pCi/L

2000

Location	D-53 Treated Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1702	DWW-4134	DWW-7471	DWW-10109
Gross Beta	2.3 ± 0.6	2.5 ± 0.6	2.8 ± 0.6	2.6 ± 0.6
H-3	< 183	< 181	< 157	< 179
Location	D-54 Inlet to Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1703	DWW-4135	DWW-7133	DWW-10110
Gross Beta	3.4 ± 0.7	2.8 ± 0.6	3.1 ± 0.7	3.8 ± 0.7
H-3	< 183	< 181	< 179	< 179
Location	D-55 On-site Well			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1704	DWW-4136, 7	DWW-7472	DWW-10111
Gross Beta	1.0 ± 0.5	< 0.9	< 1.0	< 1.0
H-3	< 183	< 181	< 157	< 179
Location	D-57 Bull Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1705	DWW-4138	DWW-7134	DWW-10112
Gross Beta	2.0 ± 0.7	1.8 ± 0.6	1.5 ± 0.6	2.2 ± 0.6
H-3	< 183	< 181	< 179	< 179
Location	D-58 Franz Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1706	DWW-4139	DWW-7135	DWW-10113
Gross Beta	5.5 ± 0.8	7.6 ± 0.8	8.5 ± 0.9	1.9 ± 0.6
H-3	< 183	< 181	< 179	< 179
Location	D-72 Van Note Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1707	DWW-4140	DWW-7136	DWW-10111
Gross Beta	< 1.0	< 1.1	< 1.0	< 0.9
H-3	< 183	< 181	< 179	< 179

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Table 16. Well water samples, analyses for gross beta and tritium.
Collection: Quarterly
Units: pCi/L

2001

Location	D-53 Treated Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-2353	DWW-5244	DWW-8512	DWW-10523
Gross Beta	2.8 ± 0.6	1.9 ± 0.5	2.5 ± 0.6	2.9 ± 0.7
H-3	< 162	< 175	< 156	< 155
Location	**D-54 Inlet to Municipal Water**			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-2354	DWW-5245	DWW-8513	DWW-10524
Gross Beta	2.5 ± 0.6	3.1 ± 0.5	3.2 ± 0.6	3.6 ± 0.7
H-3	< 162	< 175	< 156	< 155
Location	**D-55 On-site Well**			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-2355	DWW-5214	DWW-8514	DWW-10525
Gross Beta	< 0.9	< 0.9	< 0.9	< 0.9
H-3	< 162	< 175	< 156	< 155
Location	**D-57 Bull Farm**			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-2356,7	DWW-5215	DWW-8515	DWW-10526
Gross Beta	1.3 ± 0.3	1.5 ± 0.5	1.6 ± 0.6	1.5 ± 0.6
H-3	< 162	< 175	< 156	< 155
Location	**D-58 Franz Farm**			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-2358	DWW-5216	DWW-8516	DWW-10527,8
Gross Beta	8.6 ± 0.8	5.6 ± 0.7	6.5 ± 0.7	6.1 ± 0.6
H-3	< 162	< 175	< 156	< 155
Location	**D-72 Van Note Farm**			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-2359	DWW-5217,8	DWW-8517	DWW-10529
Gross Beta	< 0.8	0.9 ± 0.4	2.0 ± 0.6	< 1.1
H-3	< 162	< 175	< 156	< 155

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Table 16. Well water samples, analyses for gross beta and tritium.
Collection: Quarterly
Units: pCi/L

2002

Location	D-53 Treated Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1691	DWW-3513	DWW-6113	DWW-8385
Gross Beta	2.1 ± 0.5	2.3 ± 0.6	2.7 ± 0.6	3.2 ± 0.6
H-3	< 132	< 136	< 144	< 158

Location	D-54 Inlet to Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1692	DWW-3514	DWW-6114	DWW-8386
Gross Beta	2.8 ± 0.6	2.9 ± 0.7	3.2 ± 0.6	3.4 ± 0.6
H-3	< 132	< 136	< 144	< 158

Location	D-55 On-site Well			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1693	DWW-3515	DWW-6115	DWW-8387
Gross Beta	< 0.9	< 1.1	< 1.6 [a]	< 0.8
H-3	< 132	< 136	< 144	< 158

Location	D-57 Bull Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1694,5	DWW-3516	DWW-6116	DWW-8388
Gross Beta	1.7 ± 0.4	1.0 ± 0.5	1.0 ± 0.6	1.0 ± 0.5
H-3	< 132	< 136	< 144	< 158

Location	D-58 Franz Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1696	DWW-3517	DWW-6117	DWW-8389
Gross Beta	4.9 ± 0.6	5.7 ± 0.8	5.9 ± 0.8	4.5 ± 0.6
H-3	< 132	< 136	< 144	< 158

Location	D-72 Van Note Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1697	DWW-3518	DWW-6118	DWW-8390
Gross Beta	< 0.8	< 1.0	< 1.5 [a]	< 0.9
H-3	< 132	< 136	< 144	< 158

[a] Samples counted longer to achieve lower LLD.

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Table 16. Well water samples, analyses for gross beta and tritium.
Collection: Quarterly
Units: pCi/L

2003

Location	D-53 Treated Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1263	DWW-3376	DWW-5576	DWW-7371
Gross Beta	2.4 ± 0.6	2.9 ± 0.6	3.0 ± 0.6	3.6 ± 0.7
H-3	< 157	< 153	< 137	< 161

Location	D-54 Inlet to Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1264	DWW-3377	DWW-5577	DWW-7372
Gross Beta	3.4 ± 0.7	4.1 ± 0.6	3.3 ± 0.6	4.8 ± 0.8
H-3	< 157	< 153	< 137	< 161

Location	D-55 On-site Well			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1265	DWW-3378	DWW-5578	DWW-7373,4
Gross Beta	< 1.0	< 0.8	< 0.9	< 1.1
H-3	< 157	< 153	< 137	< 161

Location	D-57 Bull Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1266	DWW-3379	DWW-5579	DWW-7375
Gross Beta	1.5 ± 0.6	1.4 ± 0.5	1.2 ± 0.5	1.5 ± 0.5
H-3	< 157	< 153	< 137	< 161

Location	D-58 Franz Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1267	DWW-3380,1	DWW-5580	DWW-7376
Gross Beta	5.3 ± 0.8	5.3 ± 0.5	6.7 ± 0.7	7.0 ± 0.7
H-3	< 157	< 153	< 137	< 161

Location	D-72 Van Note Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1268	DWW-3382	DWW-5581	DWW-7377
Gross Beta	1.6 ± 0.6	< 1.0	< 0.9	< 0.8
H-3	< 157	< 153	< 137	< 161

2004

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Table 16. Well water samples, analyses for gross beta and tritium.
Collection: Quarterly
Units: pCi/L

Location	D-53 Treated Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1196	DWW-3172	DWW-5630	DWW-7374
Gross Beta	2.3 ± 0.5	2.5 ± 0.5	2.0 ± 0.5	2.2 ± 0.5
H-3	< 162	< 160	< 163	< 165

Location	D-54 Inlet to Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1197	DWW-3173	DWW-5631	DWW-7375,6
Gross Beta	3.3 ± 0.6	5.0 ± 0.7	3.2 ± 0.6	14.7 ± 0.7[a]
H-3	< 157	< 160	< 163	< 165

Location	D-55 On-site Well			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1198	DWW-3174	DWW-5369	DWW-7377
Gross Beta	< 0.8	< 0.9	< 0.9	< 0.9
H-3	< 157	< 160	< 162	< 165

Location	D-57 Bull Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1199	DWW-3175	DWW-5370	DWW-7378
Gross Beta	2.0 ± 0.5	1.3 ± 0.5	1.6 ± 0.5	1.6 ± 0.5
H-3	< 157	< 160	< 162	< 165

Location	D-58 Franz Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1200	DWW-3176	DWW-5632	DWW-7379
Gross Beta	5.5 ± 0.7	4.5 ± 0.6	5.3 ± 0.7	4.7 ± 0.7
H-3	< 157	< 160	< 163	< 158

Location	D-72 Van Note Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1201	DWW-3177	DWW-5633,4	DWW-7380
Gross Beta	< 0.8	< 0.9	< 0.9	< 1.1
H-3	< 157	< 160	< 163	< 158

[a] Analyses for gamma emitting isotopes, strontium-89 and strontium-90 were performed. It was determined that the cause of the higher beta activity was contribution from naturally-occurring isotopes. No plant effect was indicated. Refer to laboratory report no. 8100-100-169.

DUANE ARNOLD

Table 16. Well water samples, analyses for gross beta and tritium.
Collection: Quarterly
Units: pCi/L

2005

Location	D-53 Treated Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1332	DWW-3135	DWW-5327	DWW-7184
Gross Beta	1.9 ± 0.6	3.0 ± 0.7	2.3 ± 0.4	2.8 ± 0.6
H-3	< 166	< 157	< 149	< 191

Location	D-54 Inlet to Municipal Water			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1333	DWW-3136	DWW-5328	DWW-7185
Gross Beta	3.3 ± 0.6	3.4 ± 0.7	5.3 ± 0.6	2.7 ± 0.6
H-3	< 166	< 157	< 164	< 191

Location	D-55 On-site Well			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1334	DWW-3137	DWW-5329	DWW-7186
Gross Beta	< 1.4	< 1.1	< 0.5	< 1.2
H-3	< 166	< 157	< 164	< 191

Location	D-57 Bull Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1335	DWW-3138	DWW-5330	DWW-7187,8
Gross Beta	1.8 ± 0.6	1.9 ± 0.6	1.2 ± 0.4	1.6 ± 0.5
H-3	< 166	< 157	< 149	< 191

Location	D-58 Franz Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1336	DWW-3139	DWW-5331	DWW-7189
Gross Beta	4.3 ± 0.8	4.0 ± 0.7	3.7 ± 0.5	5.0 ± 0.8
H-3	< 166	< 157	< 149	< 191

Location	D-72 Van Note Farm			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DWW-1337	DWW-3140	DWW-5332	DWW-7190
Gross Beta	< 1.2	< 1.2	< 0.5	< 1.2
H-3	< 166	< 157	< 149	< 191

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2006

Table 12. Well water samples, analyses for gross beta and tritium.
Collection: Quarterly
Units: pCi/L

Location	D-53 Treated Municipal Water	
Period	1st Qtr.	2nd Qtr.
Lab Code	DWW-1502	DWW-4287
Gross Beta	1.4 ± 0.4	1.5 ± 0.6
H-3	< 182	< 144

Location	D-54 Inlet to Municipal Water	
Period	1st Qtr.	2nd Qtr.
Lab Code	DWW-1503	DWW-4288
Gross Beta	5.1 ± 0.6	2.7 ± 0.6
H-3	< 182	< 166

Location	D-55 On-site Well	
Period	1st Qtr.	2nd Qtr.
Lab Code	DWW-1504	DWW-4289
Gross Beta	< 0.5	< 1.2
H-3	< 182	< 166

Location	D-57 Bull Farm	
Period	1st Qtr.	2nd Qtr.
Lab Code	DWW-1505	DWW-4153
Gross Beta	< 0.5	0.5 ± 0.3
H-3	< 182	< 141

Location	D-58 Franz Farm	
Period	1st Qtr.	2nd Qtr.
Lab Code	DWW-1506	DWW-4154
Gross Beta	2.5 ± 0.5	3.4 ± 0.5
H-3	< 182	< 141

Location	D-72 Van Note Farm	
Period	1st Qtr.	2nd Qtr.
Lab Code	DWW-1507	DWW-4290
Gross Beta	< 0.5	< 1.1
H-3	< 182	< 166

New Monitoring Wells
Initial Sample Results

Environmental, Inc.
Midwest Laboratory
an Allegheny Technologies Co.

700 Landwehr Road • Northbrook, IL 60062-2310
ph. (847) 564-0700 • fax (847) 564-4517

Mr. Stephan M. Funk
NMC LLC
Duane Arnold Energy Center
3277 DAEC Road
Palo, Iowa 52324

LABORATORY REPORT NO.: 8001-100-176
DATE: 08-28-2006
SAMPLES RECEIVED: 08-21-2006
PURCHASE ORDER NO.:

Dear Mr. Funk:

Below are the results of the analyses for tritium on six ground water samples.

Sample Description	Collection Date	Lab Code	Concentration (pCi/L) H-3	Re-count
MW-01 A	08-16-06	DWW-5661	345 ± 119	481 ± 107
MW-01 B	08-16-06	DWW-5662	< 158	< 175
MW-02 A	08-16-06	DWW-5663	< 152	< 175
MW-02 B	08-16-06	DWW-5664	< 158	< 175
MW-03 A	08-16-06	DWW-5665	297 ± 107	238 ± 100
MW-03 B	08-16-06	DWW-5666	< 152	< 175

The error given is the probable counting error at 95% confidence level. Less than (<), value is based on 4.66 sigma for the background sample.

Sincerely,

Bronia Grob
Laboratory Manager

APPROVED BY _____
Tony Coorlim,
Quality Assurance

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APPENDIX A2

SURFACE WATER

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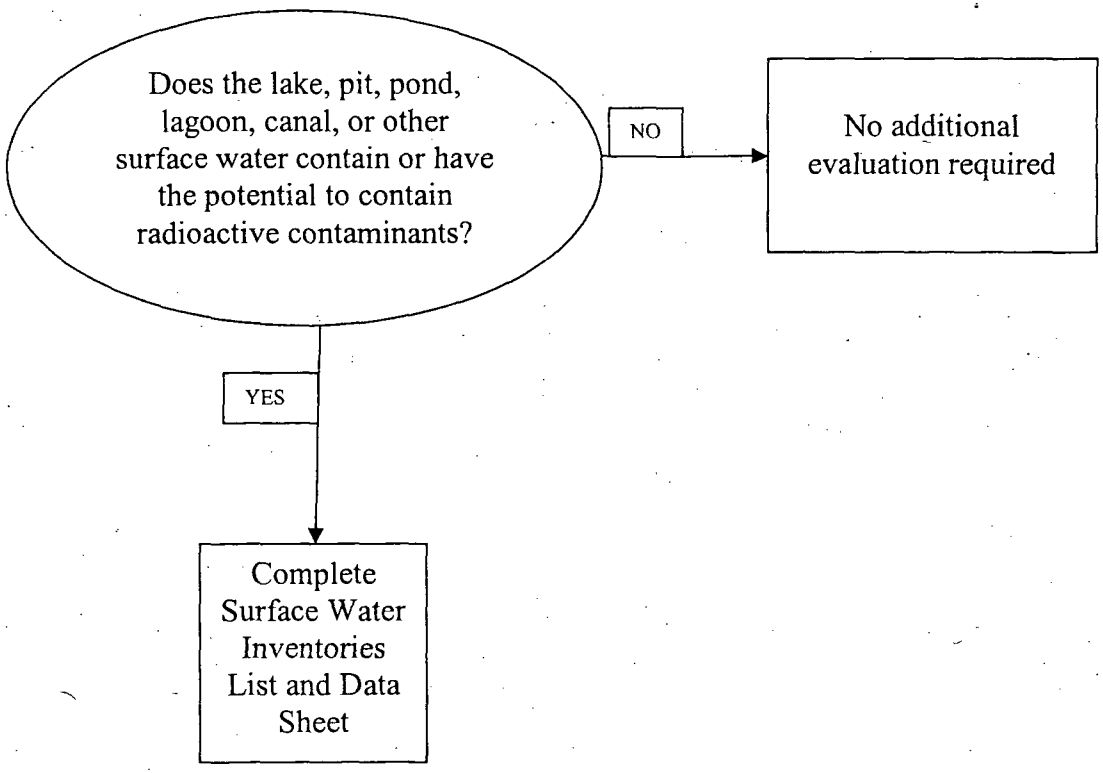
DECISION TREE
SURFACE WATER BODIES



Surface Water Bodies Inventory List

Pits, Basins, Ponds, Canals, Lakes, Lagoons or other surface water bodies that contain, contained or could contain radioactively contaminated water.

Site: Duane Arnold Energy Center

Information Submitted By: Stephan Funk

Surface Water Bodies Inventory List					
Name / Description	Location	Water Source	Public Access	Lined	Sampled? (min , avg / max)
Cedar River	River trends NNW to SSE on the eastern edge of the site boundary.	Drainage of the Cedar River Basin.	Yes	No	Monthly. No plant by-product materials have ever been identified in samples from the river.
North Drainage Ditch - NPDES Discharge Point -002	Ditch trends west to east just north of the protected area.	Rainwater runoff, sewage plant liquid effluent	No	No	Yes Monthly. Tritium from air conditioner condensation has been identified to xxx pCi/liter in summer months

Surface Water Bodies Inventory List

Name / Description	Location	Water Source	Public Access	Lined	Sampled? (min , avg / max)
Blowdown Canal, NPDES Discharge Point -001	Ditch trends northwest to south east from the plant to the river.	Circulating water blow-down. (1500 gpm typical), rainwater runoff.	No	Yes, clay	Circulating water that provides the bulk of the flow is sampled as a part of the Effluents Controls Program. "Effluent LLDs" are used for these analyses. Weekly for Gamma emitters, monthly composite for tritium.
Sluice Pond	South of the protected area.	Rain water runoff.	No	Yes, clay	No
Transformer Pit	Between the Pumphouse and the Turbine building	Condensate from plant air intake coils, rain water, and floor drains in the aux. boiler room and diesel rooms.	No	Yes, concrete	Yes, before release. This body of water is considered a part of the effluents controls program. Tritium has been identified in a fraction of samples. Concentrations of up to 4000 pCi/liter have been seen here.

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Surface Water Bodies Inventory List

Name / Description	Location	Water Source	Public Access	Lined	Sampled? (min , avg / max)
CST Pit	South of the reactor building.	Rain water	No	Yes, concrete	Yes, before release. This body of water is considered a part of the effluents controls program. Tritium has been identified in some samples. Concentrations of up to 4000 pCi/liter have been seen here.

Surface Water Data Sheet

Surface Water Body: Cedar River **Type** *River*

Location/Map (GPS, if possible): *N42 05 858 / W91 46 338*

Purpose or Function: *Natural Feature*

Lined/Unlined: *Unlined*

Size, Capacity: *200'-600' Bank to Bank* **Depth (if known):** *0' to 10'*

In-flow from: *Cedar River from North* **Out-flows to:** *Cedar River to south*

Average flow through, if known: *The average annual stream flow since 1903 is 3,759 cubic feet per second*

Water Sampled For Radioactivity? (Yes / No) *Yes, as part of the site REMP program* *See the attached REMP sample results*

Surface Water Data Sheet

Surface Water Body:	North Drainage Ditch NPDES Discharge Point -002 **Type** *Ditch - Creek*
Location/Map (GPS, if possible):	N42 06 160 / W91 46 640
Purpose or Function:	*This ditch carries off rain water runoff from the northern half of the site. It also takes the liquid discharge from the site's sewage treatment facility.*
Lined/Unlined:	*Unlined. In dry weather, the water in this ditch sinks into the ground before making it to the river.*
Size, Capacity:	*Typical: 30' wide, 6' deep* **Depth (if known):** *0' to 2'*
In-flow from:	*Sewage treatment plant effluent, rain water runoff* **Out-flows to:** *Cedar River*
Average flow through, if known:	*Estimated at ~30,000 gallons per month*
Water Sampled For Radioactivity? (Yes / No)	*Yes, REMP Sample Point 107* *See the attached REMP sample results*

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Surface Water Data Sheet

Surface Water Body: *Blowdown Canal NPDES Discharge Point -001* **Type** *Ditch-Canal*

Location/Map (GPS, if possible): N42 06 016 / W91 46 534

Purpose or Function: *Drainage from plant condenser circulating water*

Lined/Unlined: *Lined with clay*

Size, Capacity: *Typical 6' deep, 30' wide* **Depth (if known):** *0'-3'*

In-flow from: *Plant circ. water, Transformer pit, CST pit, Rain water runoff from south half of site.* **Out-flows to:** *Cedar River*

Average flow through, if known: *~2000 gpm typical*

Water Sampled For Radioactivity? (Yes / No) *Yes* *Sampling of the plant circulating water is performed per the effluents controls program. Plant by-product material has never been identified in the circ water.*

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Surface Water Data Sheet

Surface Water Body: *Sluice Pond* **Type** *Retention Basin*

Location/Map (GPS, if possible): *N42 05 920 / W91 46 673*

Purpose or Function: *Emergency Retention Basin. The liquid radwaste tanks in the Low Level Radwaste Storage Building are not located within containment berms. In the event of a catastrophic failure of the tanks, the sluice pond prevents that liquid radwaste from flowing into the river.*

Lined/Unlined: *Lined with clay*

Size, Capacity: *~100,000 gallons* **Depth (if known):** *0' - ~ 8'*

In-flow from: *Rainwater runoff* **Out-flows to:** *Cedar River via the blowdown canal*

Average flow through, if known: *Not known*

Water Sampled For Radioactivity? (Yes / No) *No*

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Surface Water Data Sheet

Surface Water Body:	*Transformer Pit*	**Type**	*Retention Basin*
Location/Map (GPS, if possible):	*N42 06 037 / W91 46 571*		
Purpose or Function:	*The primary purpose of this pit is to retain water that has the potential for being contaminated with oil or fuel oil. Its contents are released only after a visual examination confirms the absence of an oil sheen. Because one of the sources of water comes from within the power block, the water is sampled before release. Analyses for gamma emitters and tritium are performed.*		
Lined/Unlined:	*Lined with concrete.*		
Size, Capacity:	*49,000 - 100,000 gallons*	**Depth (if known):**	*0' - ~8'*
In-flow from:	*Transformer Retention Berm, Aux. Boiler room floor drains, Diesel Generator Room floor drains, condensation from main plant air intake, rainwater.*	**Out-flows to:**	*Batch release to Discharge Canal*
Average flow through, if known:	*Varies with Rainfall*		
Water Sampled For Radioactivity? (Yes / No)	*Yes*	*Sampling of the Transformer pit water is performed per the effluents controls program.*	

Surface Water Data Sheet

Surface Water Body: *CST Pit* **Type** *Retention Basin*

Location/Map (GPS, if possible): *N42 06 016 / W91 46 642*

Purpose or Function: *The CST pit will retain water spilled from the Condensate Storage Tanks in the event of one or both of their failures.*

Lined/Unlined: *Yes, Concrete*

Size, Capacity: *~110,000 gallons* **Depth (if known):** *~10'*

In-flow from: *Rainwater* **Out-flows to:** *Batch release to discharge canal.*

Average flow through, if known: *Varies with rainfall*

Water Sampled For Radioactivity? (Yes / No) *Yes* *Sampling of the CST pit is performed per the effluents controls program. See Effluent Controls Program results for results of positive identification of tritium.*

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Surface Water Analysis Results
REMP Program

2004

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Table 19. Surface water samples, analyses for Iodine-131 and gamma-emitting isotopes.
Collection Monthly
Units: pCi/L
Location: D-49

Date Collected	01-12-04	02-10-04	03-16-04	04-16-04	05-14-04	06-09-04
Lab Code	DSW-203	DSW-646	DSW-1190	DSW-1753	DSW-2378	DSW-3165
Mn-54	< 15	< 15	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-14-04	08-25-04	09-22-04	10-27-04	11-10-04	12-08-04
Lab Code	DSW-3987	DSW-4696,7	DSW-5362	DSW-6498	DSW-6810	DSW-7368
Mn-54	< 15	< 15	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Surface Water Analysis Results - Effluents Controls Program

2006 year-to-date there have been 15 batch releases of the CST pit. Tritium was identified in 4 of those 15 batches.
2006 year-to-date there have been 16 batch releases of the transformer pit. Tritium was identified in 1 of those 15 batches.
The required LLD for tritium in the Effluent is 10,000 pCi/liter. Typically, MDAs of ~3000 pCi/liter are achieved.

BATCH RELEASES – LIQUID EFFLUENT

Batches	06-06-01	06-07-01	06-07-02	06-07-03	06-07-04
Individual Sample #	*06-2997*	*06-2457*	*06-3181*	*06-3354*	*06-3505*
Batch Number	*06-01*	*06-02*	*06-03*	*06-04*	*06-05*
Sample ID	*06-2997*	*06-2457*	*06-3181*	*06-3354*	*06-3505*
Date and Time Sampled	*6/15/06 13:10*	*5/17/2006 1026*	*6/26/2006 1150*	*7/4/2006 1241*	*7/12/2006*
Date Analyzed	*6/22/06*	*5/19/2006 2300*	*7/3/2006 2318*	*7/10/2006 2230*	*7/25/2006 1612*
Isotopes (μCi/mL)					
Mn 54					
Co 58					
Co 60					
Fe 59					
Zn 65					
Cs 134					
Cs 137					
Cs 141					
Cs 144					
I-131					
H3	*3.00E-06*	*4.57E-06*	*3.25E-06*	*2.74E-06*	*2.88E-06*

(continued....)

...continued....

Batches	06-06-01	06-07-01	06-07-02	06-07-03	06-07-04
Volume of Batch (gal.)	*3000*	*2000*	*2000*	*2000*	*54000*
Other Information					
Release Point	*CST Pit*	*CST Pit*	*CST Pit*	*CST Pit*	*Transformer Pit*
Total Activity(uCi)	*35*	*35*	*25*	*21*	*589*
Blowdown Flow (gpm)	*1480*	*1458*	*1479*	*1449*	*1430*
Release Start	*6/15/2005 14:36*	*5/17/2006 11:55*	*6/26/2006 14:46*	*7/4/2006 14:26*	*7/12/2006 10:50*
Release End	*6/15/2006 15:54*	*5/17/2006 12:50*	*6/26/2006 15:00*	*7/4/2006 15:00*	*7/12/2006 12:35*
Release Duration (Hrs)	*1.3*	*0.92*	*0.23*	*0.57*	*1.75*
Dilution of Volume (gal.)	*115440*	*80183*	*20708*	*49283*	*150151*

2004

DUANE ARNOLD

Table 19. Surface water samples, analyses for iodine-131 and gamma-emitting isotopes.
Collection Monthly
Units: pCi/L
Location: D-50

Date Collected	01-12-04	02-13-04	03-16-04	04-16-04	05-14-04	06-09-04
Lab Code	DSW-204	DSW-647	DSW-1191	DSW-1754	DSW-2379,80	DSW-3166
Mn-54	< 15	< 15	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-14-04	08-25-04	09-22-04	10-27-04	11-10-04	12-08-04
Lab Code	DSW-3988	DSW-4698	DSW-5363	DSW-6499	DSW-6811	DSW-7369
Mn-54	< 15	< 15	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

2004

Table 19. Surface water samples, analyses for iodine-131 and gamma-emitting isotopes.
Collectior Monthly
Units: pCi/L
Location: D-51

Date Collected	01-12-04	02-13-04	03-16-04	04-16-04	05-14-04	06-09-04
Lab Code	DSW-205	DSW-648	DSW-1192	DSW-1755	DSW-2381	DSW-3167
Mn-54	< 15	< 15	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-14-04	08-25-04	09-22-04	10-27-04	11-10-04	12-08-04
Lab Code	DSW-3989	DSW-4699	DSW-5364,5	DSW-6500	DSW-6812	DSW-7370
Mn-54	< 15	< 15	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

2004

Table 19. Surface water samples, analyses for Iodine-131 and gamma-emitting isotopes.
Collectior Monthly
Units: pCi/L
Location: D-99

Date Collected	01-12-04	02-10-04	03-16-04	04-16-04	05-14-04	06-09-04
Lab Code	DSW-206	DSW-649	DSW-1193	DSW-1756,7	DSW-2382	DSW-3168
Mn-54	< 15	< 15	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-14-04	08-25-04	09-22-04	10-27-04	11-10-04	12-08-04
Lab Code	DSW-3990	DSW-4700	DSW-5366	DSW-6501	DSW-6813	DSW-7371
Mn-54	< 15	< 15	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

2004

Table 20. Surface water, analyses for potassium-40 by flame photometry and gamma-emitting isotopes.

Collection: Monthly
Units: pCi/L

Location: D-107

Date Collected	01-12-04	02-16-04	03-16-04	04-16-04	05-14-04	06-09-04
Lab Code	DSW-207	DSW-650	DSW-1194	DSW-1758	DSW-2383	DSW-3169
K-40 (fp)	24.2	25.1	8.7	10.4	19.0	15.2
Mn-54	< 15	< 15	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-14-04	08-25-04	09-22-04	10-27-04	11-10-04	12-08-04
Lab Code	DSW-3991	DSW-4701	DSW-5367	DSW-6502	DSW-6814	DSW-7372
K-40 (fp)	10.7	19.9	18.4	21.5	21.9	22.5
Mn-54	< 15	< 15	< 15	< 15	< 15	< 15
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 15	< 15	< 15	< 15	< 15	< 15
Co-60	< 15	< 15	< 15	< 15	< 15	< 15
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 15	< 15	< 15	< 15	< 15	< 15
Cs-137	< 15	< 15	< 15	< 15	< 15	< 15
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

2004

DUANE ARNOLD

Table 21. Surface water, analysis for tritium.
Collection: Quarterly composites of monthly samples.
Units: pCi/L

Location	D-49			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-1225	DSW-3183	DSW-5620	DSW-7398
H-3	< 157	< 158	< 161	< 134

Location	D-50			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-1226, 7	DSW-3184	DSW-5621	DSW-7399
H-3	< 157	< 158	< 161	< 134

Location	D-51			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-1228	DSW-3185	DSW-5622	DSW-7400
H-3	< 157	< 158	< 161	< 134

Location	D-99			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-1229	DSW-3186	DSW-5623	DSW-7401
H-3	< 157	< 158	< 161	< 134

Location	D-107 — sewage effluent			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-1230	DSW-3187[a]	DSW-5624	DSW-7402
H-3	< 157	255 ± 90	640 ± 112	292 ± 84

[a] Tritium repeated with a result of 268±95 pCi/L.

Table 19. Surface water samples, analyses for iodine-131 and gamma-emitting isotopes.
Collectior Monthly
Units: pCi/L
Location: D-50

Date Collected	01-19-05	02-21-05	03-16-05	04-20-05	05-27-05	06-27-05
Lab Code	DSW-401	DSW-793	DSW-1201	DSW-2033	DSW-2883	DSW-3875,6
Mn-54	< 10	< 10	< 10	< 10	< 10	< 10
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 10	< 10	< 10	< 10	< 10	< 10
Co-60	< 10	< 10	< 10	< 10	< 10	< 10
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10	< 10	< 10
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-27-05	08-19-05	09-26-05	10-26-05	11-15-05	12-13-05
Lab Code	DSW-4403	DSW-4822	DSW-5435	DSW-6251	DSW-6586	DSW-7181
Mn-54	< 10	< 10	< 10	< 10	< 10	< 10
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 10	< 10	< 10	< 10	< 10	< 10
Co-60	< 10	< 10	< 10	< 10	< 10	< 10
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10	< 10	< 10
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Table 19. Surface water samples, analyses for iodine-131 and gamma-emitting isotopes.
Collectior Monthly
Units: pCi/L
Location: D-51

Date Collected	01-19-05	02-21-05	03-16-05	04-20-05	05-27-05	06-27-05
Lab Code	DSW-402	DSW-794	DSW-1202	DSW-2034	DSW-2884	DSW-3877
Mn-54	< 10	< 10	< 10	< 10	< 10	< 10
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 10	< 10	< 10	< 10	< 10	< 10
Co-60	< 10	< 10	< 10	< 10	< 10	< 10
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10	< 10	< 10
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-27-05	08-19-05	09-26-05	10-26-05	11-15-05	12-13-05
Lab Code	DSW-4404,5	DSW-4823	DSW-5326	DSW-6252	DSW-6587	DSW-7182
Mn-54	< 10	< 10	< 10	< 10	< 10	< 10
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 10	< 10	< 10	< 10	< 10	< 10
Co-60	< 10	< 10	< 10	< 10	< 10	< 10
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10	< 10	< 10
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Table 19. Surface water, analyses for iodine-131 and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-107

Date Collected	01-19-05	02-21-05	03-16-05	04-20-05	05-27-05	06-27-05
Lab Code	DSW-403	DSW-795	DSW-1203	DSW-2035	DSW-2885	DSW-3878
Mn-54	< 10	< 10	< 10	< 10	< 10	< 10
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 10	< 10	< 10	< 10	< 10	< 10
Co-60	< 10	< 10	< 10	< 10	< 10	< 10
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10	< 10	< 10
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

Date Collected	07-27-05	08-19-05	09-26-05	10-26-05	11-15-05	12-13-05
Lab Code	DSW-4406	DSW-4824	DSW-5436	DSW-6253	DSW-6588	DSW-7183
Mn-54	< 10	< 10	< 10	< 10	< 10	< 10
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 10	< 10	< 10	< 10	< 10	< 10
Co-60	< 10	< 10	< 10	< 10	< 10	< 10
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10	< 10	< 10
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

2005

Table 20. Surface water, analysis for tritium.
Collection: Quarterly composites of monthly samples.
Units: pCi/L

Location	D-50			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-1228	DSW-3885	DSW-5473	DSW-7336
H-3	< 144	< 162	< 164	< 180
Location	**D-51**			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-1229,30	DSW-3886	DSW-5474	DSW-7337
H-3	< 144	< 162	< 177	< 180
Location	**D-107**			
Period	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
Lab Code	DSW-1231	DSW-3887	DSW-5475	DSW-7338
H-3	< 144	737 ± 113 [a]	720 ± 118	< 180

[a] Repeat tritium result = 791±130 pCi/L.; recomposite tritium result = 865±133 pCi/L.

2006

Table 15. Surface water samples, analyses for iodine-131, tritium and gamma-emitting isotopes.
Collection Monthly
Units: pCi/L
Location: D-50

Date Collected	01-30-06	02-14-06	03-14-06	04-19-06	05-26-06	06-21-06
Lab Code	DSW-526	DSW-792	DSW-1498	DSW-2650	DSW-3525	DSW-4148
H-3	< 167	< 167	< 166	< 165	< 133	< 141
Mn-54	< 10	< 10	< 10	< 10	< 10	< 10
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 10	< 10	< 10	< 10	< 10	< 10
Co-60	< 10	< 10	< 10	< 10	< 10	< 10
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10	< 10	< 10
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

2006

Table 15. Surface water samples, analyses for iodine-131, tritium and gamma-emitting isotopes.
Collection Monthly
Units: pCi/L
Location: D-51

Date Collected	01-30-06	02-14-06	03-14-06	04-19-06	05-26-06	06-21-06
Lab Code	DSW-527	DSW-793	DSW-1499	DSW-2651	DSW-3526	DSW-4149
H-3	< 167	< 167	< 166	< 165	< 133	< 141
Mn-54	< 10	< 10	< 10	< 10	< 10	< 10
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 10	< 10	< 10	< 10	< 10	< 10
Co-60	< 10	< 10	< 10	< 10	< 10	< 10
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10	< 10	< 10
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

2006

Table 15. Surface water, analyses for iodine-131, tritium and gamma-emitting isotopes.
Collection: Monthly
Units: pCi/L
Location: D-107

Date Collected	01-30-06	02-14-06	03-14-06	04-19-06	05-26-06	06-21-06
Lab Code	DSW-528	DSW-794	DSW-1500	DSW-2652	DSW-3527	DSW-4150
H-3	< 167	< 167	< 166	< 165	< 133	179 ± 78
Mn-54	< 10	< 10	< 10	< 10	< 10	< 10
Fe-59	< 30	< 30	< 30	< 30	< 30	< 30
Co-58	< 10	< 10	< 10	< 10	< 10	< 10
Co-60	< 10	< 10	< 10	< 10	< 10	< 10
Zn-65	< 30	< 30	< 30	< 30	< 30	< 30
Nb-95	< 15	< 15	< 15	< 15	< 15	< 15
Zr-95	< 30	< 30	< 30	< 30	< 30	< 30
I-131	< 15	< 15	< 15	< 15	< 15	< 15
Cs-134	< 10	< 10	< 10	< 10	< 10	< 10
Cs-137	< 10	< 10	< 10	< 10	< 10	< 10
Ba-140	< 60	< 60	< 60	< 60	< 60	< 60
La-140	< 15	< 15	< 15	< 15	< 15	< 15

2006

Table 16. Surface water, analysis for tritium.
Collection: Quarterly composites of monthly samples.
Units: pCi/L

Location		D-50
Period	1st Qtr.	
Lab Code	DSW-1508	
H-3	< 151	

Location		D-51
Period	1st Qtr.	
Lab Code	DSW-1509	
H-3	< 151	

Location		D-107
Period	1st Qtr.	
Lab Code	DSW-1510	
H-3	< 151	

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Surface Water Analysis Results
Effluents Controls Program

APPENDIX A3

HISTORICAL RELEASES

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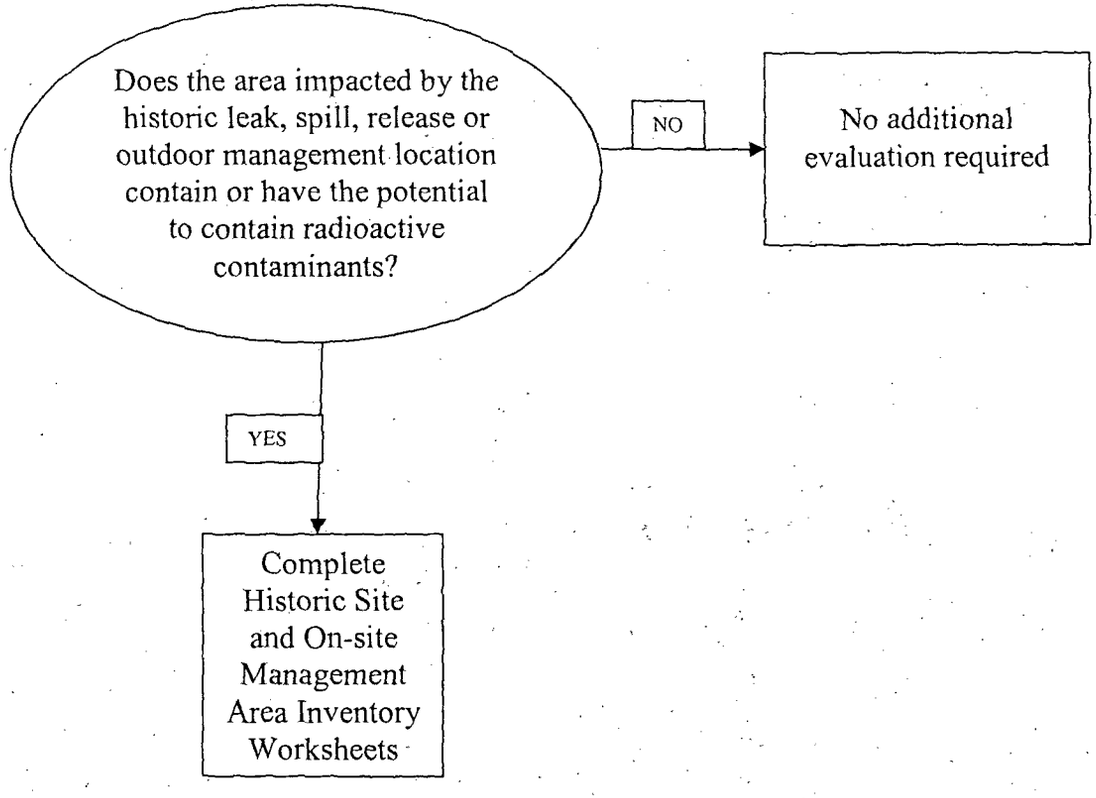
DECISION TREE
HISTORIC RELEASES/MANAGEMENT AREAS



Historical Spills/Leaks Inventory

Site: Duane Arnold Energy Center

Information Submitted by: Stephan Funk

Event (short description , ID #)	Date	Material Spilled/Leaked	Principal Nuclides & Activity	If Liquid, Vol. (gal)	H3?	Remedial Efforts
Washing Machine Leak. Location: current site of DAC Building.	2/22/83	2 gallons of contaminated water.	Unknown. Co-60 likely	Two gallons	Unknown, but probable.	The spill was completely cleaned up
Hydrolaser Leak. Location: current site of LLRPSF Building.	2/15/83	30 gallons of condensate water.	Unknown. Co-60 likely	~Thirty gallons	Unknown, but probable.	The leak flowed to a storm drain and to the blowdown canal. No activity was identified in the blowdown canal. Contaminated gravel at the spill site was cleaned up.

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On-Site Management Areas Inventory

Site: Duane Arnold Energy Center

Information Representative: Stephan Funk

Management Area , Map ID #	Date	Material	Source of Material	Quantity of Material	Principal Nuclides & Activity
NONE					

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10CFR20 75(g) Documentation

DEVIATION REPORT FORM NO. DAEC 94 1 - ORIG

ORIGINATOR: COMPLETE SECTION 1 AND FORWARD PLY 3 TO DEPARTMENT SUPERVISOR OR ATTACH TO STP.

NAME OF ORIGINATOR	EQUIPMENT AND/OR SYSTEM	DATE	REPORT #
Von Middlesworth	Unplanned Release - Hydrolazing System (Hydro nuclear)	2/15/83	83-0

DESCRIPTION OF DEVIATION:

Fitting on hydrolazing equipment developed leaks causing approximately 30 gal. of contaminated water to be released to environment.

CAUSE: Leaking Fittings

1

DISCOVERED DURING SURVEILLANCE TEST? ☐ YES ☒ NO STP NUMBER

SHIFT SUPERVISOR COMPLETES SEC. 2 AND RETAINS PLY 2

ACTION TAKEN: Stop hydrolazing operations and secured leak. Area roped off. MAR NO.

TSV?	YES ☐	NO ☑	SPEC NO
ETSV?	YES ☑	NO ☐	SPEC NO
RO?	YES ☐	NO ☑	PARA NO

REPORTABLE OCCURRENCE TYPE

14 DAY ☐ 30 DAY ☐

2

ETSV AND RO TELEPHONE NOTIFICATION WITHIN 24 HOURS TO NRC

PERSON NOTIFIED: Owen Merrill

DATE/TIME: 2/15/83 0333 BY: Von Middlesworth

NOTIFICATIONS

CHIEF ENGINEER NOTIFIED 2/15/83 0346 (DATE/TIME) OP SUP NOTIFIED 2/15/83 0320 (DATE/TIME) TECH. ENG. NOTIFIED 2/15/83 (DATE/TIME)

ASST CHIEF NOTIFIED 2/15/83 0324 (DATE/TIME) DIRECTOR, NUC. GEN NOTIFIED 2/15/83 0328 (DATE/TIME)

SSE SIGNATURE [signature] Date 2/15/83

OPERATIONS SHIFT SUPERVISOR COMPLETES SEC. 3

ADDITIONAL COMMENTS

3

REVIEWED AND APPROVED [signature] (SIGNATURE) Date 2/15/83

TECHNICAL STAFF COMPLETES SEC. 4

Received 2/16/83

DEVIATION EVALUATION

☐ NO EVALUATION REQUIRED PER ACP 1801.7

☑ SEE LER REPORT NO. [illegible]

☐ EVALUATION ATTACHED

4

☑ COPY SENT TO SAFETY COMMITTEE CHAIRMAN

☐ COPY SENT TO DIRECTOR, NUC. GEN

[signature] (SIGNATURE OF TECHNICAL ENGINEER)

OPS COMM. REVIEW REQ. ☑ YES ☐ NO

Date 4/7/83

OPERATIONS COMMITTEE CHAIRMAN COMPLETES SEC. 5

FINAL REVIEW AND APPROVAL

RECOMMENDATIONS ATTACHED (YES) (NO)